Journal of Consumer Protection and Food Safety (2024) 19:199–212
https://doi.org/10.1007/s00003-023-01476-3

Journal of Consumer Protection and Food Safety
Journal für Verbraucherschutz und Lebensmittelsicherheit

RESEARCH ARTICLE

Food safety knowledge, attitudes, and practices of food vendors participating in Nigeria's school feeding program

Bulus Barnabas[1] · Miroslava Bavorova[1] · Mustapha Yakubu Madaki[1,2] · Harald Kächele[2,3]

Received: 1 August 2023 / Revised: 27 November 2023 / Accepted: 4 December 2023 / Published online: 11 January 2024

Abstract
This study aimed to measure the food safety knowledge, attitude, and practices among food vendors engaged in Nigeria's ongoing Home-grown School Feeding Program. A cross-sectional survey was conducted in face-to-face interviews with 240 food vendors from 3 states in northeast Nigeria involved in the school feeding program using a structured questionnaire. Multiple linear regression results revealed that increased education and access to information through radio, television, and food inspection institutions increased food safety knowledge. Food safety attitudes score increased with more years of vending experience and accessing food safety information via radio, food inspection institutions, and the Internet. An increase in household size and food safety information from friends and colleagues negatively affected food safety attitude scores. As a result, we emphasize the need for dissemination of improved food safety information via radio, television and food safety inspection institutes. Food vendors in the SFP should be selected after passing a food safety training and gaining food handling experience. Higher education should be a priority criterion in the hiring process.

Keywords School feeding program · Food safety knowledge · Food safety attitude and practices · Food vendors · Nigeria

1 Introduction

Globally, food safety is a critical aspect of daily lives, affecting everyone from consumers to producers (De Boeck et al. 2019). It has emerged as one of the most difficult social problems that must be addressed in the majority of low- to middle-income nations, including Nigeria (Onyeaka et al. 2021). The diseases linked to the consumption of contaminated food affect millions of people every year, notably in developing countries (WHO 2021a; b). Children and other vulnerable populations, such as pregnant women and the elderly, are disproportionately affected by these illnesses (GAIN 2020; WHO 2021a; b). WHO estimates 600 million people, or nearly 1 in 10, get sick after eating tainted food, resulting in 420,000 deaths per year (WHO 2021a; b; Havelaar et al. 2015; GAIN 2020). The consumption of unsafe food is of great concern in Africa. The WHO (2015) reported that 1 out of every 10 people is affected by foodborne diseases every year and that the highest incidents of foodborne diseases are in Southeast Asia and sub-Saharan Africa, where 91 million fall sick every year due to foodborne-related issue and 137,000 die (WHO 2017).

In Nigeria, foodborne pathogens cause more than 200,000 deaths yearly from food poisoning (Ezirigwe 2018; WHO 2021a, b). The global food supply chain and processing methods are complex, making it challenging to ensure the safety of every product from farm to table (Sewell and Farber 2001; Lazou et al. 2012). However, implementing good hygiene practices, following food safety guidelines, and monitoring food quality can significantly reduce the risk of foodborne illness (Al-Ghazali et al. 2020; Wallace et al. 2022). The WHO names 5 essential elements to achieve safer food. Some of these practices include ensuring everything is clean, separating raw food from cooked food, thoroughly cooking food, maintaining food at safe temperatures, and using clean water and raw materials (Fontannaz-Aujoulat et al. 2019).

✉ Miroslava Bavorova
bavorova@ftz.czu.cz

[1] Faculty of Tropical AgriScience, Czech University of Life Science Prague (CZU), Kamycka 129, 16500 Prague 6-Suchdol, Czech Republic

[2] Leibniz Centre for Agricultural Landscape Research (ZALF), Eberswalder Straße 84, 15374 Müncheberg, Germany

[3] Eberswalde University for Sustainable Development, Schicklerstraße 5, 16225 Eberswalde, Germany

The federal government of Nigeria launched the Home-Grown School Feeding (HGSF) Programme in 2016 to lower the nation's out-of-school children population, alleviate temporary hunger and boost nutritional condition (UNICEF 2020). As a result, the government employs approximately 107,550 food vendors cooking for about 9.9 million pupils in over 56,000 public primary schools across 33 Nigerian states (WFP 2019; NHGSFP 2020). However, studies on food safety knowledge conducted in Nigeria revealed that vendors lack knowledge of pathogens and hygienic food safety practices relevant to tropical environments (Iwu et al. 2017; Madaki and Bavorova 2019). There was a lack of understanding on how a sick person that cooks or handles food could expose others to risk and/or result in foodborne illness (Onyeneho and Hedberg 2013). Similarly, Pepple (2017) discovered a general lack of knowledge about food safety, contamination, poisoning, control measures, and hygiene practices among formal and informal food vendors in Abuja, Nigeria. In many rural and suburban areas of Nigeria, there are severe deficiencies in terms of basic infrastructure and adequate education or sensitization regarding the significance of food safety (Egbule et al. 2020; Anyogu et al. 2021).

Despite the benefits of SFP to improve pupils' nutritional status (Zenebe et al. 2018), the program still possesses a high risk of food contamination. This is because in the global south, most schools participating in SFP have no or an insufficient system to monitor food quality and safety (Bigson et al. 2020; WFP 2012), and they lack the proper infrastructure to support skilled food vendors (Rendall-Mkosi et al. 2013). Foodborne disease outbreaks in SFPs can result in serious illnesses, astronomical medical bills, and the spread of infection to other pupils and staff, disrupting school instruction (Scharff 2012). For example, 3 pupils in South Africa's Gauteng and Limpopo provinces reportedly died after consuming contaminated school-feeding meals (Nzimande 2014; Sibanyoni et al. 2017). In a Chilean SFP, a case of *Bacillus cereus* in dried milk products was reported (Reyes et al. 2007). In North Dakota, 504 pupils reportedly suffered of nausea, stomach pains, vomiting, or diarrhea after eating their school lunch (Steinberg et al. 2006), while 3 students died in Nigeria after eating contaminated food (Premium Times 2018). Similarly, 120 children from a secondary school in Doma, Gombe State, Nigeria experienced acute gastroenteritis after consuming pesticide-contaminated bean cake (Onyeaka et al. 2021).

In Nigeria, Madaki and Bavorova (2021) found that food safety knowledge, attitudes and economic and social control affected the food safety behaviour of the food vendors in educational institutions. Madaki and Bavorova (2019) also reported a positive effect of age, literacy, and years of education on food safety knowledge of food vendors. The expansion and comprehensive coverage of radio, television, and internet service have led to its usage by all levels of government and non-governmental organizations to mobilize the public and raise awareness and preventive measures for the disease outbreak such as cholera and Lassa fever (Wogu et al. 2019). Similarly, Effiong et al. (2020) reported that the use of TV and radio for disseminating food and health safety guides has proved effective, considering its coverage among the citizen of Nigeria. Furthermore, Obi-Ani et al. (2020) reported that social media usage in Nigeria has grown significantly with the introduction of affordable Android smartphones and the availability of Internet services.

However, Wogu et al. (2019) noted that the Nigerian mass media's coverage of diseases and infections has been constrained in terms of content and undermined by a poor network connection, unreliable power supply, the time of day the broadcasts are produced, and the general public's indifference. The country has a National Environmental Health Practice Regulation (NEHPR) that consists of the Food Safety Act (FSA), which specifies the guidelines for the food processing environment, equipment, personal hygiene, and raw foods for food business operation. The FSA gave the mandate and responsibility of enforcement to the state Ministry of Health and Environment. Adebitan (2011) uncovered poor compliance with the FSA in the hospitality industry. Hotel staff were not aware of the FSA and no regular inspection from the concerned institutions.

So far, no study has focused on vendors participating in SFP in Nigeria and to our knowledge, no studies have focused on the effect of information sources on food safety knowledge, attitude, and practices, despite the foodborne-related incidences reported in the country. Therefore, this study investigates the factors influencing food safety knowledge, attitude, and practices among food vendors participating in the SFP. It attempts to answer three questions:

i. What is the vendors' food safety knowledge, attitude and practices score?
ii. How do information sources affect vendor's food safety knowledge, attitude and practices score?
iii. What is the relationship between food vendors' knowledge, attitude and practices?

Our research emphasizes food vendors that participate in the ongoing SFP in northeast Nigeria, focusing on how their socio demographic factors and information source influence their food safety knowledge, attitude, and practice. Findings will provide policy makers with methods for best food safety information dissemination methods in Nigeria and other countries with similar SFPs. By addressing research gaps, scholars can further enhance food safety

knowledge and attitude, leading to the development of more targeted and effective interventions to promote safe food practices and protect public health.

1.1 Theoretical framework and literature review

1.1.1 Theoretical background

The theoretical foundation for the development of a hypothesized model was food safety knowledge (K), food safety attitude (A), and food safety practice (P). The KAP model argues that attitudes toward food safety are influenced by knowledge of food safety and can change behavior. Essentially, food vendors' safety knowledge influences their attitudes and, as a result, their hygiene, kitchen hygiene, and disease prevention practices. Several studies have attempted to use the KAP model to investigate food vendors' attitudes and practices in various contexts over the years. For example, findings from (Madaki and Bavorova 2021; Asmawi et al. 2018; Stratev et al. 2017) revealed that food safety knowledge, attitudes and economic and social control affected the food safety behaviour of the food vendors of educational institutions. Similarly, Asmawi et al. (2018) study in Malaysia discovered that food vendors' lack of safety knowledge negatively impacted their handling behavior, while training and experience may mitigate the negative effects of a lack of safety knowledge. A study conducted among food vendors participating in the Brazil and South African SFPs by da Cunha et al. (2013) and Sibanyoni et al. (2017) discovered that their food safety knowledge improved their food safety attitude and practice. However, a study by Stratev et al. (2017) found that increasing food safety knowledge has no significant impact on food handling practices.

Media play a significant impact in how society's knowledge, attitudes, and practices are shaped and influenced (Ortiz et al. 2019). It has a significant impact on disseminating information and forming public opinion through various platforms, including television, radio, newspapers, magazines, and the Internet. Its influence goes beyond merely providing information because it actively influences how people perceive the world, develop attitudes toward particular issues, and take on new behaviors (Boles et al. 2014; Ortiz et al. 2019). As such, the media serves as a key source of knowledge, providing a platform for the exchange of information and ideas (Fig. 1). News outlets and educational programs deliver current affairs, scientific discoveries, and public awareness of disease outbreak prevention methods (Liu et al. 2020).

1.1.2 Food safety knowledge

To effectively implement food safety measures among food vending sites, it is necessary to have adequate food safety knowledge (Cortese et al. 2016). For example, Kunadu et al. (2016) and Nkosi and Tabit (2021) revealed that food vendors had insufficient food safety knowledge in Ghana and South Africa, as such it affected their food safety practices like washing their hands when handling and serving food and using soap and warm running water for cleaning their hands. Similarly, Osaili et al. (2018) in their study in Jordan revealed that vendors had insufficient food safety knowledge, with a mean score of 60.42 on a 100-maximum score, vendors scored 9.74 mean scores on a maximum score of 13 on their hygiene knowledge and food storage knowledge vendors scored a mean of 11.77 on a maximum score of 22. However, several studies from Nigeria, Pakistan, South Africa and the USA have found that providing access to food safety information and training to food vendors is critical in ensuring that they comply with food safety standards as it increases food safety knowledge (Madaki and Bavorova 2019; Moreb et al. 2017; Chuang et al. 2021).

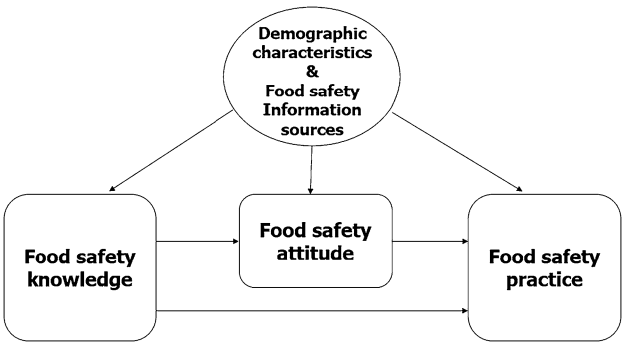

Fig. 1 The conceptual framework of food safety knowledge, attitude, and practice show the model through which practices can be changed

1.1.3 Food safety attitude

Food vendors' attitudes regarding implementing food safety standards strongly influence the incidence of foodborne illnesses. Several studies conducted in Pakistan, Ghana, Turkey, Brazil and Malaysia showed poor food safety attitudes and practices for food vendors (Baser et al. 2017; da Vitória et al. 2021; Kunadu et al. 2016). For example, Baser et al. (2017) reported that hotel staff in Turkey were unlikely to boil and refrigerate milk, or store and refrigerate food leftovers within 2 h, and checking the expiration date of food. New et al. (2017) reported that food vendors did not wash their hands before preparing a meal because they believed it is a waste of time, and also because they are unaware of the consequences of dirty hands. It is important to note that food safety attitudes do not always change only by improving food safety knowledge (Sani and Siow 2014; Al-Shabib et al. 2016). It is rather age, gender, education, and information (from internet, TV, and radio) that affect food safety

attitudes (Sibanyoni et al. 2017; Siddiky et al. 2022; Tiozzo et al. 2019).

1.1.4 Food safety practice

Although factors that influence food safety practice are well identified, which include years of vending experience, source of information, age, and gender (Siddiky et al. 2022; Teffo and Tabit 2020; Chi et al. 2017). Food vendors must have adequate knowledge of food safety, and the ability to apply that knowledge when handling food (Cunha et al. 2018). Food contamination is linked to poor hygiene practices, improper food temperatures, and an inability to follow proper food preparation techniques (Monney et al. 2013). For example, a study conducted in Bulgaria by Stratev et al. (2017) reported that 44.4% of food vendors frequently taste and dish out food with unprotected hands, and only 48.9% stated that they frequently read the condition of use and storage of packaged food. Moreb et al. (2017) revealed that vendors had an average level of food safety practices on food storage, yielding a mean score of 3.5 points (from a range of 0–6), and the average score for food handling practice was 2.1 points (from a range of 0–4), usage and maintenance of kitchen facilities had a mean score of 3.7 points (from a range of 0–6) and personal hygiene scored 3.5 points (from a range of 0–5). Studies conducted in Brazil reported that food vendors were found to be insufficiently engaged in good hygiene practices such as hand washing, hair covering, and maintaining cold storage in studies investigating foods from street vendors (Cortese et al. 2016), vendors ascribed inadequate adoption of food safety practices to their inability to acquire (economic factor) the necessary equipment (Madaki and Bavorova 2021).

2 Materials and methods

2.1 Study area

In 2021, Nigeria's total population was 211.4 million, with a 3.2% annual growth rate and a mortality rate of 101 per 1000 live births for children under 5 years (NBS 2021). More than 41% of the population is under 14 years old, and the country is expected to have a population of 410 million by 2050 (NBS 2020). Northeast Nigeria comprises six states: Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe. It covers slightly less than 1/3 of Nigeria's total land area and has 23 million people (13.5%) of the nation's population (NBS 2020). In May 2022, the Nigerian government began documenting and training food vendors nationwide for its national homegrown school feeding program (Balogun 2022). A needs assessment was carried out prior to training food vendors to determine the exact areas in which vendors needed training. Food vendors are trained in food safety and hygiene practices to ensure that the meals they prepare and serve meet the required standards. This training includes instruction on proper food handling, storage, cooking temperatures and hygiene (Balogun 2022).

In northeast Nigeria, Islam is the predominant religion, influencing dietary habits and food safety practices through halal dietary laws that prohibit the consumption of pork and alcohol. The region has a diverse range of traditional dishes, including tuwo shinkafa (rice pudding) and suya (spiced meat on a stick), which require specific cooking methods and ingredients that require special attention to food safety (Tyrone et al. 2000). The distribution of the population, many of whom live in rural areas, often lack access to clean water, refrigeration and modern food preservation techniques, posing challenges to maintaining food safety (Obioha 2008). Inadequate infrastructure in both rural and urban areas leads to problems such as poor personal hygiene, improper waste disposal and waterborne diseases that can affect food safety. In addition, traditional food preservation techniques such as sun drying, smoking, and fermentation are common but require proper practices to prevent contamination and spoilage (Ojo et al. 2018).

Food Safety Standard Legislations (Laws) relating to food safety in Nigeria include the following (1). Public Health Ordinance Cap 164 of 1958 replaced the Public Health Laws of 1917 (2). 1974's Food and Drugs Decree No. 35 (3). The Standards Organizations of Nigeria (SON) Decree, No. 56 of 1971 (4). The 1988 Animal Disease Control Decree No. 10 (5). Decree No. 41 of 1990 on the Marketing of Breast Milk Substitutes (WHO 2017).

2.2 Sampling procedure and sample size

To begin, a list of registered food vendors was received from the Federal Ministry of Humanitarian Affairs, Disaster Management and Social Development of Nigeria which is in charge of overseeing the school feeding program. A multi-stage sampling procedure was used to choose the food vendors. At the first stage, 3 of 6 states in northeastern Nigeria were purposively selected (Fig. 2): Adamawa, Bauchi, and Gombe, as those states we are less vulnerable to Boko Haram terrorist attacks. Stage 2 involved a purposive selection of four local government areas from each selected state to avoid local government areas where kidnappings and banditry attacks were rampant. At the third stage, 5 wards were randomly selected from the initial list of local government areas. At the fourth stage, the sampling approach consists of selecting (proportionate sampling) 50% of the registered food vendors participating in the SFP and using systematic random sampling to select four SFP food vendors from a readily available list in each district, resulting in a total of 240 respondents. It is important to note that the basis for

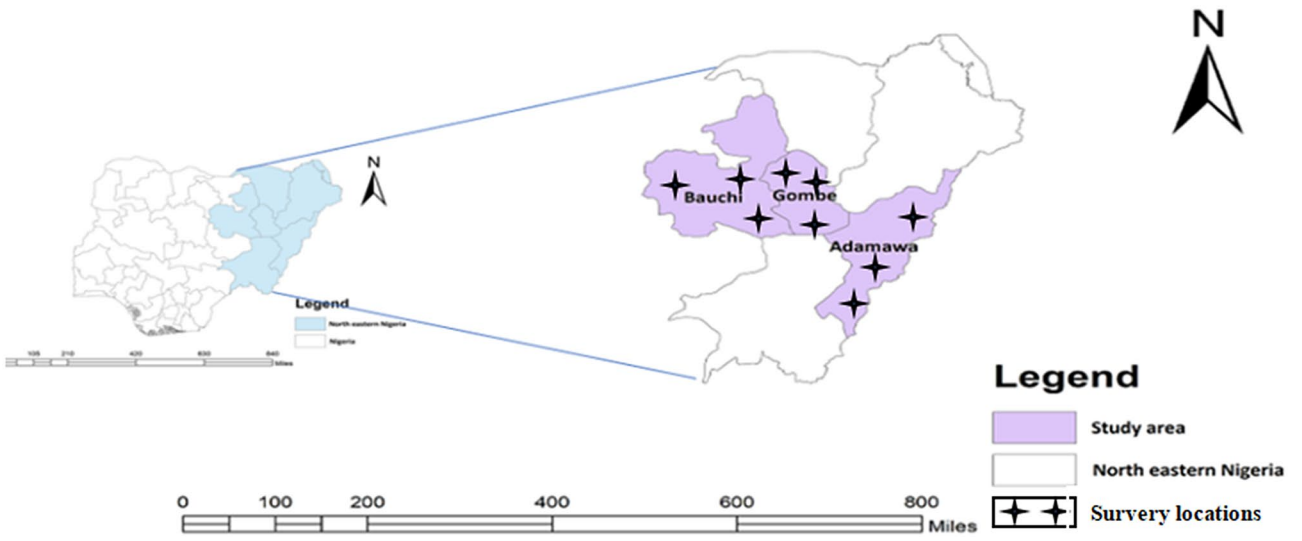

Fig. 2 Map of Nigeria showing the study area

calculating the sample size was the list of registered food vendors in the programme, which defined the inclusion and exclusion part of the criteria. In addition, food vendors in communities with a high risk of Boko Haram attacks and kidnappings were among those excluded from the sample.

2.3 Data collection

The researcher and trained enumerators conducted face-to-face pen and paper interviews to collect data. The majority of the interviews happened in Hausa (the study area's native language) and were on-site translated into English. From December 2020 to February 2021, data was collected with a 100% response rate. A pilot survey was conducted with 24 food vendors in the study sites before the primary survey, as 10% of the study sample size is recommended (Hertzog 2008). To assess the reliability and validity of the questionnaire, we conducted a preliminary survey of 24 food vendors. Two sections were used in the questionnaire, each section containing items related to five different scales for assessing food safety attitudes and practices. These scales were designed to capture guides and adherence to food safety attitudes and practices among food vendors (Tables 2 and 3). The internal consistency of the five scales for food safety attitudes and practices were calculated by the Cronbach alpha coefficient. The results showed that with individual food vendors as the unit of analysis was within the range of 0.82–0.64, which is generally considered satisfactory.

2.4 Instruments

The questionnaire was developed by using the KAP model with the food safety KAP questionnaire based on the WHO's "five keys to safer food" (Luo et al. 2019; Fontannaz-Aujoulat et al. 2019; Madaki and Bavorova 2021), combined with the socio-demographic characteristics of the food vendors (gender, age, school education level, household size, years of experience, and information sources).

Twelve items were used to assess food safety knowledge; an item was scored 1 if the answer was correct, 0 if the answer was incorrect or if answered with "I don't know". The total score was between 0 and 12, the latter indicating a high level of subject knowledge. Questions were adapted from previous studies. Eight items were used to assess food vendors' attitudes towards food safety. Each item had five levels, with a score ranging from 1 to 5, with 1 for "strongly disagree" to 5 for "strongly agree". The total score was between 8 and 40, with a higher score indicating more significant concern about food safety. Questions were adapted from previous studies, and nine items were used to evaluate food safety practices. Participants were asked to rate the frequency with which they used food safety practices: 5 = always, 4 = often, 3 = sometimes, 2 = rarely, and 1 = never. The total scores ranged from 9 to 45, with a high score indicating good food safety practices. Questions were adapted from previous studies (Luo et al. 2019; Madaki and Bavorova 2021; Osailiet al. 2018).

It's crucial to note that the KAP model does not inherently provide universal cut-off points or predefined categories to differentiate between 'poor' and 'good,' or 'high' and 'low' scores in individual KAP assessments. The interpretation of KAP scores and the establishment of cut-off points are typically context-dependent and can vary based on the specific goals of a study or program. In our case, we considered any score within the average range and below as 'poor' due to the severe health risks associated with food contamination.

This decision was made with a keen awareness of the critical implications for human health.

2.5 Data analysis

Descriptive statistics such as percentages, standard deviation and mean were used to summarize respondents' socio-demographic characteristics, food safety knowledge, attitudes, and practice scores. Linear regression models were used to analyze the factors influencing vendors' knowledge, attitudes, and practices in food safety and the association between the respondents' food safety knowledge, attitudes, and practices were tested using Spearman's correlation coefficient. The data were analyzed using STATA 14 software.

2.5.1 Linear regression

Models specification: $Y = b_0 + b_1X_1 + b_2X_2 + \cdots + b_nX_n + e \ldots$ (1)

Y is the dependent variables (food safety knowledge mean score ranges from 0–12 (model 1), food safety attitude mean score that ranges from 8–40 (model 2), and food handling practice mean score from 9 to 45 (model 3). Similar independent variables were used for the 3 models (Table 1); b_0-bn is the regression coefficients; X_1–X_n is the independent variables (age, gender, marital status, household size, years of experience, education and information sources); e is the error term.

The model was tested for multi-collinearity using correlation, coefficients of tolerance, and a variance inflation factor (VIF), which indicated that the variables were independent. The Durbin-Wu-Hausman test did not reveal any effect of potential endogeneity.

3 Result and discussion

3.1 Demographic characteristics of the food vendors

Most vendors from the study area of the SFP are females and under the age of 40 (Table 2). This is attributed to the tradition of the study area where females are responsible for cooking. This may have an implication for their food-handling experience. The majority of the vendors are married and have 5–10 people in their household who are expected to be responsible towards food safety. Almost all the food vendors have some level of education and may read and understand the written food safety act. Most of the food vendors have never attended food handling training before and during the recruitment of the program and have no medical certificate. This is contrary to the National Food Control system that ask every food handler to undergo certain

Table 1 Description variables imported into the multiple linear regression model (n = 240)

Variables	Description	Mean	Std. Dev	Min	Max
Dependent variables					
Food safety knowledge	Food safety knowledge score	8.82	1.96	2	12
Food safety attitude	Food safety attitude score	34.51	7.21	8	40
Food safety practice	Food safety practices score	33.04	7.37	9	45
Socio-demographic characteristics					
Age	Number of years	35.20	8.68	20	58
Gender	0 = Female and 1 = Male	0.04	0.20	0	1
Household size	Number of people in the house	7.60	3.48	1	27
Food vending experience	Years in the food vending business	10.90	7.29	1	30
Education qualification	Years of education	7.70	5.27	0	15
Food vending profit	Amount of profit made (Naira)[a]	8031.25	3378.20	2000	20000
Food handling training	Yes = 1 No = 0	0.30	0.46	0	1
Food safety information sources					
Radio source	Receiving food safety information from radio = 1, otherwise = 0	0.78	0.42	0	1
Television source	Receiving food safety information from television = 1, otherwise = 0	0.61	0.50	0	2
Social media	Receiving food safety information from social media = 1, otherwise = 0	0.10	0.31	0	1
Internet	Receiving food safety information from internet = 1, otherwise = 0	0.21	0.41	0	1
Food inspection institution	Receiving food safety information from Food inspection institution = 1, otherwise = 0	0.32	0.47	0	1
Friend and colleagues	Receiving food safety information from Friend & colleagues = 1, otherwise = 0	0.10	0.31	0	1

[a]NB: 1 USD = 410 Naira (Nigerian currency) on 22/01/2021

Table 2 Socio-economic characteristics of food vendors (n = 240)

Variables	Items	Frequency	Percentages
Gender	Male	27	11.25
	Female	213	88.75
Age (in years)	< 30	77	32.09
	30–40	104	43.31
	41–50	40	18.34
	> 50	15	6.26
Marital status	Single	52	21.67
	Married	167	69.58
	Divorced	19	7.92
	Widow	2	0.83
Household size	< 5	28	11.67
	5–10	169	70.41
	> 10	43	17.92
Educational level	Quranic education	61	25.42
	Primary school	60	25.00
	Secondary school	93	38.75
	Diploma	26	10.83
Years of experience	< 5	48	20.00
	5–10	92	38.33
	11–15	38	15.84
	16–20	34	14.16
	> 20	28	11.67
Food vending profit/month (Naira)1	< 5000	21	8.75
	5000–10000	181	75.42
	11000–15000	30	12.5
	> 15000	8	3.33
Food handling training	Yes	73	30.42
	No	167	69.58
Medical certificate	Yes	51	21.25
	No	189	78.75

[1]USD = 411 Naira (Nigerian currency)

training and must be free from any form of communicable disease (Omojokun 2013). This can be the genesis of food contamination due to a lack of food handling training and the source disseminating communicable diseases like tuberculosis when the food vendor is a carrier. This is consistent with Madaki and Bavorova (2019) study conducted in Nigeria, which reported that the majority of food vendors lack food handling training. A majority (78.75%) of the food vendors had no medical certificate in Nigeria.

3.2 Food safety knowledge of food vendors

The food vendors answered questions on food safety with the greatest accuracy (Table 3):

I. Microorganisms are frequently found in hands (89.6% of respondents knew);
II. Using expired food can't cause health disorders (88.3% of respondents knew);
III. Food tasting should be done with a different spoon (84.2% of respondents knew).

However, food vendors had relatively low or average knowledge of the questions:

i. Unaccredited, off-brand bulk products should not be purchased (42.9% of respondents knew);

Generally, food vendors showed a good knowledge in food safety; however, most needed to be taught that unaccredited, off-brand, and bulk products should not be purchased. Therefore, the National Agency for Food and Drugs Administration and Control (NAFDAC) may need to create better awareness on the standard certifications for effective control of food quality as part of their mandate. This

Table 3 Descriptive result of food safety knowledge of food vendors (n = 240)

Questions to food vendors about food safety knowledge	% of correct answers
Microorganisms are not frequently found in hand	89.58
Using expired food can not cause health disorders	88.33
Frequently used rags and laundry should not be kept out of the kitchen	86.67
The taste of food should be checked with a different spoon	84.17
Food from unhygienic and unclean sources might harbor the disease-causing organism	83.75
Some foodborne diseases/contamination can not cause death	82.50
After touching raw foodstuff, touching cooked food without cleaning your hand causes the transfer of microorganisms	81.25
Food can be a source of disease infection	74.17
The internal temperature of the refrigerator should be less than 5 degrees Celsius	69.17
Humans can not be infected by unhygienic foodstuff	63.75
Refrigerator storage of leftover food is recommended. within two hours	62.92
Unaccredited, off-brand and bulk products should not be purchased	42.92

Answer options: Yes, No, and I don't know

may reduce the chance of food contamination among food vendors.

3.3 Attitude towards food safety

The responds of food vendors regarding food safety attitudes revealed that most believed that safe food handling is an integral part of their job, with a mean score of 4.41 as the highest result for the level of food safety attitude compliance (Table 4). Furthermore, majority of the food vendors reported that learning more about food safety is essential, with a mean score of 4.36. This implies that food vendors would like to learn more on food safety related issues, which is an opportunity for food safety institutions like NAFDAC, Ministry of Agriculture, Health, and Standard Organization to guide vendors on standard food handling practices. Furthermore, most food vendors knew that raw food should be kept separate from cooked food, with a mean score of 4.36. Average food vendors knew that using masks, protective gloves, caps and adequate clothing reduces the risk of food contamination (mean score 3.92). Also, most reported that improper food storage might be hazardous to health (mean score 4.37). More awareness about food safety among the food vendors in the Nigerian SFP should be created e.g. by the Ministry of Health, to understand the role of using caps, gloves, and mask in reducing food contamination.

3.4 Food safety practices of food vendors

Food vendors reported that safe food handling is an integral part of their job with a mean score of 4.41, ranking highest in their procedures for food safety practices (Table 5). Vendors answered that they pay concerned about hygienic foodstuff sources with a mean score of 4.54, ranking second in their food safety practices. Third ranking in food safety practices were the answers regarding disposal of food that developed an odor, which most vendors reported is the right thing to do (mean score

Table 4 Responses on food safety attitude questions among food vendors (n = 240)

Questions food vendors were asked about food safety attitude	SD %	D %	U %	A %	SA %	Mean
Safe food handling is an integral part of their job	4.17	1.25	3.33	31.67	59.58	4.41
Sick staff should not be involved in food handling and food services	4.17	3.75	3.33	25.42	63.33	4.40
Food stored improperly could be hazardous to your health	3.33	2.92	2.92	35.42	55.42	4.37
Learning more about food safety is essential to me	6.25	1.25	1.67	32.08	58.75	4.36
Both raw and cooked foods should be kept separate	5.83	1.67	1.25	32.92	58.33	4.36
I think that food safety is related to how I handle food	6.25	0.83	4.17	29.17	59.58	4.35
Staff with cut or open wounds on fingers or hands should not touch unwrapped food	4.17	3.33	5.00	29.17	58.33	4.34
Using masks, protective gloves, caps and adequate clothing reduces the risk of food contamination	7.50	5.83	17.08	26.25	43.33	3.92

SD strongly disagree, *D* disagree, *U* undecided, *A* agree, *SA* strongly agree

Table 5 Responses on food safety practices among food handlers (n = 240)

Questions food handlers were asked on food safety practice	Never	Rarely	Sometimes	Often	Always	Mean
I frequently avoid buying expired food products	4.58	2.50	2.08	12.50	78.33	4.58
I pay concerned about hygienic sources of foodstuff	2.08	1.25	9.17	15.42	72.08	4.54
I dispose of food when it develops some odor	5.42	2.50	5.42	8.33	78.33	4.52
I dispose of food when the taste changes	4.17	5.42	7.50	17.08	65.83	4.35
I sterilize my utensils before use	7.50	15.00	25.00	27.92	24.58	3.47
I wash my hands before using gloves	22.08	14.58	30.00	15.42	17.92	2.93
I use protective clothing when touching or distributing unwrapped foods	22.50	13.33	32.50	15.42	16.25	2.90
I use a mask when touching or distributing unwrapped food	21.25	16.67	29.58	16.25	16.25	2.90
I use gloves when touching or distributing unwrapped food	22.08	15.00	32.08	15.83	15.00	2.86

4.52). Food inspection institution should motivate and encourage food vendors to maintain these practices. On the other hand, vendors scored poorly when asked about if they use gloves when touching or distributing unwrapped food (mean score 2.86), ranking it the lowest in their food safety practices. Likewise, low scores where reached regarding the use of protective clothing when touching or distributing unwrapped foods (mean score 2.90). National inspections should make sure that food vendors comply with the National Food Safety Act and make it compulsory to food handlers to use protective clothes.

3.5 Factors affecting food safety knowledge of food vendors engaged in the SFP

3.5.1 Knowledge

Socio-demographic characteristics had little effect on food safety knowledge of food vendors involved in SFP (Table 6), while education attainment showed a significant effect ($p < 0.05$). Because the more educated the individual, the more likely that they can read and understand written food safety information easily (Osaili et al. 2018; Madaki and Bavorova 2019). This is in line with studies of Sibanyoni et al. (2017), Luo et al. (2019), Moreb et al. (2017), and

Table 6 Multiple Linear Regression of the food safety KAP scores of food vendors in Northeastern Nigeria (n = 240)

Variables	Food safety knowledge		Food safety attitude		Food safety practice	
	Coefficient	Std. Err	Coefficient	Std. Err	Coefficient	Std. Err
Socio-demographic characteristics						
Age	−0.027	0.023	0.240	0.079***	−0.057	0.085
Gender	0.727	0.644	4.388	2.173**	3.774	2.337
Household size	0.030	0.038	−0.284	0.129**	−0.132	0.139
Food vending experience (years)	−0.001	0.027	0.165	0.091*	0.243	0.098**
Education qualification	0.051	0.026**	−0.017	0.087	−0.096	0.094
Food vending profit	0.000	0.000	0.000	0.000	0.000	0.000
Food safety information sources						
Radio	0.578	0.318*	2.195	1.077**	1.581	1.158
Television	0.676	0.269**	−0.582	0.918	0.220	0.987
Social media	−0.454	0.438	2.504	1.478*	0.448	1.589
Internet	0.501	0.324	2.530	1.094**	3.057	1.176**
Friend and colleagues	0.117	0.448	−2.823	1.505*	−2.201	1.619
Food handling training	0.328	0.298	−0.902	1.003	−0.036	1.079
Food inspection institution	0.653	0.243***	1.540	0.831*	3.148	0.893***
Constant	8.189	0.787	23.426	3.219	28.291	3.462
F-value	0.050		0.000		0.000	
R-square	0.092		0.244		0.165	

NB: ***1% level of significance; **5% level of significance; *10% level of significance

Siddiky et al. (2022), that found that education had a positive influence of on food safety knowledge of food vendors. Information sources could have an effect food safety knowledge of food vendors in the SFP. Vendors using radio and TV as a source of food safety information showed a significantly higher food safety knowledge scores than food vendors that were not using these information sources ($p < 0.10$ and $p < 0.05$). This indicates the role of radio and television in dissemination of food safety information because of the large coverage and easy to comprehend the information as most of the information is in local language. This is in line with studies of Liu and Ma (2016) and Tiozzo et al. (2019), who reported that access to food safety information via radio and TV improves the food safety knowledge of food vendors. Food vendors who received food safety information from food inspection institutions have significantly ($p < 0.01$) higher food safety knowledge scores than those who did not receive it. This highlighted the important role of food safety inspections for providing the reliable and credible food safety information as well as correcting false food safety information. The result is consistent with previous studies (Azanaw et al. 2019; Sibanyoni et al. 2017; Woh et al. 2016), who identified receiving food safety information from institutions improve vendors' food safety knowledge. This indicated that radio, television, and food safety institutions could improve the food safety knowledge of food vendors under the SFP, which translates to food safety practices. This implies that by utilizing the reach and influence of radio, television, and food safety institutions, it is possible to improve food safety knowledge among the general public significantly. These platforms can serve as effective tools for disseminating information, promoting best practices, and empowering individuals to make informed decisions regarding food safety.

3.5.2 Attitude

Regarding socio-demographic characteristics, the result revealed that an increase in the age of food vendors significantly ($p < 0.01$) increased food safety attitudes of the food vendors (Table 6). This implies that considering certain age during recruitment of food vendors in the program may help in avoiding cross contamination of food. This is consistent with Luo et al. (2019), Sterniša et al. (2018), Siddiky et al. (2022) and Liu and Ma (2016), who reported that older food vendors had better food safety attitudes. The plausible reason is that as age increases, so do maturity and sound decision to take responsibility. Male food vendors had significantly ($p < 0.05$) higher food safety attitude scores than their female counterparts. This is in line with Luo et al. (2019). It is possible that the males may have received more exposure to food safety information or education, leading to better awareness and understanding of safe food handling practices. This increased knowledge may result in more positive attitudes towards food safety. Also, an increase in food vendors' years of vending significantly ($p < 0.10$) increased the food safety attitude score. The plausible reason is that vendors gain more knowledge on food safety and handling over time (Teffo and Tabit 2020; Siddiky et al. 2022; Al Banna et al. 2021). This indicates using food handling experience can be used as selection criteria of the food vendors during recruitment in the program to minimize cross contamination of food.

Radio is the predominant means of information dissemination in Nigeria (BBG 2014). Vendors receiving food safety information on the radio had a significantly ($p < 0.05$) higher food safety attitude score. This is consistent with the results by Tiozzo et al. (2019) and Woh et al. (2016). Furthermore, food vendors using food inspection institutions as a source of information have a significantly ($p < 0.10$) higher food safety attitude score, in line with (Azanaw et al. 2019; Woh et al. 2016). The plausible reason is that food inspection institutions are the most trusted, precise, and dependable source of information for food vendors. In summary, our findings revealed that by utilizing radio platforms and working in conjunction with food safety institutions, food vendors can receive essential information, visual training via television, and support to for the positive attitude toward food safety.

3.5.3 Practices

The years of vending experience significantly ($p < 0.05$) impact food safety practices in a positive way (Table 6). This corroborates with Siddiky et al. (2022), Teffo and Tabit (2020), Al Mamun et al. (2019) and Al Banna et al. (2021). With more experience, food vendors can learn from past mistakes and incidents, identify the areas with low food safety and take corrective actions to prevent similar issues in the future.

There is an increase in internet services and food safety teaching platforms online providing content on food safety practices. Using the internet as a source of food safety information significantly influences vendors' food safety practices positively ($p < 0.05$), in line with Burke et al. (2016) and Chi et al. (2017). Likewise, information provided by food inspection institutions for food safety significantly ($p < 0.05$) impacted food safety practices in a positive way (Table 6). Food inspection institutions have developed quality information and continuous improvement, which has instilled trust in food vendors. This is in line with the literature (Azanaw et al. 2019; Woh et al. 2016), which reported that vendors who receive food safety information from food inspection institutions have better food safety practices. The internet enables food vendors to connect with food inspection institutes, health authorities, and other professionals in the food

Table 7 Relationship between food safety knowledge, attitudes and practices

Variables	Mean	Std Err	FSK	FSA	FSP
Food safety knowledge (FSK)	8.816	1.960	1.000		
Food safety attitude (FSA)	34.513	7.205	0.064	1.000	
Food safety practice (FSP)	33.04	7.374	0.090	0.450***	1.000

Correlation ***1% level of significance

FSK food safety knowledge, *FSA* food safety attitude, *FSP* food safety practice

industry. They can seek guidance, clarification, and advice on food safety regulations and practices.

3.6 Correlations between food safety KAP

Food safety knowledge and attitude are weakly and non-significantly associated (Table 7). Nevertheless, a sizable positive correlation between food safety attitudes and food safety practices scores with a medium correlation coefficient (45%). This suggests that food vendor practices are associated with food safety attitudes. Likewise, food vendors' attitudes towards food safety are associated with their actual food safety practices. This aligns with other studies (Kunadu et al. 2016; Azanaw et al. 2019) that reported a positive correlation between food safety attitudes and practices. In summary, a favorable food safety attitude influences food vendors' mindsets, actions, and commitment to maintaining high food safety standards. It encourages awareness, compliance, continuous learning, and improvement, ultimately resulting in safer food handling practices and the well-being of consumers.

4 Conclusion and recommendations

This study examined food safety KAP of vendors involved in the SFP in Nigeria, and the factors affecting them. The influence of socio-economic characteristics and sources of food safety information on food safety KAP was investigated using multiple linear regression. Since an increase in education increases food safety knowledge, and years of vending experience increases the food safety attitude score. Thus, as a selection criterion, food vendors should have excellent primary education and years of vending experience. This is because as food vendors gain experience over the years, they become more attuned to the significance of food safety and its impact on their customers' health.

Using the radio and internet as information sources increased food safety knowledge and attitude scores. They enable food vendors to connect with food inspection institutes, health authorities, and other professionals in the food industry, giving guidance, clarification, and advice on food safety regulations and practices.

Vendors in the study area have moderate food safety knowledge showing poor food safety practices in some areas, which can endanger pupils' life. Thus, we recommend that food vendors focus on food safety training, access to information and resources, regulatory compliance, and effective monitoring and enforcement mechanisms. A combination of education, experience, and these additional factors can collectively shape an individual's food safety knowledge and attitude.

National Food Regulatory Agencies such as NAFDAC, Standard Organization, Consumer Protection Council, Ministry of Health and Agriculture should make food safety training mandatory using food safety guide published by FAO (2023) for all vendors participating in Nigeria SFP. We also recommend that vendors should have access to the manual of the National Policy for Food System and Implementation Strategy (NPFSIS) (WHO 2021a, b). Finally, an inspection (monitoring unit) of practices is needed to implement food safety practices effectively and impose punishment on not-complying vendors.

It is important to note that the KAP model recognizes that knowledge and attitude alone may not always translate into behavioral change. Other factors, such as external influences, social support, access to resources, and individual motivation, can also impact an individual's ability and willingness to practice safe food handling. Therefore, interventions based on the KAP model should consider these additional factors and address barriers to behavioral change to promote food safety practices effectively.

The study's findings only apply to the food vendors of the SFP in northeastern Nigeria. Perhaps food vendors from different regions in the country would show different ratings. Also, a self-reporting study design may be a source of bias; therefore, observational would be useful research for future studies.

Acknowledgements The study appreciates the support of the Faculty of Tropical AgriScience, Czech University of Life Science Prague for Funding the data collection under the Internal Grant Agency (grant number: 20223113). To my supervisor, Miraslova Bavorova thank you for all your support in the questionnaire design, data analysis and result discussion.

Funding Open access publishing supported by the National Technical Library in Prague. The study appreciates the support of the Faculty of Tropical AgriScience, Czech University of Life Science Prague for Funding the data collection under the Internal Grant Agency (IGA) (grant number: 20223113).

Declarations

Conflicts of interest The authors stated that there is no conflict of interest.

Ethical approval The survey was conducted by PhD students of the Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague under supervision of senior scientist supervisor. The research complies with the ethical standards and was approved by the Doctoral Board of the Ph.D. study program "Sustainable Rural Development" No. P0888D370001.

References

Adebitan EO (2011) Assessing compliance with food hygiene requirements among urban and sub-urban classified hotels in Bauchi state, Nigeria. A thesis submitted in partial fulfillment of the requirements for the award of Master of Science with Abubakar Tafawa Balewa University Bauchi, Nigeria

Al Banna MH, Disu TR, Kundu S, Ahinkorah BO, Brazendale K, Seidu AA, Okyere J, Rahman N, Mondal S, Matubber B, Khan MS (2021) Factors associated with food safety knowledge and practices among meat handlers in Bangladesh: a cross-sectional study. Environ Health Prev Med 26(1):1–2. https://doi.org/10.1186/s12199-021-01004-5

Al Mamun AS, Hsan K, Sarwar MS, Siddique MR (2019) Knowledge and personal hygiene practice among food handlers in public university campus of Bangladesh. Int J Community Med Public Health 6(8):3211. https://doi.org/10.18203/2394-6040.ijcmph20193431

Al-Ghazali M, Al-Bulushi I, Al-Subhi L, Rahman MS, Al-Rawahi A (2020) Food safety knowledge and hygienic practices among different groups of restaurants in Muscat, Oman. Int J Food Sci 19:1–8. https://doi.org/10.1155/2020/8872981

Al-Shabib NA, Mosilhey SH, Husain FM (2016) Cross-sectional study on food safety knowledge, attitude and practices of male food handlers employed in restaurants of King Saud University, Saudi Arabia. Food Control 59:212–217. https://doi.org/10.1016/j.foodcont.2015.05.002

Anyogu A, Olukorede A, Anumudu C, Onyeaka H, Areo E, Adewale O, Odimba JN, Nwaiwu O (2021) Microorganisms and food safety risks associated with indigenous fermented foods from Africa. Food Control 129:108227. https://doi.org/10.1016/j.foodcont.2021.108227

Asmawi UM, Norehan AA, Salikin K, Rosdi NA, Munir NA, Basri NB (2018) An assessment of knowledge, attitudes and practices in food safety among food handlers engaged in food courts. Curr Res Nutr Food Sci J 6(2):346–353. https://doi.org/10.12944/CRNFSJ.6.2.09

Azanaw J, Gebrehiwot M, Dagne H (2019) Factors associated with food safety practices among food handlers: facility-based cross-sectional study. BMC Res Notes 12(1):1–6. https://doi.org/10.1186/s13104-019-4702-5

Balogun L (2022) School feeding: nigeria begins training for food vendors. https://von.gov.ng/school-feeding-nigeria-begins-training-for-food-vendors/

Baser F, Ture H, Abubakirova A, Sanlier N, Cil B (2017) Structural modeling of the relationship between food safety knowledge, attitude and the behaviour of hotel staff in Turkey. Food Control 73:438–444. https://doi.org/10.1016/j.foodcont.2016.08.032

BBG (2014) Broadcasting board of governors by contemporary media use in Nigeria. https://www.usagm.gov/wp-content/media/2014/05/Nigeria-research-brief.pdf

Bigson K, Essuman EK, Lotse CW (2020) Food hygiene practices at the Ghana school feeding programme in Wa and cape coast cities. J Environ Public Health 2020:1–7. https://doi.org/10.1155/2020/9083716

Boles M, Adams A, Gredler A, Manhas S (2014) Ability of a mass media campaign to influence knowledge, attitudes, and behaviors about sugary drinks and obesity. Prev Med 67:S40–S45. https://doi.org/10.1016/j.ypmed.2014.07.023

Burke T, Young I, Papadopoulos A (2016) Assessing food safety knowledge and preferred information sources among 19–29-year-olds. Food Control 69:83–89. https://doi.org/10.1016/j.foodcont.2016.04.019

Chi FF, Yan H, Nan J, Dong XN et al (2017) A survey on the awareness and satisfaction of the national food safety standards in Shaanxi province among relevant personnel. Foreign Med Sci Sect Medgeogr 38:122–125

Chuang E, Thomas M, Feng Y (2021) Young adult food safety knowledge gaps and perceptions of roommates' food handling practices: a survey of university students in Indiana. Food Control 126:108055. https://doi.org/10.1016/j.foodcont.2021.108055

Cortese RDM, Veiros MB, Feldman C, Cavalli SB (2016) Food safety and hygiene practices of vendors during the chain of street food production in Florianopolis, Brazil: a cross-sectional study. Food Control 62:178–186. https://doi.org/10.1016/j.foodcont.2015.10.027

Cunha DT, Rosso VV, Stedefeldt E (2018) Food safety performance and risk of food services from different natures and the role of nutritionist as food safety leader. Ciencia Saude Coletiva 23(12):4033–4042. https://www.scielosp.org/article/csc/2018.v23n12/4033-4042/en/

da Cunha DT, Fiorotti RM, Baldasso JG, de Sousa M, Fontanezi NM, Caivano S, Camargo MCR (2013) Improvement of food safety in school meal service during a long-term intervention period: a strategy based on the knowledge, attitude and practice triad. Food Control 34(2):662–667. https://doi.org/10.1016/j.foodcont.2013.06.003

da Vitória AG, de Souza Couto Oliveira J, de Almeida Pereira LC, de Faria CP, de São José JFB (2021) Food safety knowledge, attitudes and practices of food handlers: a cross-sectional study in school kitchens in Espírito Santo, Brazil. BMC Public Health 21:1–10. https://doi.org/10.1186/s12889-021-10282-1

De Boeck E, Jacxsens L, Vanoverberghe P, Vlerick P (2019) Method triangulation to assess different aspects of food safety culture in food service operations. Food Res Int 116:1103–1112. https://doi.org/10.1016/j.foodres.2018.09.053

Effiong AI, Nseobot IR, Johnny AE, Umoh JM, Frank EI, Abere OJ, Abraham UP, Essien MO, Ukpong ES (2020) Assessment of Nigerian Television Authority (NTA) ongoing programme awareness campaigns on corona virus in Nigeria. Electron Res J Soc Sci Human 2(1–3): 2020. https://ssrn.com/abstract=3567859

Egbule OS, Iweriebor BC, Odum EI (2020) Beta-Lactamase-producing Escherichia coli isolates recovered from pig handlers in retail shops and Abattoirs in selected localities in Southern Nigeria: Implications for public health. Antibiotics 10(1):9. https://doi.org/10.3390/antibiotics10010009

Ezirigwe J (2018) Much ado about food safety regulation in Nigeria. J Sustain Dev Law Policy 9:109–132. https://doi.org/10.4314/jsdlp.v9i1.6

FAO (2023) FAO strategic priorities for food safety within the FAO strategic framework. Rome. https://doi.org/10.4060/cc4040en

Fontannaz-Aujoulat F, Frost M, Schlundt J (2019) WHO Five Keys to Safer Food communication campaign-Evidence-based simple messages with a global impact. Food Control 101:53–57

Global Alliance for Improved Nutrition (GAIN) (2020) Analysis of Food Safety Investments in Nigeria: A Review. A USAID Eat-Safe Project Report. Available at: https://pdf.usaid.gov/pdf_docs/PA00Z42M.pdf

Havelaar AH, Kirk MD, Torgerson PR, Gibb HJ, Hald T, Lake RJ et al (2015) World Health Organization Global estimates and regional comparisons of the burden of foodborne disease in 2010. PLoS Med 12(12):e1001923. https://doi.org/10.1371/journal.pmed.1001923

Hertzog MA (2008) Consideration in determining sample size for pilot study. Res Nurs Health 31(2):180–191. https://doi.org/10.1002/nur.20247

Iwu AC, Uwakwe KA, Duru CB, Diwe KC, Chineke HN, Merenu IA, Ohale I (2017) Knowledge, attitude and practices of food hygiene among food vendors in Owerri, Imo State, Nigeria. Occup Dis Environ Med 5(01):11–25. https://doi.org/10.4236/odem.2017.51002

Kunadu APH, Ofosu DB, Aboagye E, Tano-Debrah K (2016) Food safety knowledge, attitudes and self-reported practices of food handlers in institutional foodservice in Accra, Ghana. Food Control 69:324–330. https://doi.org/10.1016/j.foodcont.2016.05.011

Lazou T, Georgiadis M, Pentieva K, McKevitt A, Iossifidou E (2012) Food safety knowledge and food-handling practices of Greek university students: a questionnaire-based survey. Food Control 28(2):400–411. https://doi.org/10.1016/j.foodcont.2012.05.027

Liu P, Ma L (2016) Food scandals, media exposure, and citizens' safety concerns: a multilevel analysis across Chinese cities. Food Policy 63:102–111. https://doi.org/10.1016/j.foodpol.2016.07.005

Liu Q, Zheng Z, Zheng J, Chen Q, Liu G, Chen S, Chu B, Zhu H, Akinwunmi B, Huang J, Zhang CJP, Ming W (2020) Health communication through news media during the early stage of the COVID-19 outbreak in China: Digital topic modeling approach. J Med Internet Res 22(4):19118. https://doi.org/10.2196/19118

Luo X, Xu X, Chen H, Bai R, Zhang Y, Hou X, Zhao Y (2019) Food safety related knowledge, attitudes, and practices (KAP) among the students from nursing, education and medical college in Chongqing, China. Food Control 95:181–188. https://doi.org/10.1016/j.foodcont.2018.07.042

Madaki MY, Bavorova M (2019) Food safety knowledge of food vendors of higher educational institutions in Bauchi state, Nigeria. Food Control 106:106703. https://doi.org/10.1016/j.foodcont.2019.06.029

Madaki MY, Bavorova M (2021) Determinants of food safety behaviour among food vendors: the case of Nigeria. Br Food J 123(12):3857–3875. https://doi.org/10.1108/BFJ-02-2020-0143

Monney I, Agyei D, Owusu W (2013) Hygienic practices among food vendors in educational institutions in Ghana: the case of Konongo. Foods 2(3):282–294. https://doi.org/10.3390/foods2030282

Moreb NA, Priyadarshini A, Jaiswal AK (2017) Knowledge of food safety and food handling practices amongst food handlers in the Republic of Ireland. Food Control 80:341–349. https://doi.org/10.1016/j.foodcont.2017.05.020

National Bureau of Statistics (2020) Nigeria in 2019: Economic review and 2017–2019 outlook. Retrieved from https://www.nbs.org/.

National Bureau of Statistics (2021) Nigerian Gross Domestic Product Report (Expenditure and Income Approach) (Q4 2021). www.nigerianstat.gov.ng

New CY, Ubong A, Premarathne JMKJK, Thung TY, Lee E, Chang WS, Son R (2017) Microbiological food safety in Malaysia from the academician's perspective. Food Res 1(6):183–202. https://doi.org/10.26656/fr.2017.6.013

NHGSFP (2020) National Home-Grown School Feeding Programme. www.nhgsfp.gov.ng

Nkosi NV, Tabit FT (2021) The food safety knowledge of street food vendors and the sanitary conditions of their street food vending environment in the Zululand District. South Africa. Heliyon 7(7):e07640. https://doi.org/10.1016/j.heliyon.2021.e07640

Nzimande ZZF (2014) Towards a sustainable approach to alleviate food insecurity through communal gardens: a case of Zimiseleni and Ifalesizwe, KwaZulu-Natal. http://hdl.handle.net/10413/12836

Obi-Ani NA, Anikwenze C, Isiani MC (2020) Social media and the Covid-19 pandemic: observations from Nigeria. Cogent Arts Humanities 7:1. https://doi.org/10.1080/23311983.2020.1799483

Obioha EE (2008) Climate change, population drift and violent conflict over land resources in northeastern Nigeria. J Hum Ecol 23(4):311–324. https://doi.org/10.1080/09709274.2008.11906084

Ojo A, Papachristodoulou N, Ibeh S (2018) The development of an infrastructure quality index for Nigerian metropolitan areas using multivariate geo-statistical data fusion. Urban Sci 2(3):59. https://doi.org/10.3390/urbansci2030059

Omojokun J (2013) Regulation and enforcement of legislation on food safety in Nigeria. Mycotoxin Food Saf Dev Countries. https://doi.org/10.5772/54423

Onyeaka H, Ekwebelem OC, Eze UA, Onwuka QI, Aleke J, Nwaiwu O, Chionuma JO (2021) Improving food safety culture in Nigeria: a review of practical issues. Foods 10:1878. https://doi.org/10.3390/foods10081878

Onyeneho SN, Hedberg CW (2013) An assessment of food safety needs of restaurants in Owerri, Imo State, Nigeria. Int J Environ Res Public Health 10:3296–3309. https://doi.org/10.3390/ijerph10083296

Ortiz RR, Smith A, Coyne-Beasley T (2019) A systematic literature review to examine the potential for social media to impact HPV vaccine uptake and awareness, knowledge, and attitudes about HPV and HPV vaccination. Hum Vaccin Immunother 15(7–8):1465–1475. https://doi.org/10.1080/21645515.2019.1581543

Osaili TM, Al-Nabulsi AA, Allah Krasneh HD (2018) Food safety knowledge among food service staff at the universities in Jordan. Food Control 89:167–176. https://doi.org/10.1016/j.foodcont.2018.02.011

Pepple N (2017) Environment and food poisoning: food safety knowledge and practice among food vendors in Garki, Abuja-Nigeria. J Health Educ Res Dev 5:217. https://doi.org/10.4172/2380-5439.1000217

Rendall-Mkosi K, Wenhold F, Sibanda NB (2013) Case study of the national school nutrition programme in South Africa. PCD, NEPAD, University of Pretoria. Available at http://hgsf-global.org/en/component/docman/doc_details/404-case-study-of-the-national-school-nutrition-programme-in-south-africa

Reyes J, Bastias J, Gutierrez M, Rodriguez M (2007) Prevalence of Bacillus cereus in dried milk products used by Chilean School Feeding Program. Food Microbiol 24(1):1–6. https://doi.org/10.1016/j.fm.2006.04.004

Sani NA, Siow ON (2014) Knowledge, attitudes and practices of food handlers on food safety in food service operations at the Universiti Kebangsaan Malaysia. Food Control 37:210–217. https://doi.org/10.1016/j.foodcont.2013.09.036

Scharff RL (2012) Economic burden from health losses due to foodborne illness in the United States. J Food Prot 75(1):123–131. https://doi.org/10.4315/0362-028x_jfp-11-058

Sewell AM, Farber JM (2001) Foodborne outbreaks in Canada linked to produce. J Food Prot 64(11):1863–1877. https://doi.org/10.4315/0362-028X-64.11.1863

Sibanyoni JJ, Tshabalala PA, Tabit FT (2017) Food safety knowledge and awareness of food handlers in school feeding programmes in Mpumalanga, South Africa. Food Control 73:1397–1406. https://doi.org/10.1016/j.foodcont.2016.11.001

Siddiky NA, Khan MSR, Sarker MS, Bhuiyan MKJ, Mahmud A, Rahman MT, Samad MA (2022) Knowledge, attitude and practice of chicken vendors on food safety and foodborne pathogens at wet markets in Dhaka, Bangladesh. Food Control 131:108456. https://doi.org/10.1016/j.foodcont.2021.108456

Steinberg EB, Henderson A, Karpati A, Hoekstra M, Marano N, Souza JM, Burrito Working Group (2006) Mysterious outbreaks of gastrointestinal illness associated with burritos supplied through school lunch programs. J Food Prot 69(7):1690–1698. https://doi.org/10.4315/0362-028X-69.7.1690

Stratev D, Odeyemi OA, Pavlov A, Kyuchukova R, Fatehi F, Bamidele FA (2017) Food safety knowledge and hygiene practices among veterinary medicine students at Trakia University, Bulgaria. J Infect Public Health 10:778–782. https://doi.org/10.1016/j.jiph.2016.12.001

Teffo LA, Tabit FT (2020) Assessment of the food safety knowledge and attitudes of food handlers in hospitals. BMC Public Health 20:311. https://doi.org/10.1186/s12889-020-8430-5

Premium Times (2018) Three boarding school students die of suspected food poisoning. November 25, 2018, report. (premiumtimesng.com)

Tiozzo B, Pinto A, Mascarello G, Mantovani C, Ravarotto L (2019) Which food safety information sources do Italian consumers prefer? Suggestions for the development of effective food risk communication. J Risk Res 22(8):1062–1077. https://doi.org/10.1080/13669877.2018.1440414

Tyrone L, Louis E, Grivetti C (2000) Food-related behaviors during drought: a study of rural Fulani, northeastern Nigeria. Int J Food Sci Nutr 51(2):91–107. https://doi.org/10.1080/096374800100796

UNICEF (2020) An estimated 10.4 million children in the Democratic Republic of the Congo, northeast Nigeria, the Central Sahel, South Sudan and Yemen will suffer from acute malnutrition in 2021. Impact evaluation report 2020. Available at: https://www.unicef.org/press-releases/estimated-10.4-million

Wallace F, Mittal N, Lambertini E, Nordhagen S (2022) Vendor knowledge, attitudes, and practices related to food safety in low- and middle-income countries: a scoping review. J Food Prot 85(7):1069–1078. https://doi.org/10.4315/JFP-21-439

WFP (2012) WFP's school feeding policy: a policy evaluation, volume II Annexes, 30 November 2011 commissioned by the office of evaluation measuring results, https://documents.wfp.org/stellent/groups/public/documents.

WFP (2013) State of school feeding worldwide 2013. Rome: WFP. https://www.wfp.org/publications/state-school-feeding-worldwide-2013

WFP (2019) Nigeria home grown school feeding strategic plan 2016–2020. Available at: https://docs.wfp.org/api/documents/WFP-0000116838/download/

WFP (2020) What the World Food Programme is doing to respond to the Nigeria emergency. https://reliefweb.int/report/nigeria/wfp-nigeria.

WHO (2017) Food safety, food nutrition and food law guidelines. https://www.afro.who.int/sites/default/files/2017-06/Food%20Safety%20and%20Nutrition%20Food%20Law%20Guidelines.pdf

WHO (2021a) Food Safety. World Health Organization of the United Nations. www.who.int/health-topics/food-safety/, accessed date: 01 July 2022

WHO (2021) Nigeria strengthens Food Safety, Launches Unified Training Manuals. Nigeria strengthens Food Safety, Launches Unified Training Manuals | WHO | Regional Office for Africa.

WHO/FAO (2010) FAO/WHO framework for developing national food safety emergency response plans. Rome. Available at: www.fao.org/docrep/013/i1686e/i1686e00.pdf

Wogu JO, Chukwu CO, Nwafor KA, Anikpe EA, Ugwuoke JC, Ugwulor-Onyinyechi CC, Eseadi C (2019) Mass media reportage of Lassa fever in Nigeria: a viewpoint. J Int Med Res. https://doi.org/10.1177/0300060518821552

Woh PY, Thong KL, Behnke JM, Lewis JW, Mohd Zain SN (2016) Evaluation of basic knowledge on food safety and food handling practices amongst migrant food handlers in Peninsular Malaysia. Food Control 70:64–73. https://doi.org/10.1016/j.foodcont.2016.05.033

Zenebe M, Samson G, Carol JH, Nigatu R (2018) School feeding program has resulted in improved dietary diversity, nutritional status and class attendance of school children. Ital J Pediatr 44:16. https://doi.org/10.1186/s13052-018-0449-1