

## Assessing Attitudes, Knowledges and Practices Towards Food Poisoning Among Food Handlers and Students in Sarawak

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### KEYWORDS:

Foodborne diseases  
Food poisoning  
Knowledge, Attitudes and  
Practices (KAPs)  
Food preparation process  
Food handlers

### CITATION:

Ling, S. J., Zamri, H., & Regina Garai, A. (2026). Assessing Attitudes, Knowledges and Practices Towards Food Poisoning Among Food Handlers and Students in Sarawak. *Malaysian Journal of Social Sciences and Humanities (MJSSH)*, 11(1), e002786. <https://doi.org/10.47405/mjssh.v11i1.2786>

### ABSTRACT

Foodborne diseases are responsible for millions of deaths globally. Key factors contributing to these illnesses, as well as the high incidence of food poisoning among students, include improper methods of food preparation, unhealthy lifestyles, poor sanitation, and unsafe water resources. Moreover, the combination of food handlers mismanaging food and the students' and handlers' insufficient knowledge of food hygiene significantly exacerbates the food poisoning risk in school environments. The current study aims to assess the knowledge, attitudes, and behaviours regarding food hygiene among food handlers and students. The research method adopted in this study was the quantitative method to answer the research questions. This study utilised a non-probability sampling method, specifically quota sampling, after evaluating various sampling techniques. This study presented findings on the Knowledge, Attitudes, and Practices (KAPs) of both students and food handlers concerning hygiene awareness and safe food handling. The food handlers demonstrated poor personal hygiene practices, including improper handwashing technique and a lack of knowledge about the correct steps needed for effective handwashing. In addition, the food safety influenced by the canteen environment was statistically significant, whereas there was a difference in knowledge between male and female food handlers. Furthermore, the student's knowledge was low regarding the towel used to wipe the hands could also be used to wipe the plate. The research might provide valuable insights and promote behavioural changes that could inform national health policy revisions, particularly in the area of food safety and regulations for preventing food poisoning.

**Contribution/Originality:** This study examined the knowledge, attitudes, and practices of food handlers and students concerning food hygiene and food poisoning in schools located in Betong, Sarawak. The findings align with the behavioral insights necessary to drive change, supporting the World Health Organization's Sustainable Development Goal 3: Good Health and Well-Being.

## 1. Introduction

According to [Sharifa Ezat, Netty, and Sangaran \(2013\)](#), foodborne illnesses, including cholera, typhoid fever, hepatitis A, dysentery, and food poisoning, are commonly caused by consuming food tainted with harmful chemicals or microorganisms. *Salmonella* bacteria are the most frequent factor of foodborne diseases worldwide, typically spreading to humans through contaminated animal-based foods, for instance, eggs, poultry, dairy products and meat ([World Health Organization, 2019](#)). [Soon \(2011\)](#) reported that the majority of food poisoning cases are attributed to unhygienic food handling and inadequate cleanliness during food preparation. Additionally, poor personal hygiene among food handlers is also a contributing factor ([Cowan, 2019](#)). Studies found that knowledge, attitudes and practices regarding hygiene are the key factors in the reduction of foodborne diseases ([Zyoud et al., 2019](#)). [Md Mizanur, Taha & Zainab \(2012\)](#) found that the wider social, cultural, and daily context appeared to have an impact on food handling, hygiene and risks. The increase in food poisoning cases is due to food handlers ignoring safe food handling, proper preparation methods in the kitchen ([Abdul-Mutalib et al., 2015](#)). The main contributor to foodborne diseases in New Zealand is poor food handling practices. Hence, [Al-Sakkaf \(2013\)](#) stated that there is a need to investigate the causes of these poor practices. Although school premises have been inspected and the food handlers at school are trained in the safety of food handling, however food poisoning outbreaks continue to occur ([New, Ubong & Premarathne, 2017](#)). Numerous reported cases of food poisoning were attributed to improper food safety practices and poor hygiene, and mostly occurred in the school canteens, hostel kitchens and market stalls ([Mohd Yusof et al., 2018](#)). Other factors may be due to early food preparation, incorrect food handling methods, keeping food at ambient temperature until served, and unhygienic practices ([Sharifa Ezat, Netty & Sangaran, 2013](#)). The objectives of this study are to examine the food preparation processes employed by food handlers, evaluate their levels of knowledge, attitudes, and practices (KAPs) concerning food hygiene, and evaluate physical cleanliness of school kitchens and canteens based on best practices in rural school canteens in Betong, Sarawak.

Additionally, the researcher has examined the knowledge levels, attitudes, and behaviors (KAPs) related to food hygiene practices among food handlers and students. The causes of foodborne diseases are closely linked to lifestyle choices. However, there is a lack of research exploring the relationship between food handling practices, food handlers' attitudes toward safe food handling, and the KAPs regarding food safety and hygiene among students, particularly in rural schools in Betong, Sarawak. Thus, the researcher aims to investigate how the lifestyles and food handlers' and students' hygienic habits can influence the prevalence of food poisoning.

In Malaysia, 13,686 cases of food poisoning were reported, with an incidence rate of 42.25 per 100,000 people ([Health Informatics Centre, 2018](#)). In Sarawak alone, 1,089 cases were documented, resulting in an incidence rate of 39.04 ([Health Informatics](#)

[Centre, 2018](#)). Food poisoning cases were especially common in Betong, Sarawak, where Malay students showed a higher incidence rate than Iban students.

Data from [Pejabat Kesihatan Daerah Betong \(2019\)](#) revealed that, in 2017, 113 out of 183 reported food poisoning cases involved Malay students under 18 years old, while in 2018, the number rose to 137 out of 148 cases. Food poisoning incidents have shown an upward trend, with 3,822 cases reported in 2010, rising to 3,959 in 2011, 4,305 in 2012, and further increasing to 5,107 in 2013 and 5,265 in 2014 ([Pejabat Kesihatan Daerah Betong, 2019](#)). The peak was reached in 2015 with 8,000 cases. School students were particularly vulnerable due to exposure to contaminated food from school canteens. This alarming trend prompted research into food preparation practices and food handlers' behaviours, with a focus on the cleanliness of kitchen and canteen areas. The study also considered how sociocultural factors influence hygiene practices among both food handlers and students to prevent future cases of food poisoning. Changes in lifestyle have significantly influenced food handling behaviours, frequently leading to shortened preparation times, early meal preparation, improper storage practices, and inadequate hygiene among food handlers ([Collins, 1997](#)). Most of the food poisoning cases result from unhygienic practices and poor cleanliness, highlighting the need for better food safety knowledge and attitudes ([Soon, 2011](#)). Contamination may occur when meat comes into contact with animal skin or intestines due to mishandling, stressing the need for proper preparation practices ([Abdul-Mutalib et al., 2015](#)). High standards of kitchen hygiene, including clean utensils and surfaces, are essential to prevent foodborne diseases ([Abdul-Mutalib et al., 2015](#)).

Besides, for the hygiene knowledge, attitudes, and behaviours (KAPs) in food preparation practices, there was a widespread lack of understanding among food handlers regarding the proper storage, preparation, and thawing temperatures in food handling processes. Keeping food within the recommended 2°C to 4°C range is crucial to prevent bacterial growth ([Sharif, Obaidat & Al-Dalalah, 2013](#)). In addition, schools often lack sufficient time for daily meal preparation, leading to early or day-ahead meal preparations, which can foster bacterial growth and increase food poisoning risk ([Dora-Liyana et al., 2018](#)). Food handlers frequently lack awareness in handling the cleanliness of kitchen utensils in a proper way, such as reusing the dish towels, which can lead to cross-contamination ([Dora-Liyana et al., 2018](#)).

Moreover, in terms of physical cleanliness and food hygiene in the school canteen, many rural schools lack adequate water supplies, a proper sanitation system, and handwashing facilities. This contributes to a high rate of foodborne diseases in rural schools. Next, a clean kitchen, disinfected utensils, and proper waste disposal areas were essential to prevent food contamination in rural schools ([Adams et al., 2009](#); [Abdul-Mutalib et al., 2015](#)). Food poisoning prevention can be achieved through behavioural change and safe food practices, including frequent handwashing, separating raw and cooked foods, cooking to a safe temperature, proper food storage, and the use of clean water and quality ingredients ([Ramful & Menon, 2017](#)). Based on food hygiene regulations ([Ministry of Health Malaysia, 2012](#)), food handlers must undergo training and certification, as well as receive a typhoid vaccine before employment. By violating these requirements, food handlers can face fines or imprisonment. Furthermore, by improving human health and well-being, the World Health Organisation (WHO) initiates the Sustainable Development Goals (SDGs). SDG 3 and SDG 6 aim to promote health and sanitation. WHO highlights the need for a multidisciplinary approach to influence health

behaviours, incorporating fields like psychology, sociology, and neuroscience to develop effective health interventions and policies ([World Health Organization, 2023](#)).

## 2. Methodology

The research design for this study was quantitative data. The research method adopted in this study was quantitative method to answer the research questions. This study utilised a non-probability sampling method, specifically quota sampling, after evaluating various sampling techniques. Quota sampling was determined to be the most appropriate approach as the selection of respondents were based on specific characteristics, for example, age, race, and gender. The data collection was performed on eight schools in Betong, Sarawak, involving 487 students and 23 food handlers. To ensure a better comprehension among primary school students, the questionnaire was translated from English into Bahasa Malaysia.

Responses were recorded using a 5-point Likert scale, ranging from "Strongly agree" to "Strongly disagree." The collected data were processed and analysed using the Statistical Package for Social Sciences (SPSS). To ensure the clarity and relevance of the questions, the questionnaire underwent a thorough review by a panel of healthcare professionals, including a health education officer, a public health officer, and two academicians from Universiti Malaysia Sarawak (UNIMAS). The same questionnaire was administered to both primary and secondary school students and further refined using the Knowledge, Attitude, and Practice (KAPs) survey model. This refinement drew on a questionnaire developed by the Institute of Behavioural Research ([Institut Penyelidikan Tingkah Laku Kesehatan, 2017](#)) and the survey titled "*Soal Selidik Kajian Faktor yang Mempengaruhi Pencemaran Makanan di Kantin Sekolah di bawah KPM di Kelantan.*" Data collection was conducted at eight schools in Betong, Sarawak, which reported the highest incidences of food poisoning cases.

- SMK Beladin
- SMK Ulu Layar
- SMK Pusa
- SK Kalok
- SK Semarang
- SK Tui
- SK Tambak
- SK Maludam

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 16.0, SPSS Inc., Chicago, IL), with a focus on primary and secondary school students, as well as all the canteen food handlers.

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.

For the sample size estimation in prevalence studies, the sample size was calculated using a single-proportion formula for the estimation of prevalence. The sample size for all target populations was calculated based on the prevalence of respondents who have good practices regarding food safety. The margin of error of 5% and a 95% confidence level was utilised. The sample size was calculated for each objective and was finalised according to the criteria as follows:

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

### 3. Results

#### 3.1. Demographic (Students)

Table 1 showed the student demographic profile, where there were 307 or 63.0% male students and 180 or 37.0% female students. There was a majority of Malay students in this research because the school was predominantly populated by Malay students. Malay students consisted of 355 students or 72.9%. In addition, there were 110 Iban students, accounting for 22.6% of the total students. There were only two Bidayuh students, or 0.4%. The others were 10 students, or 2.1%, while the Chinese students were 10 students, or 2.1%. Furthermore, all the students were full-time students. There were 293 students, or 60.2% children, who were still schooling. Next, 16 students (3.3%) were in Primary 6, 121 students (24.8%) were in Form 6, 27 students (5.5%) were in Form 5, 9 students (1.8%) were in Form 3, and 20 students (4.1%) were in other classes.

Table 1: Student Demographic

Gender	Frequency	Percentages
Male	307	63.0%
Female	180	37.0%
Ethnic Background		
Bidayuh	2	0.4%
Iban	110	22.6%
Others	10	2.1%
Malay	355	72.9%
Chinese	10	2.1%
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%

#### 3.2. Demographic (Food Handlers)

Table 2 showed the food handlers' demographic profile, where there were a total of 23 canteen food handlers in eight (8) targeted schools. Moreover, there were food handlers who were 15 Iban or 65.2%, 5 Malays or 21.7% and 3 others or 13.0%. All of them were

full-time school canteen food handlers in eight (8) targeted schools respectively. In terms of the educational levels, there were nine food handlers or 39.1% had completed their Form 6, 9 food handlers or 39.1% finished Form 5, and 3 or 13.0% food handlers completed Form 3 and one food handler finished Primary 6 or 4.3% and one food handler or 4.3% was from others.

Table 2: Food Handlers Demographic

Gender	Frequency	Percentage
Male	18	78.3%
Female	5	21.7%
<b>Ethnic Background</b>		
Iban	15	65.2%
Others	3	13.0%
Malay	5	21.7%
<b>Occupation</b>		
Full time school canteen food handlers	19	82.6%
Part timer	4	17.4%
<b>Educational Levels</b>		
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%

### 3.3. Knowledge, Attitude and Practices among Food Handlers

Table 3 explained that “Canteen environment affects food safety” variable had shown 11 people (47.8%) strongly agreed and five people (21.7%) agreed, whereas 2 people (8.7%) strongly disagreed, which meant the food handlers had good knowledge that a clean environment affects food hygiene. Next, for the “Canteen environment affects food safety”, the mean was 2.000 and the standard deviation (SD) was 1.2432. This indicated the food handlers had adequate knowledge of a clean kitchen to ensure food safety. Based on the Food Act 1983, Bil 15(1), the food premises shall remain in good condition, clean and neat at all times (Ministry of Health Malaysia, 2012).

Table 3: Knowledge among food handlers towards safe food handling

Variables	1	2	3	4	5	Mean	Std Deviation
Canteen environment affects food safety	11 (47.8%)	5 (21.7%)	5 (21.7%)		2 (8.7%)	2.000	1.2432
Uncooked water should be used for beverages or drinks	3 (13.0%)	3 (13.0%)	1 (4.3%)	1 (4.3%)	15 (65.2%)	3.957	1.5805
Food that has been exceed 4 hours may be allowed for consumption	1 (4.3%)	7 (30.4%)	1 (4.3%)		14 (60.9%)	4.174	1.1541
Clean cooking utensils are allowed to produce clean	14 (60.9%)	5 (21.7%)	1 (4.3%)	1 (4.3%)	2 (8.7%)	1.783	1.2777

and safe foods							
Hand towels can be used repeatedly without washing	2 (8.7%)	2 (8.7%)	2 (8.7%)	2 (8.7%)	15 (65.2%)	4.130	1.3917

Note: 1 = Strongly agree, 2 = Agree, 3 =Neutral, 4 = Disagree, 5 = Strongly disagree

The statement “Uncooked water should be used for beverages or drinks” had 15 people (65.2%) who strongly disagreed, and 1 person (4.3%) disagreed, but only 3 people (13%) strongly agreed. The mean obtained was 3.957, and the SD was 1.5805. This showed that food handlers had good knowledge that cooked water is crucial for the beverages. According to the [Malaysian Ministry of Health \(2022\)](#), uncooked water is not suitable for consumption.

There were 14 people (60.9%) who strongly disagreed with the statement “Food that has been exceeded 4 hours may be allowed for consumption”, but then there were only 7 people (30.4%) who agreed and 1 person (4.3%) who strongly disagreed. Mean was 4.174, and SD was 1.1541. This revealed that food handlers had adequate knowledge that food that has exceeded 4 hours could not be allowed for consumption. Furthermore, there were 14 (60.9%) food handlers who strongly disagreed on “Food that has been exceeded 4 hours may be allowed for consumption”. This finding aligned with Abdul-Mutalib et al. (2015), who stated that food held in the temperature danger zone for over 4 hours became unsuitable for consumption and should be discarded immediately to ensure safety.

Based on [Table 3](#), the findings show that most of the food handlers had good knowledge that hand towels could not be used repeatedly without washing. 17 people (73.9%) said hand towels need to be washed every time after use. The obtained mean was 4.130, and the SD was 1.3917. According to health experts, it is not recommended to use hand towels repeatedly without washing. Towels can become a breeding ground for bacteria and other microorganisms (Centres for Disease Control and Prevention, 2023).

[Table 4](#) showed that the variable “I do not need to wash my hands using 7 correct hygiene steps if busy serving customers” had 9 people (39.1%) who strongly agreed and 5 people (21.7%) who agreed. Nevertheless, there were 3 people (13.0%) who disagreed on using the 7 correct steps for hand washing when serving customers. The data revealed that canteen food handlers had moderate knowledge of good hand hygiene practices. More than half of the 14 (60.8%) food handlers agreed on the statement “I do not need to wash my hands using 7 correct hygiene steps if busy serving customers”.

Table 4: Attitude among food handlers towards safe food handling

Variables	1	2	3	4	5	Mean	Std Deviation
I do not need to wash my hands using the 7 correct hygiene steps if busy serving customers	9 (39.1%)	5 (21.7%)	5 (21.7%)	1 (4.3%)	3 (13.0%)	2.304	1.3959
I do not need to	1	5	4		13	3.826	1.4350

strip off watches, rings, bracelets before preparing food	(4.3%)	(21.7%)	(17.4%)		(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%)	1.696	1.2946
I do not take care of the canteen cleanliness	3 (13.0%)	3 (13.0%)	2 (8.7%)		15 (65.2%)	3.913	1.5930
I will smell and taste the food so as not to make it stale before eating it	19 (82.6%)	1 (4.3%)	2 (8.7%)		1 (4.3%)	1.391	0.9881
I will not buy food in cans that have dents	15 (65.2%)	1 (4.3%)	3 (13.0%)		4 (17.4%)	2.000	1.5667

Note: 1 = Strongly agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly disagree

This finding was supported by [Dora-Liyana et al. \(2018\)](#) and [Abdul-Mutalib et al. \(2015\)](#), who stated that food handlers demonstrated poor personal hygiene practices, including improper handwashing techniques and a lack of knowledge about the correct steps needed for effective handwashing. The statement *"I do not need to wash my hands using 7 correct hygiene steps if busy serving customers"* obtained a mean score of 2.304, and the SD was 1.3959. This proved that the food handlers did not know or understand that there were 7 correct steps in effective handwashing. According to the [Ministry of Health Malaysia \(2022\)](#), the 7-step handwashing technique recommended by MOH is crucial to prevent food poisoning.

Next, the statement *"I do not need to strip off rings, bracelets, watches before preparing food"* demonstrated that 13 people (56.5%) strongly disagreed, whereas five people (21.7%) agreed on this statement. This revealed that food handlers had moderate knowledge that they needed to strip off rings, watches and bracelets before food preparation. Next, there were 13 (56.5%) food handlers who strongly disagreed with the statement *"I do not need to strip off rings, bracelets, watches before preparing food"*. This finding was consistent with [Webb and Morancie \(2015\)](#), who reported 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 had similar findings where the food handlers should not wear jewellery during food preparation processes to prevent food contamination. In addition, the mean for the *"I do not need to strip off rings, bracelets, watches before preparing foods"* was 3.826, and the SD was 1.4350. According to the Food Act 1983, Bil 33 (1)(f), personal hygiene of food handlers, it states that they should not wear personal jewellery, clocks, pins or other accessories during food preparation ([Ministry of Health Malaysia, 2012](#)).

Moreover, the findings showed that the food handlers had a pretty good attitude toward washing their hands after touching raw foods. There were 19 (82.6%) food handlers who agreed that they must wash their hands after touching raw foods. The mean was 1.696, and the SD was 1.2946. The majority of respondents agreed that hands should be thoroughly cleaned before preparing food, and working with dirty hands should be avoided. Similar conclusions were drawn by [Abdul-Mutalib et al. \(2012\)](#) and [Al-Shabib,](#)

Husain, and Khan (2017), who found that nearly all food handlers recognised the importance of washing hands before handling food. Failure to properly wash hands can result in contamination of the prepared food. New, Ubong and Premarathne (2017) conducted a study showing that the bacterial count on food handlers' hands exceeded safe levels, indicating poor hand-washing practices among food handlers. Collins (1997) also emphasised that not washing hands before, during and after food preparation contributed to food contamination.

Based on Table 5, there were 12 people (52.2%) who strongly disagreed and 2 people (2.7%) who disagreed on the variable "Food that is not sold out may be stored in a fridge for resale". However, only four people (17.4%) strongly agreed. This had proven that a food handler had moderate knowledge that leftover food could not be resold. Furthermore, the variable "The food to be sold to the pupils does not need to be closed" elicited a strong disagreement from 15 people (65.2%) and strong agreement from five people (21.7%). This meant the food handlers had adequate knowledge that food must be kept closed by lid before being sold to students. The statement "The food to be sold to the pupils does not need to be closed" obtained a mean of 3.783, and the SD was 1.7570. The findings showed the food handlers had good knowledge that the food needed to be closed with lids before selling to the students. According to Section 37(1) of the Food Act 1983, food handlers are prohibited from storing, displaying, or selling any ready-to-eat food in food premises unless the food is adequately protected from (a) contamination by individuals who come into contact with the food, and (b) other sources of pollution. This protection must be ensured through the use of cabinets, display cabinets, containers, covers, protective equipment, systems, or other cleaning-friendly devices (Ministry of Health Malaysia, 2012).

Table 5: Practices among food handlers towards safe food handling

Variables	1	2	3	4	5	Mean	Std Deviation
Food that is not sold out may be stored in a fridge for resale	4 (17.4%)	1 (4.3%)	4 (17.4%)	2 (8.7%)	12 (52.2%)	3.739	1.5730
The food to be sold to the pupils does not need to be closed	5 (21.7%)	2 (8.7%)	1 (4.3%)		15 (65.2%)	3.783	1.7570

Note: 1 = Strongly agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly disagree

### 3.4. Anova Analysis of Variance between genders among food handlers

Table 6 presented that there was a significant difference between genders among male and female food handlers. For the variable "I do not need to wash my hands using 7 correct hygiene steps if busy serving customers", the significant value was 0.044. For the p-value < 0.05, the mean is considered statistically significant. Since the p-value is less than the significance level of 0.05, we conclude that not all population means are equal, suggesting a significant difference between male and female food handlers. This result indicated a notable disparity in hygiene knowledge between genders, particularly regarding whether they would follow the 7-step handwashing procedure when they were busy serving customers.

Table 6: Anova Analysis of variance of between genders among food handlers

Variables	Significance (Sig.)	F	Sig
I do not need to wash my hands using the 7 correct hygiene steps if busy serving customers	0.044	4.576	Significant
Canteen environment affects food safety	0.039	4.859	Significant
I do not need to strip off watches, rings, bracelets before preparing food	0.035	5.066	Significant
Food that is still hot can be kept in a fridge	0.044	4.609	Significant
Foods that contain hair will cause health problems if eaten	0.045	4.565	Significant
Germs in cooking utensils can be eradicated using hot water	0.027	5.619	Significant

In addition, the food safety influenced by the canteen environment was statistically significant, with a value of 0.039. This finding proved that there was a difference in knowledge between male and female food handlers. Besides, the variable “I do not need to strip off rings, bracelets, watches before preparing foods” was statistically significant, with a p-value of 0.035. There was also a difference in knowledge 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. Moreover, “*food that is still hot can be kept in a fridge*” was statistically significant, with a value of 0.044. Therefore, there was a knowledge barrier between male and female food handlers regarding the proper storage of hot food. In addition, “*health problems will happen if foods contain hair*” has shown a statistically significant value of 0.045. Male and female food handlers had different levels of knowledge, likely due to the fact that most of the women had long hair. Furthermore, “*germs in cooking utensils can be eradicated using hot water*” has shown a statistically significant value of 0.027. This value revealed a difference in knowledge levels between female and male food handlers.

### 3.5. Knowledge, Attitudes and Practices (KAPs) among Students towards Food Safety and Food Hygiene

Table 7 shows that there were only 89 students, or 18.3% who disagreed on “There are three (3) basic steps to handwashing”, and there were 403 students (82.7%) who agreed on “Food poisoning, such as queasiness, stomach pain, can be prevented if you eat with clean hands”. The finding outcome demonstrated that handwashing was the most important component in the prevention of food poisoning. The unclean hands contained harmful bacteria that could cause food poisoning. The practice, which did not emphasise personal hygiene and insufficient use of sanitisers, was a significant cause of the increasing cases of infectious diseases in the developing countries (Vivas et al., 2010). Moreover, a positive attitude towards hand washing helped to prevent the occurrence of food poisoning among students. Besides, unsatisfactory hand hygiene practices had been observed among food handlers and school children (Kar et al., 2018). Factors

contributing to food poisoning outbreaks in schools included cross-contamination from water in tanks, the consumption of undercooked food, and the use of untreated water (Jeffree & Mihat, 2016). School children were particularly vulnerable to food poisoning due to their poor knowledge of food safety. Although students with better knowledge tended to exhibit improved hygiene practices, they often engaged in high-risk behaviours regarding food choices (Garayoa et al., 2005).

In general, school children showed a lack of understanding of proper hand hygiene practices. According to Thailand's Global Student-Based Health Survey, 15.7% of Thai students rarely washed their hands before eating (World Health Organisation, 2017). Additionally, studies conducted among school students in Seoul and Ulsan revealed that 67% of respondents did not know the proper method of handwashing (Yoon & Yoon, 2007).

Table 7: Knowledge among Students towards food safety and food hygiene

Variables	1	2	3	4	5	Mean	Std Deviation
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%)	1.639	1.1936
There are three (3) basic steps to handwashing	230 (47.2%)	77 (15.8%)	91 (18.7%)	31 (6.4%)	58 (11.9%)	2.199	1.3964
A dirty environment does not cause food pollution	85 (17.5%)	23 (4.7%)	23 (4.7%)	34 (7.0%)	322 (66.1%)	3.996	1.5727
The date on food and beverage wrapping is important	382 (78.4%)	39 (8.0%)	29 (6.0%)	8 (1.6%)	29 (6.0%)	1.487	1.0883
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%)	1.567	1.2168
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%)	2.047	1.3131
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%)	1.632	1.2564

Note: 1 = Strongly agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly disagree

There were 382 students (78.4%) who strongly agreed on "The date on food and beverage wrapping is important". This finding was in line with respect to food safety practice; the students showed a good habit of reading labels when buying packaged foods (Cheng et al., 2017).

Four reviewed studies on knowledge, attitude, and practice (KAP) levels among students found that three of them reported a high level of knowledge regarding food poisoning prevention (Ali, William, Prajapati et al., 2018; Mahmood et al., 2018). However, a study by Syahira et al. (2019) in Selangor revealed that most of the Form Four students had inadequate food safety knowledge. In contrast, a separate study by Ruby et al. (2019) on consumers in Sibul, Sarawak, Malaysia, showed that food safety knowledge among the respondents was generally good.

Cheng et al. (2017) also observed that secondary school students in Beijing generally had a good level of food safety knowledge, with nearly half ranking at a high level. However, in other Chinese cities, especially second-tier cities, students demonstrated relatively low food safety knowledge, likely due to Beijing's status as a more developed region.

Additionally, 78.4% of students (382 respondents) strongly agreed that the date on food and beverage packaging is important, which aligned with Cheng et al. (2017), where students showed good habits of reading labels on packaged foods as part of food safety practices.

Syahira et al. (2019) found that most of the 610 Form 4 students in Hulu Langat, Selangor, had insufficient food safety knowledge. Similarly, studies in Canada indicated low overall food safety knowledge among high school students in four Ontario colleges (Majowicz et al., 2015). In the Ga West region, Tutu, Hushie, Asante, and Egyakwa-Amusah (2020) reported that upper primary and junior high school students also displayed poor food safety knowledge and attitudes.

According to Table 8, 401 students (82.3%) agreed that food pollution can be prevented when kitchen utensils are washed using washing soap. The finding was supported by the knowledge that utensils that were not washed using dishwashing soap could cause food pollution. Kitchen utensils needed to be washed using clean water, soap and appropriate washing materials and stored in an appropriate place so that they were not contaminated until use.

Additionally, 111 students (22.8%) strongly disagreed, and 130 students (26.7%) were unsure about the statement, "Hot kitchen or chamber temperature will increase germ breeding rates". The study revealed that students involved in food preparation generally had limited experience and demonstrated insufficient knowledge about the importance of temperature control for ensuring microbial food safety. In a study conducted in 26 primary schools in the Ljubljana district and surrounding areas in Slovenia, 35% of students lacked understanding regarding the impact of temperature on food safety (Ovca, Jevšnik, & Raspor, 2014).

Meanwhile, Table 9 shows that there were 340 students (69.8%) who strongly disagreed on "Chemicals such as insect poison and rat poison can be stored near dry raw materials such as onions, flour and rice". The finding proved that students in Betong had good practice in the chemicals that must be kept away from dry raw materials. Nevertheless, other studies had found that the lowest level of knowledge of students was related to chemicals (rat poison, insect poison) that could be placed near dry raw materials (rice, onions, dried chillies). Chemical contamination was believed to be possible on dry food in the event of cross-contamination (if the packaging of toxic chemicals had been exposed, torn or exposed to the dry food) (Akabanda et al., 2017).

Table 8: Attitudes among students towards food safety and food hygiene

Variables	1	2	3	4	5	Mean	Std Deviation
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%)	2.540	1.4222
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%)	1.723	1.2419
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%)	1.563	1.2170

Note: 1 = Strongly agree, 2 = Agree, 3 =Neutral, 4 = Disagree, 5 = Strongly disagree

Table 9: Practices among students towards food safety and food hygiene

Variables	1	2	3	4	5	Mean	Std Deviation
The towel used to wipe hands can be used to wipe bowls	47 (9.7%)	28 (5.7%)	40 (8.2%)	56 (11.5%)	316 (64.9%)	4.162	1.3442
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%)	1.692	1.1896
Repeated use of cooking oil is bad for health	273 (56.1%)	77 (15.8%)	64 (13.1%)	26 (5.3%)	47 (9.7%)	1.967	1.3329
Chemicals such as rat poison and insect poison can be stored near to dry raw materials such as rice, onions and flour	58 (11.9%)	16 (3.3%)	32 (6.6%)	41 (8.4%)	340 (69.8%)	4.209	1.3882
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%)	1.780	1.2385
A hand towel wiper can be used repeatedly without washing	38 (7.8%)	25 (5.1%)	42 (8.6%)	47 (9.7%)	335 (68.8%)	4.265	1.2708

Note: 1 = Strongly agree, 2 = Agree, 3 =Neutral, 4 = Disagree, 5 = Strongly disagree

There were 316 students (64.9%) who strongly disagreed on *“Towel used to wipe hands can be used to wipe bowls”*. And there were 335 students (68.8%) who strongly disagreed on *“Hand towel wiper can be used repeatedly without washing”*. The findings revealed that the student's knowledge was also low regarding the towel used to wipe the hands, which could also be used to wipe the plate. Hand-wiping towels and equipment used for food preparation were intermediaries that contributed to food contamination because dirty towels became breeding grounds for bacteria and fungi, which eventually became the cause of food poisoning events. Akabanda et al. (2017) stated that wiping towels, hands, and utensils could cause food pollution. These findings suggested that the students still did not have explicit knowledge of the basic principles of food safety.

Table 10 showed a significant difference in the level of education among school students. The findings indicated that food poisoning symptoms, such as stomach pain and squealing, could be prevented by eating with clean hands, with a significant value of 0.026.

Table 10: ANOVA Analysis of Variance between Levels of Education among students

Variables	Sum of Squares	Mean Square	F	Sig.	Result
Food poisoning, such as stomach pain and squealing can be avoided if you eat with clean hands	20.279	3.380	2.414	0.026	Significant
The date on food and beverage wrapping is important	20.070	3.345	2.890	0.009	Significant
Food affected by flies or cockroaches is not safe to eat	35.979	5.997	3.936	0.001	Significant
Hot kitchen or chamber temperature will increase germ breeding rates	26.865	4.477	2.248	0.038	Significant
Kitchen utensils that are not washed using washing soap can cause food pollution	28.231	4.705	3.131	0.005	Significant

*“The date on food and beverage wrapping is important”* had a 0.009 significant value. The significant value for *“Food affected by cockroaches or flies is not safe to eat”* was 0.001. *“Hot kitchen or chamber temperature will increase germ breeding rates”* had a significant value of 0.038. The significant value for *“Kitchen utensils that are not washed using washing soap can cause food pollution”* was 0.005.

The findings of this study were in line with the findings that Secondary school students in Beijing generally demonstrated good food safety knowledge, with nearly half scoring at a high level, and many practised reading labels on packaged foods for safety information (Cheng et al., 2017). However, studies in various regions revealed that overall food safety knowledge among students was often low. For instance, participants displayed a lack of understanding regarding the role of temperature control in microbial safety (Ovca, Jevšnik & Raspor, 2014), and poor food safety knowledge was commonly observed among students (Tutu, Hushie, Asante & Egyakwa-Amusah, 2020; Majowicz et al., 2015, 2017).

Based on [Table 11](#), there was a 0.017 significant difference in “*Dirty environment does not cause food pollution according to races*”. Malay, Iban, Bidayuh, and Chinese students had different knowledge about how a dirty environment causes food pollution.

Table 11: ANOVA Analysis of Variance between Ethnicity among students

Variables	Sum of Squares	Mean Square	F	Sig.	Result
A dirty environment does not cause food pollution	29.509	7.377	3.033	0.017	Significant

According to [Table 12](#), there was a significant difference between male and female students, where the significance value for “*Towel used to wipe hands can be used to wipe bowls*” was 0.003. “*The kitchen canteen needed to be protected from creatures such as lizards and rats*” had a significance value of 0.019.

Table 12: ANOVA Analysis of variance between Genders among students

Variables	Sum of Squares	Mean Square	F	Sig.	Result
The towel used to wipe hands can be used to wipe bowls	15.399	15.399	8.656	0.003	Significant
The canteen kitchen needs to be protected from creatures such as rats and lizards	8.077	8.077	5.503	0.019	Significant

#### 4. Conclusion

In conclusion, this indicated that the food handlers had adequate knowledge of a clean kitchen to ensure food safety. Based on the Food Act 1983, Bill 15(1), the food premises shall remain in good condition, clean and neat at all times. Most of the food handlers had adequate knowledge that hand towels could not be used repeatedly without washing ([Ministry of Health Malaysia, 2012](#)). The food handlers were unaware of the 7 correct steps in effective handwashing. According to the [Ministry of Health Malaysia \(2022\)](#), the 7-step handwashing technique recommended by MOH was crucial to prevent food poisoning. There was a significant difference in terms of the level of education among school students. Therefore, those students who had a higher education level tended to be more knowledgeable in food safety and hygiene practices. The study found that the students' knowledge was also low regarding the fact that the towel used to wipe the hands could also be used to wipe the plate. The findings revealed that children's limited experience and insufficient knowledge of proper temperature control during food preparation can significantly impact microbial food safety, as improperly stored or cooked foods can harbour harmful bacteria. School children, who were vulnerable to foodborne illnesses, often lacked adequate food safety awareness. Studies showed that, despite some students having basic food safety knowledge and hygiene practices, many still engaged in high-risk behaviours when choosing food, indicating a gap between knowledge and safe food practices. This suggested the importance of comprehensive

food safety education that not only imparts knowledge but also promotes safer food handling behaviours (Garayoa et al., 2005). The contribution of these findings was in line with the behavioural insights for behavioural change based on the World Health Organisation Sustainable Development Goals (SDGs) goal 3, which was good health and well-being.

### **Ethics Approval and Consent to Participate**

The researchers adhered to the ethical guidelines established by the Research Ethics Committee of UNIMAS. Approval for data collection was obtained from the Economic Planning Unit (Reference number: (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 number: JPNSW.SKPP.LAT.600-1/1/1 Jld.9(68)). Additionally, the UNIMAS Research Committee approved the data collection process (UNIMAS/NC-17.04/04-01 Jld. 1(4)). All procedures involving human participants were conducted in accordance with the ethical standards set forth by the institutional research committee.

### **Acknowledgement**

First of all, I would like to express my special thanks of gratitude to my supervisors, Ministry of Education Sarawak (KPM) and the State Planning Unit (SPU) for the data collection approval. In addition, I must thank the Ministry of Health for the sharing of food poisoning data in Betong schools. Last but not least, I must thank the school's principals, teachers, students and food handlers during the data collection period. This research was self-funded research by the researcher himself.

### **Funding**

This study received no funding.

### **Conflict of Interest**

The authors reported no conflicts of interest for this work and declare that there is no potential conflict of interest with respect to the research, authorship, or publication of this article.

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