

KNOWLEDGE AND ATTITUDES OF FOOD SAFETY AND ITS ASSOCIATED FACTORS AMONG STREET FOOD CONSUMERS IN KUALA KANGSAR, PERAK, MALAYSIA

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Abstract

Street food plays a significant role in the economy, where it supports the livelihoods of millions of people living in urban and rural areas while also contributing to tourism industries. As such, the hygiene and safety of street food should not be underestimated, as poor adherence to food hygiene and safety can contribute to foodborne diseases. A good understanding of food safety among consumers can reduce the incidence of foodborne outbreaks. However, comprehensive literature on the safety of street food is still inadequate. Therefore, a cross-sectional online survey was conducted among street food consumers in Kuala Kangsar, Perak Malaysia, to determine the level of food safety knowledge and attitudes, as well as the associated factors. For data analysis, descriptive statistics, Pearson correlation and Chi-square tests were conducted using SPSS version 26. Findings revealed that street food consumers in Kuala Kangsar have a moderate knowledge (59 ± 17) on, and positive attitudes (78 ± 14) towards food safety. Analysis revealed a significant association between participants' food safety knowledge and attitudes scores, and gender with participants' knowledge ($p < 0.05$). Even though the level of food safety knowledge and attitudes among street food consumers were satisfactory, the study suggests that several important factors, including cross-contamination, food pathogens, proper food storage, and time/temperature control, should be stressed when providing food safety education to the general public since these are the topics that the participants could not correctly answer. In addition, to promote hygiene and safety with regard to street food in Malaysia, related agencies such as the Ministry of Health and regulatory authorities must design effective initiatives and implement adequate control.

Keywords: Attitudes, Consumers, Knowledge, Kuala Kangsar, Street food

Introduction

Street foods are commonly available worldwide. Street foods are ready-to-eat foods and/or beverages prepared and/or sold by vendors or food handlers in streets or other similar public places (1) for immediate consumption without further processing or preparation (2, 3). Street food vendors include those who sell food and/or beverages from vehicles (carts, bicycles, trucks, etc.) or from plastic or cloths set out on the street, and street hawkers (4). People prefer to buy street foods rather than cook at home due to the variety of foods available at affordable prices, making it both convenient and easily accessible (5-7). However, even though street foods play an essential role in the economy of developed and developing countries (3, 8), the safety,

hygiene, and quality of street food is of major concern (3, 9-11). Various studies revealed that most of the street food vendors have poor hygiene practices and often operate under unacceptable conditions when preparing and selling foods and/or beverages (2-3, 9-11). Several factors have been linked to poor food safety and hygiene practices including lack of food safety awareness and education, and poor attitude towards food safety (2, 9-11), all of which can lead to outbreaks of foodborne illness.

According to the World Health Organization (WHO) (12) global statistics, one in ten people becomes ill after they accidentally eat contaminated food, while approximately 420,000 people die every year, resulting in the loss of 33 million healthy life years (DALYs). Microorganisms such as

bacteria, viruses and parasites, or chemical substances are the most common agents that contributed to foodborne illnesses, and these diseases are often infectious or toxic in nature (3, 12). Consumption of food contaminated with chemicals can lead to acute poisoning or long-term diseases such as cancer. Meanwhile, pathogenic microorganisms found in contaminated food can cause individuals to suffer from severe diarrhoea or debilitating infections like meningitis that may possibly lead to death (3, 13).

Food safety encompasses many aspects of food handling, preparation, and storage. Unfortunately, street food vendors commonly lack basic infrastructures and services due to their transient nature, and this include clean and adequate water supply. In fact, it is quite common to observe street food vendors storing water for hand and dishwashing, cooking or drinking in containers, which increases the risk of contamination, especially if the container itself is not maintained adequately (13). Not only that, the presence of pests and animals such as cats and dogs, poor air quality, inappropriate vendor locations, unclean equipment and poor personal hygiene also further contribute to poor food safety (14-16). Therefore, the safety and hygiene of street food remains a major global concern, as there are various outbreaks of foodborne illness associated with this type of food (3, 17-20).

In 2018, we were shocked by two incidents of death due to food poisoning associated with a laksa eatery in Baling, Kedah, where an additional 81 victims suffered from fever, diarrhea, and vomiting (19). Laboratory analysis found *Salmonella enterica serovar weltevreden* in the clinical samples of the patients and the laksa samples. The laksa was produced by the food stall owner at his own processing premises and it was believed that improper processing and unclean storage during its manufacture as well as poor temperature control during preparing ready-to-eat laksa were the factors contributing to bacterial contamination that had resulted in food poisoning (19). Another case was reported in 2014, involving the death of a 5-year-old boy and 68 surviving victims who had to seek treatment after eating food contaminated with *Salmonella* (21). It was believed that the poor holding time and temperature control by vendors were the main cause, since the foods were exposed to temperature danger zones (5°C to 63°C) for more than 4 hours (21). Food sold at vendors' stalls may spend a long of time in the temperature danger zone as a result of their longer daily operating hours (22); this is a concern since it might result in food with high bacterial counts (23). While these are just two of the cases of food poisoning that have occurred in Malaysia, both provided a clear reason as to why food safety knowledge and attitudes among street food consumers are important.

At present, limited studies have been conducted to assess food safety knowledge and attitudes among street food consumers in Malaysia, especially in Kuala Kangsar. Therefore, this study aims to fill this gap by determining the level of food safety knowledge and attitudes, as well as identifying factors associated with knowledge and

attitudes. Given that every location has its own distinct local context and unique characteristics, such as cultural practises, food handling practises, ingredient sources, and the potential for emerging food safety challenges, this study can offer insightful information and contribute to the body of knowledge on food safety in various settings. Even in the lack of any cases that have been publicly reported, the study may be helpful in promoting general food safety and preventing future cases of food poisoning in the food street environments of Kuala Kangsar. Hence, the data provided in this study could assist health authorities such as the Ministry of Health, to take appropriate control measures and develop effective strategies to improve food hygiene and safety involving street foods in Malaysia.

Materials and Methods

Study design and sampling

This cross-sectional study was conducted among street food consumers in Kuala Kangsar, Perak, Malaysia, from December 2021 to January 2022. Kuala Kangsar is a royal town that stands out for its heritage and history, making it one of the most well-known cultural heritage tourism destinations (24). An electronic questionnaire was constructed using Google Forms, and a URL link was distributed to the social media such as WhatsApp Group, Facebook, and Telegram within the Kuala Kangsar community. In response to social distancing restrictions put in place by the government to stop COVID-19 from spreading, this survey was carried out using an online platform (25). This study successfully recruited 150 participants using a snowball sampling method, following a similar approach by Zulkarnain et al. (25), where those who were initially recruited were encouraged to distribute the survey link to recruit future participants. The individuals who participated in this research had to be Kuala Kangsar residents who had eaten a street food item sold in the district at least once. The study was approved by the Ethics and Research Committee of UiTM [Reference no: REC/12/2021 (UG/MR/1077)]. The participants were provided with all the necessary information regarding the study, and at the beginning of the electronic questionnaire, informed consent was requested. The participants were also informed that their involvement in the study was completely voluntary, and they were free to refuse to participate or withdraw at any time. The identity of the participants is kept anonymous.

Questionnaire and data analysis

The questionnaire used to assess the food safety knowledge and attitudes of the street food consumers was adopted from previous studies pertaining food safety (2, 10). There are three sections in the questionnaire. The first section is designed to determine the demographic characteristic of the participants. The second and third sections focus on participants' food safety knowledge and attitudes, respectively. Each correct answer is awarded with 1 point. However, there are no points given when selecting a "do not

know” response or for providing an incorrect or negative answer. The total scores are then converted to 100. A score of < 50% is considered as having either poor knowledge or attitudes towards food safety. A score between 50% to 75% is considered as moderate food safety knowledge and attitudes, while >75% is considered as good. The scoring system used for these two sections is similar to that used in previous studies (2, 10). Descriptive statistics of means, standard deviation, frequencies and percentages were used for variables as appropriate. Pearson correlation analysis was used to assess the correlation between food safety knowledge and attitudes, while Chi-square test was used to determine the association between demographic characteristics and scores for food safety knowledge and attitudes. The statistical analysis was performed using IBM SPSS version 26 and the significance level was set at 0.05.

Results

Demographic characteristics of study participants

Table 1 summarized the demographic information for the participants (n = 150) in this study. Majority of the participants were between 18 to 25 years old (64.0%) with 81.3% female. Out of the 150 participants, 48.0% had bachelor’s degree and 76.7% earned less than RM2,500.00 per month. Most participants did not receive any food safety training (70.0%).

Table 1: Demographic characteristics of street food consumers (n = 150)

Demographic characteristics	Frequency, n	Percentage, %
Age (Years)		
18-25	96	64.0
26-35	25	16.7
36-45	5	3.3
46-55	14	9.3
≥56	10	6.7
Gender		
Male	28	18.7
Female	122	81.3
Highest education level		
Secondary school	21	14.0
Certificate	8	5.3
Sijil Tinggi Persekolahan Malaysia (STPM)	9	6.0
Diploma	33	22.0
Bachelor’s degree	72	48.0
Master’s degree	7	4.7
Average monthly income		
≤ RM 2,500	115	76.6
RM 2,501 - RM 3,170	4	2.7
RM 3,171 - RM 3,970	4	2.7
RM 3,971 - RM 4,850	4	2.7
RM 4,851 - RM 5,880	8	5.3
RM 5,881 - RM 7,100	9	6.0
RM 7,101 - RM 10,970	4	2.7
RM 10,971 - RM 15,040	2	1.3
Received food safety training		
Yes	45	30.0
No	105	70.0

Food safety knowledge score of street food consumers in Kuala Kangsar district

Table 2 summarized the findings and provides more insight on the food safety topics that street food consumers in Kuala Kangsar are most and least knowledgeable about. The mean score was 59 ± 17, indicating that street food consumers in Kuala Kangsar had moderate level of food safety knowledge. This study found that more than 50% of the participants were unaware that Hepatitis A viruses and *Staphylococcus spp.* are pathogens that are responsible for foodborne diseases, except for *Salmonella spp.* Out of 150 participants, 49.3% either did not know or did not think that typhoid could be transmitted by food, while only 46.0% knew that microbes are present on the skin and in the nose and mouth of healthy workers. Not only that, participants in this study misconstrued that washing utensils with detergent leave them free of contamination (78.0%) and that food prepared in advance reduces the risk of food contamination (68.7%). Additionally, more than 50% of the participants were not aware that eating and drinking in the workplace increase the risk of food contamination and that reheating cooked foods could be used to prevent the occurrence of foodborne diseases.

The following topics are where consumers’ understanding of food safety was strongest. Out of 150 study participants, 59.3% believed that abortion in pregnant women could be induced by foodborne disease. More than 75% of those surveyed were also aware that bloody diarrhoea can be transmitted by food, that swollen cans contain microorganisms, and it is necessary to take leave from work during infectious disease of the skin. However, despite 83.3% of participants agreeing that temperature and time are the two most important factors in regulating the growth of germs, only 34.0% of the participants knew that the danger zone for potentially hazardous foods is between 5°C and 60°C. Street food consumers in Kuala Kangsar also demonstrated knowledge about cross-contamination (62.7%) and who is most at risk for food poisoning (68.7%). Majority of the participants also understood and agreed that the following facts reduce the risk of food contamination: 1] washing hands before working (94.7%), 2] using gloves when handling food (87.3%), and 3] proper cleaning and sanitization of utensils (74.0%).

Table 2: Food safety knowledge of street food consumers in Kuala Kangsar (n = 150)

Question	Number of response (%)		
	Yes	No	Do not know
1. Abortion in pregnant women can be induced by foodborne disease.	89 (59.3)	21 (14.0)	40 (26.7)
2. Bloody diarrhoea can be transmitted by food.	122 (81.3)	10 (6.7)	18 (12.0)
3. Swollen cans contain microorganisms.	113 (75.3)	4 (2.7)	33 (22.0)

Table 2: Food safety knowledge of street food consumers in Kuala Kangsar (n = 150) (continued)

Question	Number of response (%)		
	Yes	No	Do not know
4. During infectious disease of the skin, it is necessary to take leave from work.	130 (86.7)	14 (9.3)	6 (4.0)
5. Eating and drinking in the workplace increase the risk of food contamination.	68 (45.3)	58 (38.7)	24 (16.0)
6. Hepatitis A virus is a foodborne pathogen.	49 (32.7)	15 (10.0)	86 (57.3)
7. Microbes are in the skin, nose, and mouth of healthy handlers.	69 (46.0)	24 (16.0)	57 (38.0)
8. <i>Salmonella</i> is among the foodborne pathogens.	81 (54.0)	4 (2.7)	65 (43.3)
9. <i>Staphylococcus</i> is among the food-borne pathogens.	51 (34.0)	11 (7.3)	88 (58.7)
10. Typhoid fever can be transmitted by food.	76 (50.7)	22 (14.7)	52 (34.7)
11. The most important factors to control the growth of bacteria are temperature and time.	125 (83.3)	10 (6.7)	15 (10.0)
12. When holding hot foods for service, it is required that internal food temperatures be taken at least every two hours.	67 (44.7)	17 (11.3)	66 (44.0)
13. The temperature danger zone for potentially hazardous foods is 5° to 60°C.	51 (34.0)	11 (7.3)	88 (58.7)
14. Cross contamination is the transfer of harmful substances or micro-organisms to food from food or from a non-food contact surface, such as equipment, utensils, or hands.	94 (62.7)	9 (6.0)	47 (31.3)
15. Using gloves while handling food reduces the risk of food contamination.	131 (87.3)	9 (6.0)	10 (6.7)
16. Washing hands before work reduces the risk of food contamination.	142 (94.7)	2 (1.3)	6 (4.0)
17. AIDS can be transmitted by food.	28 (18.7)	86 (57.3)	36 (24.0)
18. Children, healthy adults, pregnant women, and older individuals are at equal risk for food poisoning.	103 (68.7)	33 (22.0)	14 (9.3)

Table 2: Food safety knowledge of street food consumers in Kuala Kangsar (n = 150) (continued)

Question	Number of response (%)		
	Yes	No	Do not know
19. Food prepared in advance reduces the risk of food contamination.	103 (68.7)	19 (12.7)	28 (18.7)
20. Proper cleaning and sanitization of utensils increase the risk of food contamination.	32 (21.3)	111 (74.0)	7 (4.7)
21. Reheating cooked foods can contribute to food contamination.	72 (48.0)	54 (36.0)	24 (16.0)
22. Washing utensils with detergent leaves them free of contamination.	117 (78.0)	19(12.7)	14 (9.3)
Total mean score ± stdev.	59 ± 17		

stdev. = standard deviation.

Food safety attitudes score of street food consumers in Kuala Kangsar district

Table 3 summarized the scores and provides more insight for food safety attitudes among street food consumers in Kuala Kangsar district. The mean score for food safety attitude is (78 ± 14), which indicates that consumers had a good and positive attitude towards food safety. Most study participants were aware that proper hand hygiene could prevent foodborne disease (98.0%) and that workers’ health status should be evaluated before employment (94.7%). Additionally, more than 89% of the participants knew and agreed that wearing masks, gloves, and caps are important practices to reduce the risk of food contamination, while food handlers who have abrasions or cuts on their hands should not touch food without gloves (94.7%). They also believed that dish towels can be a source of food contamination (88.7%), while knives and cutting boards should be properly sanitized to prevent cross-contamination (92.7%).

Only 42.7% of the participants, however, were aware that the best way to thaw a chicken was in a bowl of cold water. More than half of the participants (64.7%) thought that the eggs should be washed as soon as possible after purchasing and that defrosted food can be refrozen (67.3%). 12.7% of study participants claimed that it was unnecessary to check the temperature of refrigerators/freezers periodically, and there are participants who believed that it was safe to store raw and cooked food together (6%). In addition, 38.0% of the consumers felt that it is not ideal to store raw meat in the refrigerator on the bottom shelf. Out of 150 participants, only 48.0% agreed that closed food cans/jars and closed cans/jars of cleaning supplies should be kept separate. The findings of this study highlight the need to emphasize the importance of proper food storage

practices to reduce the risk of food contamination and the need for cold temperatures to retard the growth of microorganisms, especially while defrosting food in the refrigerator. Nevertheless, 91.3% of study participants stated they would like to learn more about food safety.

Table 3: Food safety attitudes of street food consumers in Kuala Kangsar (n = 150)

Question	Number of response (%)		
	Yes	No	Do not know
Proper hand hygiene can prevent food-borne diseases.	147 (98.0)	3 (2.0)	0 (0)
Raw and cooked foods should be stored separately to reduce the risk of food contamination.	141 (94.0)	5 (3.3)	4 (2.7)
It is necessary to check the temperature of refrigerators/ freezers periodically to reduce the risk of food contamination.	131 (87.3)	7 (4.7)	12 (8.0)
The health status of workers should be evaluated before employment.	142 (94.7)	3 (2.0)	5 (3.3)
The best way to thaw a chicken is in a bowl of cold water.	64 (42.7)	49 (32.7)	37 (24.7)
Wearing masks is an important practice to reduce the risk of food contamination.	134 (89.3)	10 (6.7)	6 (4.0)
Wearing gloves is an important practice to reduce the risk of food contamination.	139 (92.7)	5 (3.3)	6 (4.0)
Wearing caps is an important practice to reduce the risk of food contamination.	139 (92.7)	5 (3.3)	6 (4.0)
Dish towels can be a source of food contamination.	133 (88.7)	7 (4.7)	10 (6.7)
Knives and cutting boards should be properly sanitized to prevent cross-contamination.	139 (92.7)	5 (3.3)	6 (4.0)
Food handlers who have abrasions or cuts on their hands should not touch foods without gloves.	142 (94.7)	1 (7)	7 (4.7)
Well-cooked foods are free of contamination.	117 (78.0)	26 (17.3)	7 (4.7)
Can a closed can/jar of cleaning product be stored together with closed cans and jars of food products?	56 (37.3)	72 (48.0)	22 (14.7)
Defrosted foods can be refrozen.	101 (67.3)	27 (18.0)	22 (14.7)

Table 3: Food safety attitudes of street food consumers in Kuala Kangsar (n = 150) (Continued)

Question	Number of response (%)		
	Yes	No	Do not know
The ideal place to store raw meat in the refrigerator is on the bottom shelf.	93 (62.0)	28 (18.7)	29 (19.3)
Eggs must be washed after purchase as soon as possible.	97 (64.7)	41 (27.3)	12 (8.0)
Willing to obtain more food safety knowledge.	137 (91.3)	6 (4.0)	7 (4.7)
Total mean score ± stdev.	78 ± 14		

stdev. = standard deviation.

Factors associated with the food safety knowledge and attitudes among street food consumers in Kuala Kangsar district

This study revealed that those between the ages of 36 and 45 had better food safety knowledge (20.0%) and attitudes (100.0%) than those between the ages of 18 to 25 and above 46, as shown in Table 4. When comparing gender, females had better knowledge (18.0%) compared to males (7.1%). In other words, more than half of the questions were correctly answered by 18.0% of the female participants. Comparison between the highest education level revealed that STPM holders had good knowledge (22.2%) and attitudes (88.9%) regarding food safety. Additionally, those who made between RM 5,881 and RM 7,100 a month also had good food safety knowledge (44.4%) and attitudes (100.0%). This study also discovered that those who had undergone food safety training had better knowledge and attitudes than those who had not. However, statistical analysis revealed that there is no significant association between overall food safety attitudes score with demographic characteristics of street food consumers ($p > 0.05$), while only gender was shown to be significantly associated with food safety knowledge score ($p < 0.05$).

A summary of the correlation between food safety knowledge and attitudes among street food consumers in Kuala Kangsar district is shown in Table 5. A significant positive correlation is found between food safety knowledge with attitudes ($r = 0.395$, $p < 0.05$). This showed that the food safety knowledge level of street food consumers had a significant effect on their attitudes regarding food safety.

Table 4: Association between demographic characteristics and food safety knowledge and attitudes among street food consumers in Kuala Kangsar (n = 150)

Variables	Frequency, n (%)	Level of knowledge			p-value	Level of attitudes			p-value
		Poor	Moderate	Good		Poor	Moderate	Good	
Age (Years)									
18-25	96 (64.0)	23 (24.0)	57 (59.4)	16 (16.7)	0.906	6 (6.3)	17 (17.7)	73 (76.0)	0.673
26-35	25 (16.7)	3 (12.0)	18 (72.0)	4 (16.0)		1 (4.0)	2 (8.0)	22 (88.0)	
36-45	5 (3.3)	1 (20.0)	3 (60.0)	1 (20.0)		0 (0.0)	0 (0.0)	5 (100.0)	
46-55	14 (9.3)	4 (28.6)	9 (64.3)	1 (7.1)		0 (0.0)	1 (7.1)	13 (92.9)	
≥56	10 (6.7)	3 (30.0)	5 (50.0)	2 (20.0)		0 (0.0)	1 (10.0)	9 (90.0)	
Gender									
Male	28 (18.7)	11 (39.3)	15 (53.6)	2 (7.1)	0.045*	2 (7.1)	4 (14.3)	22 (78.6)	0.784
Female	122 (81.3)	23 (18.9)	77 (63.1)	22 (18.0)		5 (4.1)	17 (13.9)	100 (82.0)	
Highest education level									
Secondary school	21 (14.0)	8 (38.1)	10 (47.6)	3 (14.3)	0.838	1 (4.8)	4 (19.0)	16 (76.2)	0.792
Certificate	8 (5.3)	2 (25.0)	5 (62.5)	1 (12.5)		0 (0.0)	2 (25.0)	6 (75.0)	
STPM	9 (6.0)	2 (22.2)	5 (55.6)	2 (22.2)		1 (11.1)	0 (0.0)	8 (88.9)	
Diploma	33 (22.0)	9 (27.3)	20 (60.6)	4 (12.1)		2 (6.1)	2 (6.1)	29 (87.9)	
Bachelor's degree	72 (48.0)	12 (16.7)	47 (65.3)	13 (18.1)		3 (4.2)	12 (16.7)	57 (79.2)	
Master's degree	7 (4.7)	1 (14.3)	5 (71.4)	1 (14.3)		0 (0.0)	1 (14.3)	6 (85.7)	
Average monthly income									
≤ RM 2,500	115 (76.6)	27 (23.5)	68 (59.1)	20 (17.4)	0.423	7 (6.1)	17 (14.8)	91 (79.1)	0.813
RM 2,501 - RM 3,170	4 (2.7)	1 (25.0)	3 (75.0)	0 (0.0)		0 (0.0)	1 (25.0)	3 (75.0)	
RM 3,171 - RM 3,970	4 (2.7)	1 (25.0)	3 (75.0)	0 (0.0)		0 (0.0)	1 (25.0)	3 (75.0)	
RM 3,971 - RM 4,850	4 (2.7)	0 (0.0)	4 (100)	0 (0.0)		0 (0.0)	1 (25.0)	3 (75.0)	
RM 4,851 - RM 5,880	8 (5.3)	1 (12.5)	7 (87.5)	0 (0.0)		0 (0.0)	0 (0.0)	8 (100.0)	
RM 5,881 - RM 7,100	9 (6.0)	2 (22.2)	3 (33.3)	4 (44.4)		0 (0.0)	0 (0.0)	9 (100.0)	
RM 7,101 - RM 10,970	4 (2.7)	1 (25.0)	3 (75.0)	0 (0.0)		0 (0.0)	0 (0.0)	4 (100.0)	
RM 10,971 - RM 15,040	2 (1.3)	1 (50.0)	1 (50.0)	0 (0.0)		0 (0.0)	1 (50.0)	1 (50.0)	
Received food safety training									
Yes	45 (30.0)	8 (17.8)	25 (55.6)	12 (26.7)	0.061	2 (4.4)	4 (8.9)	39 (86.7)	0.489
No	105 (70.0)	26 (24.8)	67 (63.8)	12 (11.4)		5 (4.8)	17 (16.2)	83 (79.0)	

* p-value is significant at 0.05.

Table 5: Correlation of food safety knowledge and attitudes level

Level	Pearson Correlation	Sig.
Knowledge - Attitude	0.395**	0.000

** Correlation is significant at the 0.01 level (2-tailed).

Discussion

This study examined the knowledge and attitudes of street food consumers in Kuala Kangsar on food safety, as well as the relationship between these two domains with participants' demographic characteristics. Overall, average knowledge and good attitudes regarding food safety were found among street food consumers in Kuala Kangsar. This finding is in line with previous studies conducted in Haiti (2), Vietnam (10), China (26), Bangladesh (27), and Saudi Arabia (28) that found street food consumers had a moderate level of knowledge about food safety. Additionally, the type of pathogens (Hepatitis A virus, *Salmonella spp.*, and *Staphylococcus spp.*) that can result in foodborne disease, received the most incorrect responses from study participants. This could be because it was challenging for participants to identify each pathogen's precise name (29). Furthermore, most consumers seem to be unaware of important time/temperature control and safe food storage practises. These results are consistent with previous studies (2, 10) in which consumers of street food only partially answered these questions correctly. Therefore, this study emphasized that street food consumers in Kuala Kangsar need to improve their knowledge about food safety to reduce the likelihood of them getting foodborne diseases and subsequently help them maintaining their health.

This study also revealed that the level of food safety knowledge among street food consumers in Kuala Kangsar district varied across different demographic characteristics (i.e., gender, age, level of education, monthly income and whether or not they have attended food safety training). Aligning with previous studies (27, 30-31), current findings revealed that females possessed higher food safety knowledge compared to their male counterparts. This may be explained by the fact that women are typically in charge of food preparation at home (31), which offers them more knowledge of food safety compared to men, who, because of the prevalent patriarchal structure, are not frequently involved in food preparation in the household (27). As seen in this study, older street food consumers in Kuala Kangsar district (36–45 and 56 years) have greater knowledge of food safety than younger consumers, which is consistent with findings from Al Banna et al. (27) and Low et al. (32) who found that older consumers often have better knowledge regarding food safety. Older consumers may have had years of experience with food contamination and related food safety issues, which has led to better knowledge and awareness of food safety (27). In addition, street food consumers with education level above a certificate had better food safety

knowledge compared to those with only secondary school or a certificate. These results are in agreement with the findings from previous studies (9, 27-28). Not only that, those who had attended food safety training certainly had better attitudes and knowledge about food safety. In general, it is suggested that food safety education and interventions target young people, particularly males, and those with lower educational profiles in order to reduce the risk of foodborne disease related to the consumption of street foods.

In terms of attitudes towards food safety, this study found that while street food consumers were aware of the importance of good hygiene while handling food, their awareness of best practices when thawing is needs to be improved. Most participants were unaware of the ideal method for thawing a chicken, which is in a bowl of cold water. This result aligned with the findings from previous studies conducted in China (26), Haiti (2), and Vietnam (10). To note, there are only three safe ways for thawing perishable food, such as chicken, as recommended by USDA-FSIS. This includes thawing in the refrigerator, in the cold water, and in the microwave (33). During the thawing process, perishable foods must be kept at a safe temperature since bacteria that may have been present before freezing can start to multiply as soon as the temperature rises above 5°C (33). Therefore, frozen food should not be allowed to thaw at room temperature since it can encourage the growth of harmful bacteria, which consequently increases the risk of foodborne illness. It is interesting to note that most participants thought it was acceptable to wash eggs as soon as possible after purchasing. However, this finding is different from previous studies (2, 10, 26) which found that only a very small number of street food consumers believed that it was appropriate to wash the eggs as soon as possible after purchasing. Eggs should not be washed, and you can use a dry rag to clean the dirt from the egg shells (26). Washing the eggs may remove the powdery gelatinous substances that serve as a natural barrier to prevent bacteria such as *Salmonella spp.* from entering the inside of eggs (26). This will shorten the egg's shelf life and increase the risk of egg contamination by foodborne pathogens.

The results of this study also indicated that customers' attitudes can be positively influenced by their knowledge of food safety. This could subsequently result in good practices and behaviour pertaining to food safety (27). With the increased popularity of social media across all age groups, especially children and adolescents (34), it appears plausible to disseminate information on food safety using platforms like TikTok, Twitter, YouTube, Facebook, and Instagram. Future research should incorporate practice domain for better understanding on how consumer's knowledge and attitudes might change into a behaviour. It is also suggested that future studies could assess how consumers' perception/perspective on food hygiene practices of operators and food sales/preparation areas influence their decisions to buy from street vendors.

However, this study has some limitations. People without internet or social media access were unable to participate in the surveys since they were conducted online, and the URL link was shared through social media connections and databases. Since the survey is self-administered and conducted online, it is possible for response biases, a lack of understanding of the questions, and a lack of seriousness in responding to the survey to occur. Despite its limitations, online data collection is still an effective research method, especially in emergency circumstances and locations with limited resources (35). Data collection for this study took place during a COVID-19 wave where doing face-to-face survey would be riskier for both researcher and participants. Since this study was focused on street food consumers in Kuala Kangsar, the findings cannot be generalized to the entire population in Malaysia.

Conclusion

The present study provides evidence that street food consumers in Kuala Kangsar district had moderate knowledge and good attitudes towards food safety. The consumer's knowledge was associated with food safety attitudes and gender. Nevertheless, the level of food safety knowledge and attitudes among street food consumers in the district varied across different demographic characteristics. The findings confirm the need to enhance consumers' understanding of food safety issues such as cross-contamination, food pathogens, proper food storage, and time/temperature control in order to lower the risk of food contamination and, ultimately, prevent the incidence of foodborne diseases brought on by a lack of knowledge and attitudes in food safety.

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Competing interests

The authors declare that they have no competing interests.

Ethical Clearance

We obtained approval from the Ethics and Research Committee of UiTM [Reference no: REC/12/2021 (UG/MR/1077)].

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