



International Association of
Scientists
www.iasnetedu.com

Available online at www.jobiost.com

IJBLS 2023; 2(3):409-423



International Journal of
BioLife Sciences

Original paper

Assessing Food Safety Knowledge, Attitudes and Practices (KAP) of Street Food Vendors and Sanitary Conditions of Vendor Stalls in Gia Lam, Ha Noi, Vietnam

Salifu Adam¹, Janete Taiobo Algumassa¹, Thuy Thi Thanh Nguyen², Hung Van Pham³, Sinh Dang Xuan⁴, Dung Thi Bui^{5,6*}

¹ Vietnam National University of Agriculture, Trau Quy, Gia Lam, Ha Noi, Vietnam

² Department of Food Safety and Quality Management, Faculty of Food Science and Technology, Vietnam National University of Agriculture, Trau Quy, Gia Lam, Ha Noi, Vietnam

³ Faculty of Economics and Rural Development, Vietnam National University of Agriculture, Trau Quy, Gia Lam, Ha Noi, Vietnam

⁴ International Livestock Research Institute, 298 Kim Ma, Ba Dinh, Ha Noi, Vietnam

⁵ Department of Parasitology, Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Cau Giay, Ha Noi, Vietnam

⁶ Graduate University of Science and Technology, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Cau Giay, Ha Noi, Vietnam

Received: 7 November 2023

Revised: 5 December 2023

Accepted: 12 December 2023

Abstract

Background and aim: Food safety plays an important role in human health. Street food vendors are common and highly associated with food culture in Vietnam. This study evaluated the food safety knowledge, attitudes and practices (KAP) of street food handlers and the sanitary conditions of their vendor stalls to identify areas to improve towards consumer's safety in Gia Lam District.

Materials and methods: A cross-sectional study was conducted with 216 street food handlers. KAP data were collected using a face-to-face interview format via a structured questionnaire adapted from Vietnam's national food safety and hygiene regulations for street food vendors. An observational checklist similarly adapted from the national regulations was used to assess the sanitary conditions of their vending sites.

Results: The results showed that 62.0% of street vendors had good levels of food safety knowledge. However, using their aprons as towels to rub their hands while handling food was agreed upon by only 31%, and 29.2% practice it occasionally. While 90% of food handlers washed their hands with soap and water before handling or serving food, vectors and domestic animals that facilitate the spread of foodborne pathogenic organisms were observed in more than half of the vending stalls.

Conclusion: Overall, food vendors showed good compliance to food safety KAP, but very low compliance areas at stall that needs to be focused on.

***Corresponding author:** Dung Thi Bui, Institute of Ecology and Biological Resources, Hanoi, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Cau Giay, Ha Noi, Vietnam.

E-mail address: dung_parasitologist@yahoo.com

It is recommended that management of the street food business continue to adhere to food safety handling laws and provide sanitary facilities, education and motivation for their workers.

Keywords: Health, Good food handling, Proper hygiene, Street food, Vietnam

Introduction

Street food business has become a major livelihood source for individuals in developing and developed countries [1]. Street foods are commonly consumed by individuals in many cities and highly populated areas [2]. The World Health Organization has defined street foods as food and beverages that are prepared and sold by food vendors to consumers on the streets, and can be consumed immediately or later without any additional preparation or processing. The street food vending sector has grown in many countries because of changing socioeconomic activities and status [3]. The underlined feature in the definition of street food is the location which is referred to the food sold on the street [4]. An impact of rapid urbanization and industrialization on lifestyle, society, and production has been increasing demand for convenient food, as many individuals have less time to prepare food for themselves and now prefer to buy and/or go to the street food vendors to eat to save time.

Using traditional cooking methods, street food vendors prepare, cook and serve food to large numbers of people in a very short time, and consumers can be exposed to foodborne illness unless sanitary and hygienic conditions are effectively maintained during the process [5]. Mensah et al. (2002) reported that rodents and flies can be attracted to street food vendor sites due to poor sewage disposal, infrequent disinfection of vendor sites and a lack of hand and dishwashing facilities [6]. In addition, inadequate food temperature control and poor hygienic practices were also found as major causes of food contamination among street food vendors [7]. Inadequate handwashing space, limited garbage dustbins, and lack of basic environmental infrastructure for food operations also have significant effects on microbial contamination of foods [8]. As a consequence, foodborne illness outbreaks, such as *Listeria*, *Salmonella*, and *Escherichia coli* O157, are often linked to street food purchased and consumed in public [9]. The global foodborne illness burden is estimated at 600 million people every year, and 420,000 deaths because of unsafe food consumption [10], [11].

Foodborne illnesses and food poisoning has received much media attention in Vietnam, due to frequent incidents of contaminated and improper handling of food [12]. The Vietnamese Ministry of Health reported a total of 21,002 foodborne illnesses between 2011 and 2014, though these are considered underestimates due to poor investigation and case-reporting failures across the country [13]. The street food business in Vietnam has grown rapidly with urbanization and economic growth resulting from the 1986 “Doi Moi” economic reforms. Street food vendors are now common on all streets of big cities and urban residences in Vietnam, such as Ha Noi, Hue, Da Nang, Ho Chi Minh, and Can Tho. Due to street food safety concerns, several Vietnamese Food Safety Authorities have issued street food safety and hygiene practice regulations, especially No.3199/2000/QD-BYT of Vietnam Ministry of Health that specifies ten assessment criteria for street food safety and food hygiene practices [14].

With an increasing population of street food vendors in the Vietnam, vendors’ food safety knowledge, attitude and practices are significant in ensuring food safety and are also of major concern for the consumers who rely on them for their meals [15]. Therefore, this study aimed to evaluate the food safety knowledge, attitudes and practices of street food vendors and sanitary conditions of street food stalls in Gia Lam district, Ha Noi, Vietnam.

preparing the food at each vending site.

- Questionnaire, Observation Checklist and Interview

A structured questionnaire and an observational checklist were used to gather data from food vendors and about the food vending sites respectively. The questionnaire had different sections covering the knowledge, attitudes, and practices (KAP) on vendors' food safety and hygiene standards, while the observation checklist covered the vendors' food preparation and selling environment. Interview questions and checklist observation items were adopted from the protocols in Regulation No.3199/2000/QĐ-BYT (Vietnam Ministry of Health). A pilot survey questionnaire was first developed in English and translated into Vietnamese and pretested for comprehension with 7 food vendors in Trau Quy town prior to it being finalized. The questionnaire had four sections which focused on: (i) food vendors' demographic information, such as gender, age, main occupation, work experience, and education level; (ii) food safety knowledge, which contained ten Yes/No questions targeting safe food handling and preparation practices; (iii) food vendors' attitudes towards food safety, which prompted reflections on ten questions such as the importance of vendors' health examination, food safety training, and issues of personal hygiene among others (possible answers 'agree', 'disagree' or 'not sure'). The fourth section had 12 questions on food vendors' practices related to food safety (possible answers, 'always', 'sometimes', 'rarely', and 'never').

- Data Collection

Interviews using the structured questionnaires were conducted face-to-face by the two first authors and trained enumerators. In addition, the researchers also used the observational checklist to directly evaluate the food safety and hygienic practices and sanitary status of the selected food vendors' immediate environs. The overall length of each interview and observation period lasted about 60 minutes.

- Data Processing and Analysis

Questionnaire and observational checklist data was entered into MS Excel spreadsheets (version 2022, Microsoft) and validated for consistency and completeness. To compute the appropriateness of the respondents' KAPs, the KAP answers were scored following each interview session. Each of the ten knowledge or attitudes questions were either scored 1 for the correct response or 0 for the incorrect response, or 'don't know' or 'not sure'. Thus, the scores on food safety knowledge or attitude could range from 0 to 10. Scores were then classified as indicating appropriate (good) food safety knowledge/attitude if they reached ≥ 8 out of 10, or inappropriate (poor) food safety knowledge/attitude if less than 8. For the 12 food safety practice questions, answers, 'always' or 'never', were scored 2 or -2 respectively, with intermediate answers, 'sometimes' or 'rarely', being scored as 1, or, -1, respectively. Practice scores could range from 24 (all correct) to -24 (all wrong). Good, or, poor food safety practice scores were then classified as ≥ 19 , or, < 19 out of 24, respectively.

Descriptive statistics were used to summarize the data as frequencies, percentages, averages, standard deviation, etc. Pearson's Chi-square or Fisher exact tests, were used to determine levels of association between food safety knowledge, attitudes, and practices and demographic characteristics via Minitab (software version 16). Statistical significance level was set at p -value ≤ 0.05 .

- Research Ethics

Ethical review and approval was obtained from the Institutional Review Board of the Ha Noi University of Public Health, (No. 436/2022/YTCC-HD3, dated 21st November 2022). Participants were fully informed about the purpose of the study and the confidentiality of their responses was

assured. Participants' written informed consent was obtained prior to all interviews.

Results

- Socio-Demographic Information

Sixty-one percent (61.6%) of the food vendors were females, and 38.4% were male. Vendors' average age was 33 years (standard deviation-SD: 9.2), and ages ranged from 17-55 years. Just over half (51.9%) reported street food vending as a full-time job, 21.3% were part-time and 20.4% were self-employed and the rest (79.6%) were employees at the food stalls. Almost a third, (29.6%), had been in street food vending from 3 to 5 years, while (19.9%) had 5 or more years of experience and (21.3%) had less than a year of experience. Almost 35% of the food vendors served 100 to 200 clients a day (Table 1).

Table 1. Street food vendors' socio-demographics characteristics

Characteristics	Frequency (N=216)	Percentage	
Gender	Female	133	61.6
	Male	83	38.4
Age*	17-29 years	83	38.4
	30-39 years	85	39.4
	40-49 years	33	15.3
	50 years and above	15	6.9
Current occupation	Full time	112	51.9
	Part-time	46	21.3
	Self-employed	44	20.4
	Unemployed	14	6.5
Work experience**	< 1 year	46	21.3
	1 to <3 years	63	29.2
	3 to < 5 years	64	29.6
	≥ 5 years	43	19.9
Education level	None	14	6.5
	Primary school	2	0.9
	Junior secondary school	82	38
	Senior secondary school	37	17.1
	College	12	5.6
	University	69	31.9
How many people served per day	< 100	71	32.9
	100 to < 200 people	75	34.7
	200 to < 300 people	32	14.8
	≥ 300 people	38	17.6

Note: * and ** are the two numeric variables (age in years old, and work experience in years) that have an average, standard and the min-max ranges were 32.7 ± 9.2 (17-55) and 3.0 ± 2.5 (0.1-15), respectively.

- Food Vendors' Food Safety Knowledge, Attitude, and Practices

1. Food safety knowledge:

Almost all (99%) of the food vendors showed good knowledge about the significant role handwashing plays in reducing food contamination risks, and 88% answered correctly that it is not

good to keep raw food close to, or, in contact with cooked food. Similarly, 91.7% answered correctly about not working at the food stalls when they have open wounds on their hands to reduce the risk of disease spread and contamination. The majority (99.3%) also knew to display food in clear glass cabinets to protect food from exposure to sun, dust, and insects. However, forty-one percent (40.7%) did not know that hand and arm jewelry were potential food contamination sources (Table 2, section A)

2. Food safety attitudes:

Most of the street food vendors (95.4%) agreed that food safety training is important and 97.2% agreed that they should have regular health status examinations when working as food vendors. Also, the vast majority (94%) agreed that the origin of their raw materials and ingredients should always be recorded. However, 22% of the food vendors did not consider washing hands after using the toilet, touching money, or cell phones before handling food as important. One-third of participants agreed that an apron could be used as a towel to wipe hands while handling food. Also, 85.6% of the food vendors agreed that food ingredients that had exceeded the expiry dates should not be used (Table 2, section B).

3. Food safety practices:

Table 2 (section C) shows the food safety practices of the street food vendors. The majority (97.2%) indicated that they always wash their hands with soap and water before preparing and handling food. Almost all (99.1%) always cleaned food preparation areas after carrying out the work, and 56.5% reported that they never smoke while preparing and handling food. Most (93.5%) always separated raw food from cooked food, and 95% always purchased raw materials from safe and official suppliers. Eighty-five percent of the food vendors reported having periodic health checks.

Table 2. Food safety knowledge, attitude, and practices of street food vendors.

Variables	Response n (%)		
	Yes	No	I don't know
Section A. Food vendors' food safety knowledge			
1. Washing your hands before handling food reduces the risk of food contamination?	214 (99.1) ⁺	2 (0.9)	0 (0)
2. Mixing raw food with cooked food during storage is a very good method?	18 (8.3)	190 (88.0) ⁺	8 (3.7)
3. Food presented for sale must be kept in a glass cabinet or hygienic storage containers.	208 (96.3) ⁺	5 (2.3)	3 (1.4)
4. Is clean water according to you a drinking water or treated well water (settle, filter, disinfect)?	91 (42.1) ⁺	43 (19.9)	82 (38.0)
5. It is a good way to wash dishes, bowls, forks, chopsticks, and spoons every time you change it or several times instead of once?	166 (76.9) ⁺	39 (18.0)	11 (5.1)
6. Is it okay for a person to handle food when he has open wounds on his hands?	16 (7.4)	198 (91.7) ⁺	2 (0.9)
7. Your bare hands and cooking utensils can be a source of contamination to food?	163 (75.5) ⁺	48 (22.2)	5 (2.3)
8. Does The use of masks, caps, protective gloves, and adequate clothing reduce the risk of food contamination?	170 (78.7) ⁺	33 (15.3)	13 (6.0)
9. Hand and arm jewelry are possible sources of contamination?	128 (59.3) ⁺	70 (32.4)	18 (8.3)
10. Knowing the temperature of the refrigerator/ freezer reduces the risk of food spoilage?	190 (88.0) ⁺	18 (8.3)	8 (3.7)

Section B. Food vendors' Food Safety Attitude	Agree	Disagree	Not sure	
1. You need to be trained in the knowledge of food safety and hygiene.	206 (95.4) ⁺	4 (1.8)	6 (2.8)	
2. You can prepare and handle food whilst having cuts or abrasions on your hand without bandage or gloves.	23 (10.7)	188 (87.0) ⁺	5 (2.3)	
3. You should always record the origin of raw materials and ingredients.	203 (94.0) ⁺	4 (1.9)	9 (4.1)	
4. Health examination of food vendors is important for food safety?	210 (97.2) ⁺	5 (2.3)	1 (0.5)	
5. You should not use food ingredients that exceed the expiry date.	26 (12.0) ⁺	185 (85.7)	5 (2.3)	
6. You should always clean the cooking area before we start working?	212 (98.1) ⁺	4 (1.9)	0 (0)	
7. Apron can be used as a towel to rub my hands while handling food?	67 (31.0)	134 (62.0) ⁺	15 (7.0)	
8. You should always buy your raw materials from a safe and known origin.	208 (96.3) ⁺	8 (3.7)	0 (0)	
9. You should always wash your hands after using the toilet, touching money or cell phones before handling food?	167 (77.3) ⁺	26 (12.0)	23 (10.7)	
10. Food displayed for sale must be kept in clean glass cabinets and storage containers.	215 (99.5) ⁺	0 (0)	1 (0.5)	
Section C. Food vendors' food safety practice	Always	Sometimes	Rarely	Never
1. Do you wash your hands with soap and water before preparing and handling food?	210 (97.2) ⁺	6 (2.8)	0 (0)	0 (0)
2. Do you always have a periodic medical examination?	184 (85.2) ⁺	28 (13.0)	3 (1.4)	1 (0.4)
3. Do you buy your raw materials from safe and official suppliers?	205 (95.0) ⁺	10 (5.0)	0 (0)	0 (0)
4. Do you use separate knives and cutting boards when dealing with cooked and raw food?	208 (96.3) ⁺	7 (3.2)	1 (0.5)	0 (0)
5. Do you wash utensils using clean water and soap and immediately after eating?	213 (98.6) ⁺	3 (1.4)	0 (0)	0 (0)
6. Do you use separate cloths in drying your hands and in cleaning your vending area?	204 (94.4) ⁺	10 (4.6)	2 (1.0)	0 (0)
7. Do you clean your area after preparing the food?	214 (99.1) ⁺	2 (0.9)	0 (0)	0 (0)
8. Do you always check to ensure that the refrigerator is at the right temperature during storing foods?	166 (76.9) ⁺	15 (6.9)	31 (14.3)	4 (1.9)
9. Do you always smoke whilst handling and preparing food?	11 (5.1)	41 (19.0)	42 (19.4)	122 (56.5) ⁺
10. Do you handle food without washing your hands after visiting the toilet?	5 (2.3)	11 (5.1)	26 (12.0)	174 (80.6) ⁺
11. Do you separate raw food from cooked food?	202 (93.5) ⁺	10 (4.6)	4 (1.9)	0 (0)
12. Do you use your working gear (apron) as a towel whilst preparing and handling food?	20 (9.3)	63(29.1)	49(22.7)	84 (38.9) ⁺

Note: (+) indicated the positive (good) responses.

- Observations of Food Vendors' Hygienic Practices and Sanitary Conditions of Their Vending Setting

Observations of food handlers' practices and the sanitary conditions of the food vending settings are shown in Table 3. From observation, only a minority of the vendors, wore a nose mask, or apron, 21.8% and 37% respectively. Approximately 16% had long nails and 37.5% wore hand jewelry while handling or preparing food. The majority of the vending facilities (71.8%) had

visible smoke stains on the walls and 62% had liquid waste on the kitchen floor. Only 51.9% had proper liquid waste disposal management, but nearly all (90%) had good ventilation. About 77.3% had water available for hand washing but 86.6% had no place or sink for hand washing. Two thirds (67.6%) of the vending sites had vectors (flies, cockroaches, and mice) and 60.2% had domestic animals on site (Table 3).

Table 3. Observed food safety practices and sanitary conditions of vending facilities

Variables	Observation N (%)	
	Yes	No
1. Food vendors wearing an apron	80 (37.0)	136 (63.0)
2. Vendors wearing a mask	47 (21.8)	169 (78.2)
3. Vendors wearing hand jewelry (rings, watches, etc.)	81 (37.5)	135 (62.5)
4. Vendors having long nails	35 (16.2)	181 (83.8)
5. Is there any insects (flies, ants, cockroaches, spiders) or mouse present	146 (67.6)	70 (32.4)
6. Is there the presence of visible smoke on the walls	155 (71.8)	61 (28.2)
7. Is there liquid waste on the kitchen floor	82 (38.0)	134 (62.0)
8. Is there a properly managed liquid disposal system	112 (51.9)	104 (48.1)
9. Is there an availability of a dustbin in the dining room	195 (90.3)	21 (9.7)
10. Food are placed on the surface that is > 60 cm above the ground	194 (89.8)	22 (10.2)
11. Is the main waste bin not nearer to the kitchen or dining hall	159 (73.6)	57 (26.4)
12. Is the solid waste in the dustbin covered	53 (24.5)	163 (75.5)
13. Is there a washing area (sink, pipe) in the vending facility	142 (65.7)	74 (34.3)
14. Is the condition of the washroom good? (if yes to Q13)	105 (73.9)	37 (26.1)
15. Is the facility having good ventilation	192 (88.9)	24 (11.1)
16. Are there any domestic animals (e.g., dogs, cats) in the facility	130 (60.2)	86 (39.8)
17. The facility has a sink or place to wash hands	29 (13.4)	187 (86.6)
18. Is there available pipe water at the facility for washing utensils and raw materials	167 (77.3)	49 (22.7)
19. The facility has a toilet	12 (5.6)	204 (94.4)
20. Does the facility manage its waste by daily estimates	75 (34.7)	141 (65.3)

- Factors Related to Knowledge, Attitude and Practices on Food Safety of Street Food Vendors

- Scores distribution of food safety knowledge, attitude and practices among food vendors:

Generally, street food vendors reported good levels of food safety knowledge. The overall percentage of food vendors with good food safety knowledge was 62% (135/216). Most of the food vendors reported good food safety attitudes, with a total of 10 questions, individual food vendors that showed a good attitude towards food safety was 82%. From a total of 12 questions about food safety practices, 71% (153/216) of the vendors reported good food safety handling practices in the questionnaire interview (Figure 2).

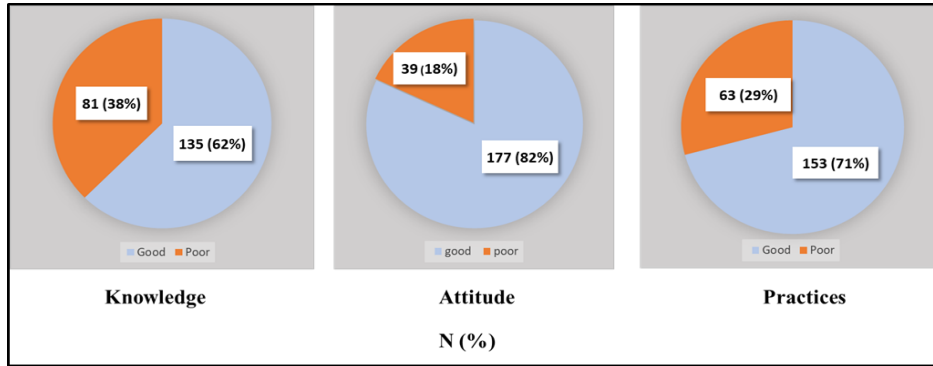


Figure 2. Distribution of food safety knowledge, attitude, and practices among food vendors.

- Relation of Food Safety Knowledge, Attitude and Practice Scores on the Socio-Demographic Data of Food Vendors

Street food handler's sociodemographic and their knowledge, attitude and practice data are shown in Table 4. Food vendors having 3 to < 5 years of experience (n=64), with percentages of 60.9%, 79.7%, and 76.6% obtained good food safety KAPs, respectively. The food vendors (n=38) that serve 300 and more consumers a day significantly self-reported (p=0.011) a better good knowledge (60.5%), attitude (86.8%) and practices (84.2%) compared to the food vendors sold to less than 300 consumers. Likewise, the educational level of food vendors positively affected food safety, with food vendors who attained junior high school recording the highest frequency (n=82 with p=0.001) of their KAPs scores in the food business. Almost all (85.4%) of the food vendors showed a good attitude, 72.0% recorded a good practice and more than half (58.9%) recorded a good knowledge of food safety as shown in Table 4. Based on the number of communes sampled, Trau Quy recorded the highest number of food vendors (n=66), followed by Co Bi (n=60), Yen Vien (n=37), Da Ton (n=31), and Bat Trang (n=22) sequentially. Scores for self-reported food safety KAPs by food vendors show significant variations based on Da Ton (p=0.017) and Co Bi (p=0.029) as shown in Table 4.

Good food safety scores for the independent variables of food vendors on knowledge (K), attitude (A), and practices (P) all separated, combined knowledge and attitude (KA), combined knowledge and practice (KP), combined attitude and practices (PA) and combined knowledge, attitude, and practices (KAP) evaluated based on the list of sampled communes are shown in Figure 3.

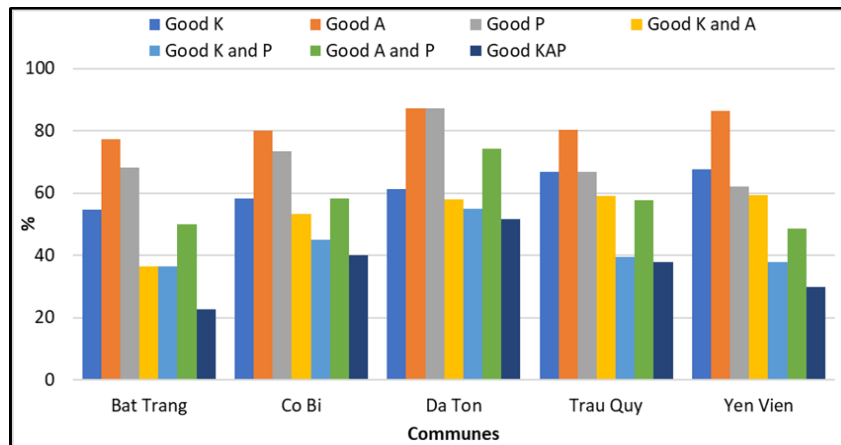


Figure 3. The differences in food safety knowledge, attitudes, and practices (KAP) among food vendors across various communes.

Table 4. Sociodemographic characteristics of food vendors and their level of knowledge, attitude, and practices towards food safety.

Variables	N	Knowledge		Attitude		Practice		p-Value
		Good	Poor	Score N (%)		Good	Poor	
				Good	Poor			
Gender								
Female	133	82 (61.7)	47 (35.3)	106 (79.7)	23 (17.3)	86 (64.7)	43 (32.3)	0.002
Male	83	53 (63.9)	34 (41.0)	71 (85.5)	16 (19.3)	67 (80.7)	20 (24.1)	0.005
Current occupation								
Full time	112	67 (59.8)	45 (40.2)	90 (80.4)	22 (19.6)	80 (71.4)	32 (28.6)	0.003
Part-time	46	31(67.4)	15 (32.6)	39 (84.8)	7 (15.2)	35 (76.1)	11 (23.9)	0.148
Self-employed	44	30 (68.2)	14 (31.8)	38 (86.4)	6 (13.6)	29 (65.9)	15 (34.1)	0.059
Unemployed	14	7 (50.0)	7 (50.0)	10 (71.4)	4 (28.6)	9 (64.3)	5 (35.7)	0.493
Work experience								
< 1 year	46	27 (58.7)	19 (41.3)	38 (82.6)	8 (17.4)	31 (67.4)	15 (32.6)	0.041
1 to < 3 years	63	44 (69.8)	19 (30.2)	51 (81.0)	12 (19.0)	44 (69.8)	19 (30.2)	0.264
3 to < 5 years	64	39 (60.9)	25 (39.1)	51 (79.7)	13 (20.3)	49 (76.6)	15 (23.4)	0.039
≥ 5 years	43	25 (58.1)	18 (41.9)	37 (86.0)	6 (14.0)	29 (67.4)	14 (32.6)	0.015
Education								
None	14	10 (71.4)	4 (28.6)	11 (78.6)	3 (21.4)	9 (64.3)	5 (35.7)	
Primary school	2	2 (100)	0	2 (100)	0	2 (100)	0	
Junior secondary school	82	49 (58.9)	33 (40.2)	70 (85.4)	12 (14.6)	59 (72.0)	23 (28.0)	0.001
Senior secondary school	37	24 (64.9)	13 (35.1)	29 (78.4)	8 (21.6)	27 (73.0)	10 (27.0)	0.427
College	12	7 (58.3)	5 (41.7)	8 (66.7)	4 (33.3)	9 (75.0)	3 (25.0)	0.685
University	69	43 (62.3)	26 (37.7)	57 (82.6)	12 (17.4)	47 (68.1)	22 (31.9)	0.026
How many people do you serve per day?								
< 100	71	47 (66.2)	24 (33.8)	58 (81.7)	13 (18.3)	49 (69.0)	22 (31.0)	0.089
100 to < 200 people	75	46 (61.3)	29 (38.7)	60 (80.0)	15 (20.0)	49 (65.3)	25 (33.3)	0.037
200 to < 300 people	32	19 (59.4)	13 (40.6)	26 (81.3)	6 (18.8)	22 (68.8)	10 (31.3)	0.161
≥ 300 people	38	23 (60.5)	15 (39.5)	33 (86.8)	5 (13.2)	32 (84.2)	6 (15.8)	0.011
Commune								
Bat Trang	22	12 (54.5)	10 (45.5)	17 (77.3)	5 (22.7)	15 (68.2)	7 (31.8)	0.274
Co Bi	60	35 (58.3)	25 (41.7)	48 (80.0)	12 (20.0)	44 (73.3)	16 (26.7)	0.029
Da Ton	31	19 (61.3)	12 (38.7)	27 (87.1)	4 (12.9)	27 (87.1)	4 (12.9)	0.017
Trau Quy	66	44 (66.7)	22 (33.3)	53 (80.3)	13 (19.7)	44 (66.7)	16 (24.2)	0.207
Yen Vien	37	25 (67.6)	12(32.4)	32 (86.5)	5 (13.5)	23(62.2)	14 (37.8)	0.050

*Numbers in bold show significant differences with the reference demographic category.

Discussion

The current study interviewed 216 food vendors in Gia Lam District, Ha Noi, on their food safety knowledge, attitudes, and practices (KAP) and made direct observations on sanitary conditions at their vending sites. For the first time in Vietnam, food vendors have demonstrated good compliance with food safety KAP during the initial stage of risk assessment. The risk level

demonstrated by the street food vendors was satisfactory with respect to their overall KAP scores. These results indicate that the level of food safety awareness among food vendors are very satisfactory, providing a crucial foundation for developing measures to enhance food safety. Additionally, the outcomes offer a basis for identifying solutions to address the current food safety issues and insecurity. The vast majority (61.7%) were females similar to previous studies [14], [17], [18], [19] confirming the over-representation of women in the street food sector. Our participants also had low levels of education, with many having junior secondary school as their highest level. This is similar to Addo-Tham et al's. (2020) [20] findings in Ghana who considered this was due to migration of more highly educated individuals to developed countries to seek jobs in the formal sector.

Our study found 62% of food vendors had good food safety and personal hygiene knowledge consistent with similar studies by Kalpana et al. (2019) [21] in India and Soe & Kallawicha (2020) [22] in Myanmar. A very positive result was that most food vendors (99.1%) confirmed the importance of washing hands with soap and water before food handling and 76.9% also indicated it is necessary to wash cooking utensils repeatedly to reduce the risk of contamination. This is a very encouraging hygienic practice as washing hands and utensils is a major prevention method of diarrhea [23]. Our results are similar to a study in Can Tho, Vietnam where the majority of the fixed food vendors (73.6%) had good knowledge about hand washing [14].

Most food vendors (88.0%) also knew about the health hazards from improper food storage and knew not to mix raw food with cooked food during storage, and know about appropriate refrigerator temperatures for reducing food spoilage risk. Another study in Malaysia by Abdul-Mutalib et al. (2012) [24] showed that 76.6% of their vendors knew about the importance of proper refrigerator temperature reducing food storage risk.

The majority of our food vendors (82%) had good food safety attitude scores, higher than the study conducted by Samapundo et al. (2016) [19] in Ho Chi Minh City, Vietnam. Although positive food safety knowledge than attitudes has been found among food vendors [25], our present study shows the reverse where food vendors recorded a higher level of attitude than knowledge. Food vendors displayed a proactive attitude towards food safety, potentially due to increased customer concern regarding the safety of street food. Most of the vendors (95.4%) agreed that they should be trained in food safety and hygiene and that personal health examination is important for food safety (97.2%). They knew that both training and health examination are important to elevate their business profiles to attract many consumers. However, the formation of a good attitude leads to good practices, and sometimes good knowledge levels can create misconceptions and negative attitudes towards food safety [26]. Almost all the food vendors (95.5%) agreed that food must be kept in clean glass cabinets and storage containers and this is a key compliance requirement for regulation No.3199/2000/QD-BYT by the Vietnam Ministry of Health prevent food from exposure to harmful gases and disease vectors.

Overall, food vendors' self-reports suggest that 71% have good food safety practice. The majority (94.4%) of vendors separated hand drying and cleaning cloths in their vending areas, 94.4% used of separate knives and boards for cooked or raw food and 96.3% always cleaned the vending area before working. All (99.1%), reported they had the right refrigeration temperature for food storage, 76.9% separated raw food from cooked food. The majority (93.5%) self-reported practices that comply directly with WHO's five keys to safer food [27]. The vendors considered all as integral parts of their job responsibilities to prevent consumers from getting food-borne diseases [16]. A positive finding was that most food vendors had designated individuals mainly responsible for collecting and receiving cash from consumers.

Food safety knowledge may not always translate into good food safety practice but attitude and practices can be significantly related. In previous studies, high levels of food safety knowledge have been related to good hygienic practices in Ghana and Malaysia [28], [29]. Even though our food vendors self-reported good food safety practice knowledge, their actual food safety practices may not reflect their interview survey answers. The good food safety practice level displayed by food vendors in this current study has not been recorded in previous studies conducted in Vietnam [14], [19], [30]. Food vendors who handle food while smoking (43.5%) need serious attention for non-compliance in the study. Only 37% percent were observed wearing aprons while food handling similar to a study by Odipe et al. (2019) [31] in Nigeria where 38.8% of food vendors wore aprons while vending. This low compliance is important as use of an apron can prevent cross-contamination and also protects the vendor from food spillage as well.

We also found that the food stalls had vectors (flies, ants, and mice) and domestic animals (cats and dogs) present, 68% and 60% respectively. Our results are lower than the (90.1%) presence of rodents/insect in a recent Ethiopian study [32], but this is still a significant risk as cats and dogs can be major carriers of pathogens such as *E. coli* and *Salmonella* and cause foodborne disease [33], [34]. Okojie & Isah (2014) [35] in Nigeria found that the presence of waste bins at the vending sites still did not totally eradicate these vectors. A majority of food stalls (77.3%) were observed to have washing water available at the site, however, only a few (13.4%) had a sink for hand washing. This was similar to the study in Ho Chi Minh city where 47.5% of the sites lacked sinks for hand washing, and 52.5% did not even have running water available at their vending sites [19]. Nearly all of the vendor stalls (90%) complied with the regulation to have food preparation and display tables 60 cm above the ground. Huynh-Van et al. (2022) found in Can Tho, Vietnam 92.1% compliance for keeping food away from direct sun, dust, and insects [14], however, Samapundo et al. (2016) found only 47.5% of vendors' foods were protected from the sun, dust, and insects in their study in Ho Chi Minh City [19]. The studies in Quoc Oai district, Ha Noi, and Ho Chi Minh City showed that street food vendors operated in unsanitary environmental conditions with poor food handling practices [19], [30]. We observed that there were individuals whose main activities were clearing tables and washing plates which may have contributed to the good conditions we found at the vending sites.

Conclusion

The present study shows that street food vendors in Gia Lam District, Ha Noi have generally good food safety knowledge, attitude, and practices, but low sanitary conditions around their vending sites indicating modest compliance with the Vietnam Food Administration's (VFA) regulations for street food vendors. This study shows improvement on previous food safety KAP studies conducted in some other parts of Vietnam. The VFA communications on street vendor food safety regulations appear to have been effective for the new urban populations in the Gia Lam district. The growing street food consumer population might have positive influence on vendors' food safety practices. Consumers can be very sensitive to their hygiene practices and therefore vendors are incentivised to maintain good food safety to attract customers. To maintain good levels of food safety and hygiene, there should be a regular vendor food safety education with follow-up monitoring of the food safety practices and the vending stall environments respectively by the VFA. Also, managers of street food vendor sites should encourage adherence to food safety laws by the provision of basic sanitary facilities and motivation for their workers.

Acknowledgment

The authors are grateful to colleagues from the International Livestock Research Institute (ILRI, Hanoi-Vietnam) and the Department of Food Safety and Quality Management at the Vietnam National University of Agriculture. The authors would also like to thank all street food handlers in the Gia Lam district who participated willingly in the studies and also students who supported during the interviewing of food handlers. The authors also thank Prof. John F Smith (Khon Kaen University, Thailand) for reviewing and English editing of the manuscript.

Conflict of interests

The authors state that there are no conflicts of interest regarding the publication of this article.

Reference

- [1]. Hiamey SE, Amuquandoh FE, Boison GA. Are we indeed what we eat? Street food consumption in the Market Circle area of Takoradi, Ghana. *Nutrition and Health*. 2013;22(3-4):215-35.
- [2]. Bellia C, Bacarella S, Ingrassia M. Interactions between Street Food and Food Safety Topics in the Scientific Literature- A Bibliometric Analysis with Science Mapping. *Foods*. 2022;11(6):789.
- [3]. WHO. Essential Safety Requirements for Street-Vended Foods. World Health Organization. 1996;96.7:36.
- [4]. Edeme RK, Nkalu NC. Operations of Street Food Vendors and Their Impact on Sustainable Life in Rural Nigeria. *American Economic & Social Review*. 2018;4(1):1-7.
- [5]. Kumie A, Genete K, Worku H, Kebede E, Ayele F, Mulugeta H. The sanitary conditions of public food and drink establishments in the district town of Zeway, Southern Ethiopia. *The Ethiopian Journal of Health Development*. 2017;16(1).
- [6]. Mensah P, Yeboah-Manu D, Owusu-Darko K, Ablordey A. Street foods in Accra, Ghana: How safe are they?. *Bulletin of the World Health Organization*. 2002;80(7):546-54.
- [7]. Eromo T, Tassew H, Daka D, Kibru G. Bacteriological Quality of Street Foods and Antimicrobial Resistance of Isolates in Hawassa, Ethiopia. *Ethiopian Journal of Health Sciences*. 2016;26(6):533-42.
- [8]. Abdulqadir ZS, Yakubu N, Yakubu U, Abaka UG. Sanitary Conditions and Food Handling Practices of Selected Restaurants: A Case Study of Bauchi Metropolis, Bauchi State, Northeastern Nigeria. 2019;8883:26-33.
- [9]. Bař M, řafak Ersun A, Kivanç G. The evaluation of food hygiene knowledge, attitudes, and practices of food handlers' in food businesses in Turkey. *Food Control*. 2006;17(4):317-22.
- [10]. WHO. Food safety: Key facts. Available in: <https://www.who.int/news-room/fact-sheets/detail/food-safety>. 2020. Accessed 14 June 2022.
- [11]. Havelaar AH, Kirk, MD, Torgerson PR, Gibb HJ, Hald T, Lake RJ, Praet N, Bellinger DC, de Silva N R, Gargouri N, Speybroeck N, Cawthorne A, Mathers C, Stein C, Angulo FJ, Devleeschauwer B. World Health Organization Foodborne Disease Burden Epidemiology Reference Group. World Health Organization Global Estimates and Regional Comparisons of the Burden of Foodborne Disease in 2010. *PLoS Med*. 2015;12(12):e1001923.
- [12]. Nguyen-Viet H, Tuyet-Hanh TT, Unger F, Dang-Xuan S, Grace D. Food safety in Vietnam: Where we are at and what we can learn from international experiences. *Infectious Diseases of Poverty*. 2017;6(1):1-6.
- [13]. Ministry of Health, Health Partnership Group: Joint Annual Health Report (JAHR) 2015:

Strengthening grass-root health towards universal health coverage. Ha Noi; 2016.

[14]. Huynh-Van B, Vuong-Thao V, Huynh-Thi-Thanh T, Dang-Xuan S, Huynh-Van T, Tran-To L, Nguyen-Thi-Thao N, Huynh-Bach C, Nguyen-Viet H. Factors associated with food safety compliance among street food vendors in Can Tho city, Vietnam: implications for intervention activity design and implementation. *BMC Public Health*. 2022;22(1):1-11.

[15]. Ababio PF, Adi DD. Evaluating Food Hygiene Awareness and Practices of Food Handlers in the Kumasi Metropolis. *Internet Journal of Food Safety*. 2012;14:35-43.

[16]. Hossen MT, Ferdous MJ, Hasan MM, Lina NN, Das AK, Barman SK, Paul DK, Roy RK. Food safety knowledge, attitudes and practices of street food vendors in jashore region, bangladesh. *Food Science and Technology (Brazil)*. 2021:226-39.

[17]. Bhandari N, Bhusal BR. Food safety, sanitation and hygiene practices among street food vendors in Pokhara, Kaski. *Journal of Gandaki Medical College-Nepal*. 2021;14(2):127-32.

[18]. Fanta F, Azene M, Habte K, Samson H, Kebede A. Determinants of safe food handling practice among food handlers in food establishments, Yeka sub city, Addis Ababa, Ethiopia. *Heliyon*. 2023;9(1):e12977.

[19]. Samapundo S, Cam Thanh TN, Khaferi R, Devlieghere F. Food safety knowledge, attitudes and practices of street food vendors and consumers in Ho Chi Minh city, Vietnam. *Food Control*. 2016;70:79-89.

[20]. Addo-Tham R, Appiah-Brempong E, Vampere H, Acquah-Gyan E, Gyimah Akwasi A. Knowledge on Food Safety and Food-Handling Practices of Street Food Vendors in Ejisu-Juaben Municipality of Ghana. *Advances in Public Health*. 2020:1-7.

[21]. Kalpana P, Saibaba J, Akshaya S, Ramasubramanian MR, Antony U. Study on food safety knowledge, attitude and practice followed by street food vendors in Chennai, India. *International Journal of Current Research*. 2019;10(11):74927-9.

[22]. Soe Htway TA, Kallawicha K. Factors Associated with Food Safety Knowledge and Practice Among Street Food Vendors in Taunggyi Township, Myanmar: A Cross-Sectional Study. *Malaysian Journal of Public Health Medicine*. 2020;20(3):180-8.

[23]. Soares LS, Almeida RCC, Cerqueira ES, Carvalho JS, Nunes IL. Knowledge, attitudes and practices in food safety and the presence of coagulase-positive staphylococci on hands of food handlers in the schools of Camaçari, Brazil. *Food Control*. 2012;27(1):206-13.

[24]. Abdul-Mutalib NA, Abdul-Rashid MF, Mustafa S, Amin-Nordin S, Hamat RA, Osman M. Knowledge, attitude and practices regarding food hygiene and sanitation of food handlers in Kuala Pilah, Malaysia. *Food Control*. 2012;27(2):289-93.

[25]. Kalua F. The Relationship between Knowledge, Attitude and Practices Ofcare Givers and Food Hygiene in Day Care Centers. M. Tech degree dissertation, Pretoria, Technikon Pretoria. 2001.

[26]. Mizanur MR, Mohd Taha A, Kamaluddin B, Zainab T. Food Safety Knowledge, Attitude and Hygiene Practices Among The Street Food Vendors in Northern Kuching City, Sarawak. *Borneo Science*. 2012;107-16.

[27]. WHO. Working together for health. World Health Organization. 2006.

[28]. Ain Saipullizan SN, Mutalib SA, Sedek R. Knowledge, attitude and practice of food utensils hygiene amongst food handlers in Kuala Pilah, Negeri Sembilan, Malaysia. *Sains Malaysiana*. 2018;47(7):1527-33.

[29]. Tuglo LS, Agordoh PD, Tekpor D, Pan Z, Agbanyo G, Chu M. Food safety knowledge, attitude, and hygiene practices of street-cooked food handlers in North Dayi District, Ghana. *Environmental Health and Preventive Medicine*. 2021;26(1):1-13.

- [30]. Toan LQ, Tam NT, Hao LTH, Loi NTM. Condition of food safety and some relevant factors of street food stores in Quoc Oai district, Ha Noi in 2017. *Vietnamese J Food Control*. 2020;3(1):54-61.
- [31]. Odipe OE, Raimi M, Deinkuro NS, Funmilayo AA, Edewor OP E, Habeeb ML, Fadeyibi M. Assessment of Environmental Sanitation, Food Safety Knowledge, Handling Practice among Food Handlers of Bukateria Complexes in Iju Town, Akure North of Ondo-State, Nigeria. *SSRN Electronic Journal*. 2019;3(6):186-200.
- [32]. Fanta F, Azene M, Habte K, Samson H, Kebede A. Determinants of safe food handling practice among food handlers in food establishments, Yeka sub city, Addis Ababa, Ethiopia. *Heliyon*. 2023;9(1):e12977.
- [33]. Bentancor A, Rumi MV, Gentilini MV, Sardoy C, Irino K, Agostini A, Cataldi A. Shiga toxin-producing and attaching and effacing *Escherichia coli* in cats and dogs in a high hemolytic uremic syndrome incidence region in Argentina. *FEMS Microbiology Letters*. 2007;267(2):251-6.
- [34]. Lefebvre SL, Waltner-Toews D, Peregrine AS, Reid-Smith R, Hodge L, Arroyo LG, Weese JS. Prevalence of zoonotic agents in dogs visiting hospitalized people in Ontario: Implications for infection control. *Journal of Hospital Infection*. 2006;62(4):458-66.
- [35]. Okojie PW, Isah EC. Sanitary conditions of food vending sites and food handling practices of street food vendors in Benin city, Nigeria: Implication for food hygiene and safety. *Journal of Environmental and Public Health*. 2014;(3).