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Assessment of food safety knowledge, attitudes, and practices among street food vendors in Malaysia

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Abstract

Street food in Malaysia is gaining popularity due to its competitive pricing and accessibility for consumers. However, unsanitary methods and processes have raised concerns about foodborne diseases, making it a major food safety concern. This study aims to: 1) investigate the levels of food safety knowledge, attitudes, and practices among street food vendors; 2) determine the association between demographic characteristics and food safety practices; and 3) investigate the factors influencing food safety practices among these vendors. The study was conducted in the Klang Valley area, and a purposive sampling method was used to select 268 street food vendors. Descriptive, Chi-square, and logistic regression analyses were conducted to analyse the data. The findings reveal that most street food vendors possess adequate knowledge, favourable attitudes and follow food safety practices. Key factors influencing food safety practices included knowledge, attitudes, education level, type of stall, monthly revenue, food safety training, and typhoid injection. Most notably, monthly revenue emerged as a significant factor, where vendors with higher incomes were more likely to implement good food safety practices. Hence, authorities should offer incentives such as equipment procurement subsidies and microcredit schemes to street food vendors to empower them to overcome financial constraints and invest in necessary practices that ultimately lead to improved food safety standards.

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1. Introduction

In Malaysia, the food and beverage (F&B) industry is a booming market; it is one of the major drivers of the nation's economy, with small and medium-sized businesses (SMEs) being the dominant force in the industry (1-3). Restaurants, street stalls or kiosks, fast food, cafes, bars, and self-service cafeterias are examples of F&B outlets (4). The rise of SMEs, particularly street vendors, has played a crucial role in government efforts to tackle unemployment, generate income, and stimulate regional economic growth (5). Street food has gained immense popularity in Malaysia owing to its accessibility, affordability, and convenience. The trend of dining out has been driven by the increasing number of working mothers who do not have time to prepare meals at home, coupled with the growth of food companies offering a variety of options (6,7). Additionally, the growing presence of hawker stalls, typically operating from morning until midnight and serving a wide range of meals, further entices Malaysians to dine out (7-9). However, this ubiquity presents a challenge because street sales in Malaysia often exist in an informal space, characterized by the lack of regulation and protection from the government (10,11). Many street vendors operate without business licenses, tax reports, or adherence to labor regulations (12,13), which contributes to the scarcity of official statistics on the street food business (14,15).

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Despite its popularity, street food is considered a major public health risk (16,17) owing to frequent contamination by microorganisms associated with foodborne diseases (18-20). Prior research highlights that the cleanliness of food premises and hygiene of food handlers are Malaysia's most critical issues when it comes to foodborne illnesses (21, 22). The risk is compounded by the lack of environmental regulations, inadequate facilities, and unsafe street food practices (23-25). In Malaysia, foodborne diseases are caused by unhygienic food handling practices and poor environmental sanitation (26-28), with incorrect holding temperatures and extended holding times, resulting in severe food poisoning and foodborne outbreaks (29). This is because street food vendors often sell pre-cooked and ready-to-eat (RTE) foods (30,31) prepared in advance (4-8 hours). These foods are then displayed in an unprotected setting without proper incubation, which exposes them to a significant risk of bacterial contamination (32) and increases the likelihood of foodborne illnesses (33). Studies have demonstrated a correlation between eating-out and increased food poisoning in Malaysia (34,35). A further exacerbating issue is the lack of mandatory food safety training for Malaysian food handlers (37). Without crucial knowledge of food safety practices, these vendors unknowingly contribute to foodborne illness outbreaks through improper food handling practices, leading to instances of food poisoning (36, 38).

Most Malaysians apparently prioritize food taste over food safety (39,40), often neglecting considerations of safety, quality, and hygiene (41,42). This indicates a general lack of awareness of food safety issues within the population (35). Latchumaya et al. (32) found that all 50 randomly selected RTE street food samples were highly infected with aerobic bacteria, coliforms, and *E. coli*. Another study (43) also found that 90.3% of beverage samples sold by street vendors in Kuala Lumpur failed to meet Malaysia and World Health Organization (WHO) standards and were contaminated with viable bacteria. In the Chow Kit area, street vendors sold food that exceeded the International Microbiological Specifications on Foods (ICMSF) standard, with high levels of coliforms, *E. coli*, and *S. aureus* detected in the samples (36). Shafizi et al. (44) reported *S. aureus* contamination in food samples from 68% of the premises in Putrajaya, exposing consumers to contaminated food. These findings highlight the significant public health risk associated with the consumption of street foods and beverages.

The global prevalence of foodborne disease outbreaks associated with street food emphasizes the need for vendors to improve food-handling practices (45,46). Hence, research on street food vendors' food safety knowledge, attitudes, and practices is crucial for minimizing foodborne diseases and protecting public health. While most studies have focused on food handlers in canteens, residential colleges, and food service businesses, there is limited research on street food sellers. Therefore, the objectives of this study are: 1) to investigate the level of food safety knowledge, attitudes, and practices; 2) to determine the associations between demographic characteristics and food safety practices; and 3) to determine the factors influencing food safety practices among street food vendors.

2. Materials and Methods

2.1. Sampling Method

A purposive sampling method was used to select targeted street food vendors in the Klang Valley, Malaysia. The respondents in this study were chosen based on two specific

criteria: (1) food handlers involved in the street food business and (2) street food vendors who actively participate in food handling.

Given the lack of precise information regarding the total number of Malaysian street food vendors, Cochran's formula was used to determine the sample size required for the study. Thus, the sample size was calculated using Cochran's formula:

$$n=\frac{z^2(pq)}{e^2} \quad (1)$$

$$n=\frac{1.96^2(0.5)(0.5)}{0.5^2}$$

$$n=3.84.16$$

$$n=385$$

n = sample size
p = the population proportions
q = 1-p
e = acceptable sampling error (e = 0.05)
z = z value at reliability level or significance level
Reliability level 95% or significance level 0.05; z = 1.96

The initial calculation, using Cochran's formula, indicated that a sample size of 385 respondents was necessary to achieve a 95% confidence level. Nonetheless, when dealing with a small population, adjustments to the sample size using a correction factor are necessary (54). Given the actual population size of 876 street food vendors, a list obtained from the Kuala Lumpur City Hall (DBKL) database, a revised sample size was calculated using Equation 2. This resulted in 268 street food vendors participating in the study.

$$n=\frac{n_0}{1+\frac{(n_0-1)}{N}} \quad (2)$$

$$n=\frac{385}{1+\frac{(385-1)}{876}}$$

$$n=268$$

where:
no = Cochran's sample size recommendation
N = population size
n = adjusted sample size

2.2. Research Instrument

To gather data, this study employed a survey research design, with a structured questionnaire administered through face-to-face interviews. The structured questionnaire was divided into four sections: Section A demographic characteristics; Section B, food safety

knowledge; Section C, food safety attitudes; and Section D, food safety practices. Informed consent was obtained from all street food vendors prior to participation.

2.3. Conceptual Framework

The Knowledge, Attitudes, and Practices (KAP) model serves as a foundational framework for social research (47), particularly in exploring individuals' cognisance, beliefs, and behaviours regarding specific issues (48). At its core, the KAP model asserts that the interplay between one's attitudes and knowledge towards a given practice invariably shapes one's behavioral patterns. Accordingly, individuals who possess a strong understanding of a subject coupled with a positive disposition towards a particular behavior are poised to exhibit more effective practices (49). Thus, the KAP model is important for investigating and explaining food safety measures (50). By illuminating the connections between knowledge, attitudes, and behaviors, the KAP model offers a critical lens for understanding food hygiene and sanitation quality (51,52). The conceptual framework of this study demonstrates the relationship between KAP model variables. Specifically, the independent variables consisted of knowledge, attitudes, and demographic characteristics, which were used to explain the dependent variable, that is, street food vendors' practices towards food safety. Figure 1 presents the conceptual framework of this study adapted from Abdullah Sani and Siow (37) and Kwol et al. (49). The framework shows that knowledge influences attitudes towards food safety practices among street food vendors (49). Attitudes in turn shape food safety practices adopted by vendors (38). Previous studies also indicate that demographic characteristics significantly influence street food vendors' food safety practices (53,54). Thus, the hypotheses developed in this study are as follows:

H_0: There is no association between demographic characteristics and food safety practices among street food vendors.

H_1: There are associations between demographic characteristics and food safety practices among street food vendors.

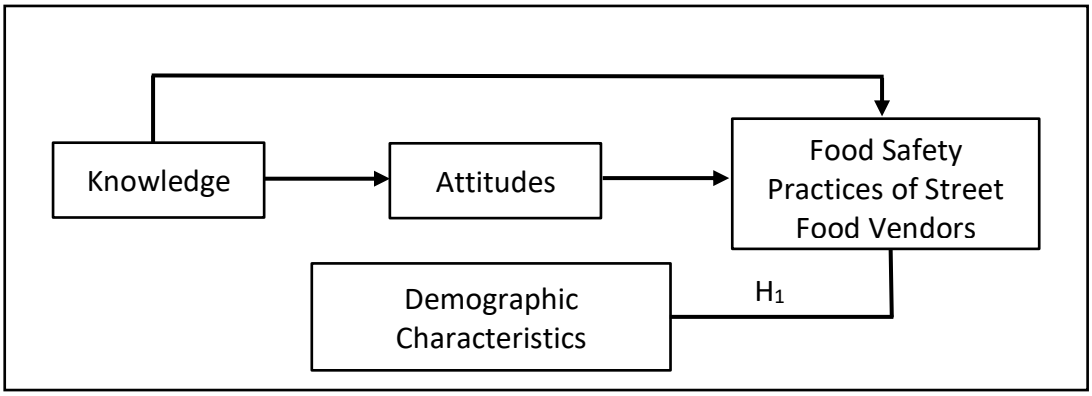

Figure 1. Conceptual framework of food safety practices among street food vendors.

2.4. Statistical Analysis

Initially, a descriptive analysis was used to summarize the demographic characteristics of the respondents. To evaluate the levels of knowledge, attitudes, and practices regarding food safety, 18 statements were developed for each category. Food safety knowledge was measured using a 3-point Likert scale (1= No, 2= Do not know, 3= Yes) (26, 27, 55). Each of the 18 statements was scored as 1 for a correct answer (yes) or 0 for an incorrect answer (No,

Do not know). The possible scores ranged from 0 to 18, with total scores above eight (8) categorized as adequate knowledge and inadequate knowledge if less than 8 (54). Attitudes towards food safety were determined using a 5-point Likert scale (1= strongly disagree, 2= disagree, 3= neutral, 4= agree, and 5= strongly agree) (55). A score of 1 was assigned for a "Strongly disagree" response, while a score of 5 was assigned for a "Strongly agree" response. This scale produced a range from 18 to 90, with scores exceeding 54 indicating favorable attitudes and scores less than or equal to 54 indicating unfavorable attitudes (56). Food safety practices were evaluated using a 3-point Likert scale (1= Never, 2= Seldom, 3= Always) (55). For 18 questions, a score of 1 was given for a "Never" response, while scores of 2 and 3 were given for "Seldom" and "Always" responses, respectively. The possible score for practice ranged from 18 to 54. A total score ranging from 36 to 54 indicated good practices (54), and 18 to 35 indicated poor practices.

In a subsequent analysis, a chi-square analysis was used to determine the associations between street food vendors' demographic characteristics and food safety practices. The null hypothesis was rejected when the p-value was less than or equal to the significance level ($p < \alpha$), indicating a statistically significant association. Conversely, if the p-value was greater than the significance level, the test result was not statistically significant. This study employed the significance levels of 1%, 5%, and 10%. Logistic regression analysis was used to identify the most influential factors affecting food safety practices among street food vendors. The dependent variable, food safety practices, was categorized into 'good practices' (coded as 1) and 'poor practices' (coded as 0). Eight (8) independent factors were analyzed: knowledge, attitudes, education level, stall type, license, monthly revenue, food safety training, and typhoid injection. In this analysis, three (3) significance levels were used: 1%, 5%, and 10% (57). The relationships between the variables can be expressed using the following equation:

$$\log\left(\frac{p(x)}{1-p(x)}\right) = \alpha + \beta 1\,\chi 1 + \beta 2\,\chi 2 + \beta 3\,\chi 3 + \beta 4\,\chi 4 + \beta 5\,\chi 5 + \beta 6\,\chi 6 + \beta 7\,\chi 7 + \beta 8\,\chi 8 + \varepsilon i \quad (3)$$

Where:

$\log\left(\frac{p(x)}{1-p(x)}\right)$ = food safety practices among street food vendors,
α = constant
$\beta 1 – \beta 8$ = coefficient of $\chi 1 – \chi 8$
$\chi 1$ = Knowledge (1=Adequate, 0=Inadequate)
$\chi 2$ = Attitudes (1=Favourable, 0=Unfavourable)
$\chi 3$ = Education level (1= high education, 0=Low Education).
$\chi 4$ = Type of stalls (1=Stationary, 0=Mobile)
$\chi 5$ = License (= Yes, 0=No)
$\chi 6$ = monthly revenue (1= high revenue, 0= low revenue).
$\chi 7$ = Food safety training (1=Attend, 0=Did not attend).
$\chi 8$ = Typhoid injection (1=Yes, 0=No)
εi = error term

3. Results and Discussion

3.1. Respondents' demographic characteristics

A total of 268 street food vendors in the Klang Valley participated in this study. Table 1 reveals that most vendors were male (166 vendors), with a predominant age range of 30–39 years (38.4%). The Malay ethnicity was the most prevalent (90.3%), with an overwhelming majority (98.1%) identified as Muslims. More than half of the vendors were married (61.6%), and nearly half had graduated from secondary school (49.6%). The operational structure of these vendors is characterized mainly by sole proprietorships (89.2%), with nearly half operating at night (45.9%). Vendors typically had 1-15 years of experience in food handling (94.0%) and operated on stationary stalls (71.6%). They employed an average of one to seven helpers (91.8%) and generated monthly revenue between RM1,000 and RM10,000 (65.3%). Regulatory compliance is notably high, with 82.1% of vendors possessing licenses issued by local authorities for street food vendor operations. Food safety training participation was moderate (56.0%), and vaccination rates for typhoid were encouraging, with 69.4% (186) of vendors having taken their typhoid vaccine before their involvement in food handling and processing.

Table 1. Respondents' demographic characteristics.

Characteristics		Frequency (n)	Percentage (%)
Gender	Male	166	61.9
	Female	102	38.1
Age (years)	20 – 29	97	36.2
	30 – 39	103	38.4
	40 – 49	52	19.4
	50 – 59	16	6.0
Race	Malay	242	90.3
	Chinese	6	2.2
	Indian	1	0.4
	Others	19	7.1
Religion	Islam	263	98.1
	Buddha	5	1.9
Marital status	Single	103	38.4
	Married	165	61.6
Education level	Primary School	19	7.1
	Secondary School	133	49.6
	Certificate	30	11.2
	Diploma	40	14.9
	Bachelor's Degree	42	15.7
	Master	4	1.5
Business ownership	Sole Proprietorship	239	89.2
	Partnership	23	8.6
	Company	6	2.2

Operation hour	Morning	66	24.6
	Evening	79	29.5
	Night	123	45.9
Experience in food handling (years)	1 – 15	252	94.0
	16 – 30	16	6.0
Type of stalls	Mobile	76	28.4
	Stationary	192	71.6
Number of workers	1 – 7	246	91.8
	8 – 15	22	8.2
Monthly revenue (RM)	1,000 – 10,000	175	65.3
	10,001 – 50,000	91	34.0
	50,001 – 100,000	2	0.7
License	Yes	220	82.1
	No	48	17.9

n = 268

3.2. Street Food Vendors' food safety knowledge

An 18-statement questionnaire assessed the knowledge base of street food vendors regarding food safety practices. Scores were calculated based on the total scores of the responses across all statements. According to the findings in Table 2, the majority of street food vendors (92.5%, n=248) demonstrated awareness of the need to wash hands before handling food to minimize the risk of food contamination, with a mean score of 2.91. This result corroborates previous research highlighting the widespread knowledge about hand hygiene in reducing food contamination (58). About 91.8% of the respondents were aware that changes in appearance, taste, color, and smell can identify foods that are not safe to eat. Additionally, 82.2% of street food vendors reported that it was important to know the correct temperatures of refrigerators and freezers to reduce the risk of spoilage.

Table 2. Street Food Vendors' food safety knowledge.

	Statements	Responses n (%)			Mean	SD
		1	2	3		
1.	Washing hands before handling food reduces the risk of food contamination.	3 (1.1)	17 (6.3)	248 (92.5)	2.91	0.318
2.	Foods that are not safe to eat can be identified by changes in appearance, taste, colour, and smell.	4 (1.5)	18 (6.7)	246 (91.8)	2.90	0.343
3.	It is important to know the temperature of the refrigerators and freezers to reduce the risk of food spoilage.	2 (0.7)	35 (13.1)	231 (86.2)	2.85	0.374
4.	Eating and drinking in the workplace increases the risk of food contamination.	9 (3.4)	24 (9.0)	235 (87.7)	2.84	0.447
5.	Wearing gloves is required for safe food handling.	8 (3.0)	27 (10.1)	233 (86.9)	2.84	0.442
6.	Proper cleaning and sanitation of utensils lower the risks of food contamination.	9 (3.4)	32 (11.9)	227 (84.7)	2.81	0.469
7.	Well-cooked foods are free from microbes that can otherwise cause foodborne illnesses.	9 (3.4)	46 (17.2)	213 (79.5)	2.76	0.500

8.	Foodborne illnesses are caused by food contaminated with microbes (bacteria, pathogens, viruses, or parasites) that spoil food.	23 (8.6)	35 (13.1)	210 (78.4)	2.70	0.620
9.	Foodborne illnesses are caused by unhygienic practices in the production, post-harvest, processing, and preparation of food.	15 (5.6)	56 (20.9)	197 (73.5)	2.68	0.575
10.	I have heard about foodborne illnesses.	15 (5.6)	65 (24.3)	188 (70.1)	2.65	0.585
11.	Preparing food in advance increases the risk of food contamination.	28 (10.4)	46 (17.2)	194 (72.4)	2.62	0.668
12.	Reheating cooked food can contribute to food contamination.	29 (10.8)	55 (20.5)	184 (68.7)	2.58	0.680
13.	Frozen foods can kill microbes that cause food spoilage and foodborne illnesses.	21 (7.8)	73 (27.2)	174 (64.9)	2.57	0.635
14.	Cross-contamination is a major contributing factor to food contamination.	25 (9.3)	96 (35.8)	147 (54.9)	2.46	0.660
15.	Foodborne illnesses are illnesses caused by consuming food contaminated with harmful bacteria, viruses, parasites, or toxins.	46 (17.2)	57 (21.3)	165 (61.6)	2.44	0.770
16.	*Salmonella, S. aureus,* and *E. coli* are among the foodborne pathogens.	41 (15.3)	133 (49.6)	94 (35.1)	2.20	0.683
17.	Food handlers with minor injuries should not be involved in food handling activities.	122 (45.5)	47 (17.5)	99 (36.9)	1.91	0.906
18.	Typhoid injection can prevent typhoid fever.	159 (59.3)	34 (12.7)	75 (28.0)	1.69	0.882

Note: 1=No, 2=Do not know, 3=Yes

3.3. Street Food Vendors' food safety attitudes

Table 3 presents the survey statements ranked by their means, with the highest-rated statement (4.21) reflecting the strongest agreement. The results revealed that 113 (42.2%) street food vendors agreed that they were responsible for handling food properly and safely, with a mean score of 4.21. This finding is consistent with that of Ahmed et al. (59) and Al-Kandari et al. (60). Approximately 35.8% strongly agreed that maintaining good personal hygiene could prevent foodborne illnesses. This finding is consistent with those of other studies (26, 37, 55). Only 33.2% strongly agreed to take leave when sick or experiencing fever, which is in line with the findings of previous studies (26,37). According to the standard operating procedure (SOP), food handlers suspected of having any illnesses are not permitted to work or handle food.

Table 3. Street Food Vendors' Food Safety Attitudes.

	Statements	Responses n (%)					Mean	SD
		1	2	3	4	5		
1.	I believe that handling food properly and safely is my responsibility.	0 (0.0)	6 (2.2)	40 (14.9)	113 (42.2)	109 (40.7)	4.21	0.776
2.	I know that good personal hygiene can prevent foodborne diseases.	1 (0.4)	1 (0.4)	46 (17.2)	124 (46.3)	96 (35.8)	4.17	0.743
3.	I am willing to take leave when sick, with a fever or cold.	0 (0.0)	1 (0.4)	74 (27.6)	104 (38.8)	89 (33.2)	4.05	0.789
4.	I am willing to attend food safety training.	0 (0.0)	16 (6.0)	38 (14.2)	137 (51.1)	77 (28.7)	4.03	0.818

5.	I believe defrosted food should not be refrozen.	0 (0.0)	10 (3.7)	77 (28.7)	99 (36.9)	82 (30.6)	3.94	0.861
6.	I am willing to change my food handling habits if it is unsafe.	0 (0.0)	5 (1.9)	73 (27.2)	130 (48.5)	60 (22.4)	3.91	0.752
7.	I believe that wearing clean and appropriate attire will prevent food contamination.	0 (0.0)	9 (3.4)	85 (31.7)	107 (39.9)	67 (25.0)	3.87	0.828
8.	I think food premises should always be kept clean to prevent food contamination.	0 (0.0)	10 (3.7)	101 (37.7)	98 (36.6)	59 (22.0)	3.77	0.834
9.	I believe it is necessary to check the temperature of the refrigerators and freezers to reduce the risk of food contamination.	2 (0.7)	15 (5.6)	60 (22.4)	156 (58.2)	35 (13.1)	3.77	0.772
10.	I believe improper food storage can contribute to food contamination.	0 (0.0)	9 (3.4)	81 (30.2)	150 (56.0)	28 (10.4)	3.74	0.687
11.	I believe raw materials and cooked food must be stored separately.	0 (0.0)	29 (10.8)	73 (27.2)	111 (41.4)	55 (20.5)	3.72	0.913
12.	I believe that it is my responsibility to ensure that the food provided is safe.	0 (0.0)	30 (11.2)	62 (23.1)	133 (49.6)	43 (16.0)	3.71	0.869
13.	I believe wearing caps, masks, and gloves is critical to avoid food contamination while handling food.	1 (0.4)	11 (4.1)	81 (30.2)	149 (55.6)	26 (9.7)	3.70	0.714
14.	I believe that educating myself with food safety knowledge enhances my confidence in handling food.	0 (0.0)	20 (7.5)	85 (31.7)	132 (49.3)	31 (11.6)	3.65	0.781
15.	I think that food handlers with abrasions or cuts on their hands should not touch unwrapped food.	0 (0.0)	7 (2.6)	112 (41.8)	121 (45.1)	28 (10.4)	3.63	0.704
16.	I believe that producing safe food is more important than tasty food.	2 (0.7)	26 (9.7)	104 (38.8)	101 (37.7)	35 (13.1)	3.53	0.867
17.	I think the health status of workers should be evaluated before employment.	1 (0.4)	50 (18.7)	55 (20.5)	138 (51.5)	24 (9.0)	3.50	0.910
18.	I believe that wearing accessories can lead to cross-contamination.	3 (1.1)	39 (14.6)	72 (26.9)	140 (52.2)	14 (5.2)	3.46	0.845

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

3.4. Street Food Vendors' Food Safety Practices

Table 4 presents the statements ranked in descending order of mean scores, from the highest (2.71) to the lowest (2.36). The results revealed an encouraging finding, where 79.9% (214) of street food vendors prioritized examining the quality of raw materials upon purchase. This is an important practice because the quality of the raw materials used to prepare food is critical for food safety. However, contrary to this favorable discovery is the emerging worrisome trend, where vendors reportedly prioritize cost reduction by using low-quality, inexpensive ingredients from unreliable sources (61) or even using illegal additives to disguise poor-quality materials (62). These practices undermine food safety and pose significant health risks to consumers. Most street food vendors (207) thaw food at room temperature. In contrast, food handlers in Brazil do not thaw food outside the refrigerator (24), indicating that they may still be unaware of standard food thawing practices.

Table 4. Street Food Vendors' Food Safety Practices.

	Statements	Responses n (%)			Mean	SD
		1	2	3		
1.	Inspect the quality of raw materials upon purchase/receipt from the supplier.	24 (9.0)	30 (11.2)	214 (79.9)	2.71	0.622
2.	Thaw frozen food at room temperature.	26 (9.7)	35 (13.1)	207 (77.2)	2.68	0.644
3.	Maintain a clean work area for safe food production.	23 (8.6)	58 (21.6)	187 (69.8)	2.61	0.641
4.	Use separate utensils for preparing cooked and raw food.	14 (5.2)	76 (28.4)	178 (66.4)	2.61	0.586
5.	Wash hands with soap and water before and after handling food.	39 (14.6)	30 (11.2)	199 (74.3)	2.60	0.730
6.	Refrain from handling food with wounded hands.	27 (10.1)	54 (20.1)	187 (69.8)	2.60	0.666
7.	Use appropriate and clean utensils when handling food.	29 (10.8)	62 (23.1)	177 (66.0)	2.55	0.682
8.	Refrain from wearing accessories while handling food.	37 (13.8)	50 (18.7)	181 (67.5)	2.54	0.726
9.	Wash the hands before and after the use of gloves.	50 (18.7)	30 (11.2)	188 (70.1)	2.51	0.791
10.	Keep the nails short and clean when handling food.	49 (18.3)	37 (13.8)	182 (67.9)	2.50	0.786
11.	Refrain from eating and drinking in food processing areas.	38 (14.2)	70 (26.1)	160 (59.7)	2.46	0.730
12.	Wear a suitable apron and disposable head cover when handling food.	49 (18.3)	52 (19.4)	167 (62.3)	2.44	0.784
13.	Ensure all raw materials are clean before use.	45 (16.8)	59 (22.0)	164 (61.2)	2.44	0.765
14.	Wash the hands after using the toilet.	42 (15.7)	70 (26.1)	156 (58.2)	2.43	0.748
15.	Check the expiration dates of ingredients before using them in food preparation.	43 (16.0)	68 (25.4)	157 (58.6)	2.43	0.753
16.	Wear proper attire in the food premises.	64 (23.9)	41 (15.3)	163 (60.8)	2.37	0.845
17.	Always disinfect the food-handling areas to maintain sanitary environment.	54 (20.1)	63 (23.5)	151 (56.3)	2.36	0.798
18.	Wear disposable gloves when handling food.	68 (25.4)	35 (13.1)	165 (61.6)	2.36	0.861

Note: 1=Never, 2=Seldom, 3=Always

3.5. Food Safety Knowledge, Attitudes, and Practices (KAP) Levels

Table 5 summarizes the levels of food safety KAP among street food vendors in this study. The results revealed that the majority of vendors possessed adequate food safety knowledge, favorable attitudes towards food safety, and adhered to good food handling practices. These findings were supported by Jores et al. (55) and Rahman et al. (63), who similarly reported that street food handlers in Malaysia possessed commendable knowledge, attitudes, and practices (KAP) on food safety. The implication of these results is significant because a strong foundation in food safety knowledge is a crucial first step towards adopting positive attitudes and implementing safe food-handling practices. A well-informed and diligent vendor equipped with proper food handling practices is more likely to translate their knowledge into concrete actions that minimize foodborne illness outbreaks.

Table 5. Summary of Street Food Vendors' Food Safety KAP Levels.

Level (score)	Frequency (n)	Percentage (%)
Food Safety Knowledge		
Adequate knowledge (9 – 18)	219	81.7
Inadequate knowledge (0 – 8)	49	18.3
Food Safety Attitudes		
Favourable attitudes (54 – 90)	239	89.2
Unfavourable attitudes (18 – 53)	29	10.8
Food Safety Practices		
Good practice (36 – 54)	245	91.4
Poor practice (18 – 35)	23	8.6

3.6. Associations between Food Safety Practices and Street Food Vendors' Demographic Characteristics

Chi-square analysis revealed statistically significant associations between street food vendors' demographic characteristics and food safety practices (Table 6). Variables such as education level ($\chi2 = 10.213$, $p = 0.069$), type of stall ($\chi2 = 4.693$, $p = 0.030$), monthly revenue ($\chi2 = 10.233$, $p = 0.006$), licensing ($\chi2 = 4.871$, $p = 0.027$), food safety training ($\chi2 = 11.963$, $p = 0.001$), and typhoid injection ($\chi2 = 7.963$, $p = 0.005$) were all significantly associated with food safety practices among street food vendors. These findings align with those of Tuglo et al. (53), who identified that educational level, monthly income, registered street-cooked food handlers, and food safety training courses significantly influence food safety hygiene practices. Similarly, Addo-Tham et al. (54) highlighted the relationship between food-handling practices and licensing and training, while Huynh-Van et al. (64) discovered that stationary vendors often exhibit higher efficiency in maintaining food safety because of better access to resources, such as clean water, waste bins, and plastic bags. These findings provide important insights into the potential factors influencing food safety practices among street food vendors.

Table 6. Associations between Food Safety Practices and Demographic Characteristics of Street Food Vendors.

Variables	Chi-square (χ^2)	df	Sig.
Gender	1.018	1	0.313
Age	0.383	3	0.944
Race	4.588	3	0.205
Religion	0.478	1	0.489
Marital status	0.005	1	0.943
Education level	10.213	5	0.069*
Business ownership	1.207	2	0.547
Operation hour	0.399	2	0.819
Experience in food handling	1.597	1	0.206
Type of stalls	4.693	1	0.030**
Number of workers	2.250	1	0.134
Monthly revenue	10.233	2	0.006***
License	4.871	1	0.027**
Food safety training	11.963	1	0.001***
Typhoid injection	7.963	1	0.005***

****Significant at a 1% level of significance. **Significant at a 5% level of significance. *Significant at a 10% level of significance*

3.7. Factors Influencing Food Safety Practices among Street Food Vendors

Logistic regression analysis was used to estimate the influence of selected demographic characteristics. The regression model (Table 7) explained 40.2% of the variability in the dependent variable. Furthermore, the Hosmer and Lemeshow test produced p= 0.839, indicating that the independent variables explained 83.9% of the practising level. Food safety knowledge exhibited a positive relationship (β = 1.296), indicating that street food vendors with adequate knowledge were 3.656 times more likely to demonstrate proper food safety practices than were those with limited knowledge. This finding is consistent with those of Cempaka et al. (58) and Mohd Azaman et al. (56), who established a connection between increased knowledge, positive attitudes, and safe handling practices among foodservice employees. Attitudes also demonstrated a positive relationship (β=1.086), indicating that street food vendors with favorable attitudes were 2.963 times more likely to exhibit a good level of food safety practice (p=0.085). This finding is consistent with a previous study by Kılıçhan et al. (65), who attributed 23.4% of chefs' adherence to safe food-handling practices to their positive attitudes.

Table 7. Factors Influencing Food Safety Practices among Street Food Vendors.

Variables	Estimated coefficients (B)	SE	Wald	Sig.	Exponential (B)
Knowledge	1.296	0.563	5.308	0.021**	3.656
Attitudes	1.086	0.630	2.972	0.085*	2.963
Education level	1.608	0.810	3.939	0.047**	4.993
Type of stalls	1.064	0.548	3.773	0.052*	2.899
Monthly revenue	1.766	1.071	2.718	0.099*	5.848
License	0.667	0.571	1.364	0.243	1.948
Food safety training	1.220	0.581	4.417	0.036**	3.387
Typhoid injection	1.194	0.541	4.861	0.027**	3.299
Constant	-2.329	0.887	6.898	0.009	0.097
-2 Log-Likelihood			104.304		
Cox and Snell R square			0.178		
Nagelkerke R Square			0.402		
Hosmer and Lemeshow Test			0.839		

***Significant at a 5% level of significance. *Significant at a 10% level of significance.*

Education level (β = 1.608) significantly impacts food safety practices among street food vendors, with higher-educated food handlers demonstrating 4.993 times better practices than their less-educated counterparts. This resonates with the findings of Tuglo et al. (53), who argued for a minimum educational requirement for aspiring foodservice employees. Their research suggests the importance of secondary education in nurturing a culture of good hygiene practices while emphasizing the various channels through which people acquire essential skills in food preparation from interpersonal connections (friends, relatives, parents) to media influences. Therefore, it is essential to provide food handlers with a basic educational framework before they can become involved in the food business.

The type of stall shows a positive relationship (β = 1.064) with food safety practices, with street food vendors operating from stationary stalls exhibiting 2.899 times more likely to adhere to food safety practices. This increased likelihood can be attributed to the inherent challenges associated with mobile vending. As Auad et al. (24) have highlighted, the transient nature of mobile stalls makes them more susceptible to bypassing food safety regulations. Furthermore, mobile stalls are often associated with the employment of untrained staff,

which increases the risk of foodborne illnesses. In contrast, vendors operating from stationary stalls typically possess business licenses or permits, which necessitates adherence to specific regulations and a greater commitment to hygiene practices compared to mobile vendors (62,64). Another influential variable, monthly revenue (β = 1.766), also has a significant impact on food safety practices. This implies that street food vendors who earned higher monthly revenue were 5.848 times more likely to implement improved food safety measures. Tuglo et al. (53) discovered that street food vendors with higher monthly incomes exhibit better hygiene practices, as they are in a better position to invest in additional cooking utensils and adopt strategies for managing leftovers, thereby mitigating the risk of contamination and improving overall food safety standards.

Food safety training showed a positive relationship (β = 1.220) with food safety practices, indicating that street food vendors who attended such training were 3.387 times more likely to adhere to safe food-handling procedures. Addo-Tham et al. (54) recommended continuous training for food handlers to ensure compliance with regulations, reduce the incidence of foodborne illnesses, and cultivate positive attitudes towards food safety knowledge (28). Typhoid injection (β=1.194) also significantly influenced food safety practices, with vaccinated vendors exhibiting a 3.299 times higher adherence to safety practices. Regulatory frameworks often mandate food handlers to not only undergo basic training but also be vaccinated (66), as these measures collectively help prevent food safety issues and protect customer health (67). Food handlers are often the primary vectors of foodborne diseases, transmitting pathogens through feral-oral routes, skin lesions, and unclean kitchen utensils or counters (68).

Overall, the analysis presented in Table 7 identifies monthly revenue as the most influential determinant of food safety practices among street food vendors, highlighting the importance of the economic dimension in public health initiatives. Vendors with higher earnings can invest in proper equipment and hire additional staff. This, in turn, helps to create a safer and more hygienic environment and reduces the risk of food contamination. The estimated equation model illustrating these relationships is given as

$$\text{Food Safety Practices} = -2.329 + 1.296\,(\text{knowledge}) + 1.086\,(\text{attitudes}) + 1.608\,(\text{education level}) + 1.064\,(\text{type of stalls}) + 1.766\,(\text{monthly revenue}) + 1.220\,(\text{food safety training}) + 1.194\,(\text{typhoid injection}) + \varepsilon i \quad (4)$$

4. Conclusions

This study investigated food safety knowledge, attitudes, and practices (KAP) among street food vendors in the Klang Valley area in Malaysia. The primary aim of this study was to improve food safety standards and reduce foodborne disease outbreaks. The findings indicate that, while the general level of food safety KAP is commendable, there is a need for strategies to address the issue of unlicensed and unvaccinated food vendors. The Ministry of Health Malaysia, the municipal council, and related agencies must amplify their efforts to organize seminars and educational programs focused on improving vendors' knowledge and comprehension of effective food-handling practices.

Despite mandatory vaccination against typhoids, many remain unvaccinated. To address this issue, it is necessary to implement stricter enforcement of vaccination laws, more frequent inspections, and regular training programs to ensure compliance. Regular and

comprehensive in-house food safety is crucial to ensure that food handlers are equipped with the latest guidelines and best practices. Local governments should invest in improving street vendor infrastructure and provide essential amenities such as clean water and proper waste disposal facilities that can reduce the risk of foodborne illnesses.

There is also a need for local governments to invest in improving street vendor infrastructure, including providing essential amenities that can lower the risk of foodborne illnesses. Furthermore, offering incentives such as equipment procurement subsidies and microcredit programs can encourage street vendors to acquire proper equipment, further minimizing the risks associated with foodborne illnesses. As the Malaysian population increasingly opts for food away from home, there is a burgeoning opportunity for local street vendors and franchises to thrive. However, this growth must be accompanied by national surveillance and stringent food inspection regimes to ensure long-term success and public health.

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Author Contributions

NASAA and NHK: Conceptualization and questionnaire preparation. NASAA, NHK, and AHIAH: Framework development, data analysis, and original draft preparation. NHK and AHIAH: supervision and modification. All authors reviewed and read the manuscript.

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Not applicable.

Conflicts of Interest

The authors declare that they have no conflicts of interest. The funder had no role in any of the related stages.

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