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Research article

The food safety knowledge of street food vendors and the sanitary conditions of their street food vending environment in the Zululand District, South Africa

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HIGHLIGHTS

- Most of the street food vendors had not attended any food safety-training.
- Most of the street food vendors possessed inadequate food safety knowledge.
- Most of the street food vending sites are non-compliant to food safety regulations.
- There is inadequate monitoring for prevention and control actions by health authorities.

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ABSTRACT

This research sought to evaluate the food safety knowledge of street food vendors and the sanitary compliance status of their vending facilities, Zululand District, South Africa. Data collection was done in a face to face interview with respondents in a cross-sectional survey research design. Data was collected from 399 randomly selected street food vendors and 200 randomly selected street food vending facilities. Only a minority of the street food vendors had attended high school (47 %) and the vast majority (77 %) of them had not attended any food safety training courses. Overall, the vast majority (76 %) of the street food vendors had low food safety knowledge and only 14 % of the street food vending sites had high compliance with sanitary conditions. In conclusion, this study demonstrates that most of vending facilities of street food vendors constitute a food safety risk to the consumers. This was primarily due to the possession of inadequate food safety knowledge of street food vendors, non-compliant street food vending infrastructure, and inadequate monitoring and controls by competent authorities. It is recommended that, authorities should implement the food stalls/caravan system in areas with adequate sanitation and use the licensing and permit tool to ensure control and adherence to food safety regulations and street food vendors and health inspectors should be trained on safe food handling principles and practice.

1. Introduction

Street-vended foods are defined as consumables such as beverages and foods sold in public places, which may be eaten elsewhere (Bhattacharjya and Reang, 2014). Street food vending is mostly of an informal nature and is often not regulated by any relevant authority (Lues et al., 2006; Samapundo et al., 2016). Street-vended foods support the dietary diversity of most people in the informal sector, because they provide easy access to inexpensive, affordable food items (Alimi, 2016; Rane, 2011). The street food vending businesses contribute significantly to income generation for many individuals from low income households involved in the street food vending (Choudhury et al., 2011). Most street food vendors possess low educational training and often lack adequate food safety knowledge and skills (Samapundo et al., 2015). They are likely not to execute food safety procedures during the handling and preparation of food (Noor, 2016) and this could lead to the contamination of food. The occurrence of food contamination is intertwined with various factors, such as a lack of good hygiene, incorrect food temperatures and an inability to follow proper food preparation techniques (Monney et al., 2013). Furthermore, most street food vendors have been found to possess

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inadequate equipment resources such as refrigerators, potable water and electricity supply (Farahat et al., 2015). Inadequate resources - such as no electricity and contaminated water - may hamper the implementation of safe food practices; hence, exposing food to spoilage and contamination (Monney et al., 2013).

Street-vended foods are considered a food safety hazard to consumers, since vendors often lack basic food service infrastructure and equipment such as storage facilities, food reheating equipment, refrigerators and waste disposal facilities (Rane, 2011). The lack of adequate food service equipment hampers effective implementation of safe food storage practices at street food vending sites (Muyanja et al., 2011). The possession of adequate food safety knowledge and skills, adequate infrastructure and equipment is essential to effectively implement food safety measures at street food vending sites (Aluko et al., 2014; Cortese et al., 2016). In South Africa, street-vended foods are often prepared and sold on busy street corners and at taxi ranks and railway stations. These sites are usually located outdoors or within makeshift shelters (Kubheka et al., 2001). The consumption of street foods among young, black African males was found to be very common, due to its convenience, availability and affordability. Even though it has been found that consumers lack confidence in the safety of these foods, their preference for these foods is often not hampered (Asiegbu et al., 2016). The Zululand District is undergoing rapid urbanisation and food disease propagation due to enteric virus and bacteria is a concern (Soon 2019). Currently, there is little researched information regarding street food vendors' food safety knowledge and the sanitary conditions of their street food vending sites. The aim of this study is to evaluate the food safety knowledge of street food vendors in the Ulundi and AbaQulusi local municipalities of the Zululand District, South Africa, and the level of compliance to sanitary requirements of their street food vending environment.

2. Materials and methods

2.1. Research design and sampling

A cross-sectional survey design and quantitative research approach was applied, whereby a questionnaire and a checklist were used to collect data, from June 2018 to February 2019. The study was conducted in the Ulundi and AbaQulusi local municipalities, in the Zululand District in South Africa and the study population was street food vendors and their vending facilities. A stratified sampling technique was applied, in which the major towns, informal settlements and villages were divided into five zones, namely the north, south, west, east and central zones, based on where street food vending takes place. Thereafter, street food vending sites were sampled randomly, in each zone, using a list of vending sites of street food vendors. In each sampled street food vending site, a purposeful sampling was used to sample street food vendors and street food vending sites. A total of 200 street food vending sites were observed in the study: Similarly, a total of 400 street food vendors were selected from both municipalities. Cochran's formula for large population was used to estimate the sample population.

2.2. Data collection

The data collection instrument was a questionnaire as well as a checklist carefully designed for this research using information gathered from various literature. The questionnaire used had four sections: socio-demographics; location and characteristics of street food vending facility; food safety knowledge of the street food vendors; and monitoring and enforcement of the South African food hygiene regulations. A checklist was used to gather data on the sanitary compliance of street food vending sites. A pilot study was conducted with 20 vendors and 10 street food vending facilities during which the reliability of the questionnaire instrument and checklist was ascertained. The feedback was used to modify the questionnaire, before commencing with the data collection process. A panel of expert with industrial and academic experience in the field of food safety evaluated the research to ascertain face and content validity. This ensured that the instruments were suitable for the intended research and relevant for data collection. The different constructs of the instruments were measured for internal consistency and the Cronbach's α obtained ranged from 0.689 to 0.821. After obtaining permission from the Zululand District of KwaZulu-Natal province municipalities and ethics clearance from the University of South Africa, the principal researcher, together with five trained research assistants, visited selected street food vending facilities at different times of the day. Individual street food vendors were approached, and the purpose of the study was explained to willing participates after they have signed the consent form. The participants were told of their right to withdraw from the study, at any time, if they wish to do so. Data collection was by means of a face-to-face interview which lasted approximately twenty minutes per session, while each observation session lasted approximately fifteen minutes.

2.3. Data analysis

The SPSS software (version 11.0) was used for data analysis in which descriptive statistics were used to display the relationship among variables. For the purpose of evaluating the food safety knowledge and sanitary compliance, a score of 1 was allocated to a correct response to one knowledge question or a compliance to one sanitary requirement, otherwise a zero was allocated. The was maximum total of 20 points for twenty food safety knowledge questions and 31 points for thirty-one sanitary compliance requirements. The t score of each respondent was added and the following assessment scale were used: Low knowledge (1–9 point), moderate knowledge (10–15 points) and high knowledge (16–20 points) while low compliance (1–14 points), moderate compliance (15–24 points) and high compliance (25–31 points).

3. Result and discussion

3.1. Socio-demographics of respondents

Females (73.4 %), constituted most of the respondents compared to males (26.6 %). The majority (55.2 %) of the respondents were above the age of 35 and up to 99.7 % of them were black. Only 39.3 % of the respondents were found to be married while 25 % were unmarried but lived with a partner (25.8 %), 23.1 % were unmarried and lived without a partner and 11.9 %, were either separated, divorced or widowed. Most (45.6 %) of the respondents have attended high school, while only a few (16.5 %) have attended a tertiary institution. The rest of the respondents (37.8 %) did not obtain any high school education (Table 1). The fact that the majority of respondents were females is a reflection on the demographics of the KwaZulu-Natal, where 86.3 % of the population is female (Zululand District Municipality, 2018). The majority of street food vendors would be married young adults who are who have resorted to generating income from street food vending in the absence of a formal employment since most of them have not competed the high school (Aluko et al., 2014; Martins, 2006). The low number of street food vendors, who had attended high school, is as a result of inadequate access to education opportunities for the black majority in South Africa before 1994 (Salisbury, 2016). Many street food vendors possessed limited skills to secure formal employment and, as a result, they opt for street food vending as it requires a low capital start-up investment (Hill et al., 2019; Sekhani et al., 2019).

The predominantly high numbers of low income, young female adults practicing street food vending means more attention need to be given to their food safety training needs to avoid the spreading of infectious diseases considering many foodborne disease outbreaks have been traced to poor knowledge about food-handling practices (Ghatak and Chatterjee, 2018). In developing countries, it is customary for women to prepare dishes in their household, hence, their dominance in the street food vending activities (Katiyo et al., 2019). Elsewhere, females have also

Table 1. The characteristics of street vendors (N = 399).

Variables		Number of Respondents (%)
S1.1. Gender	Male	106 (26.6)
	Female	293 (73.4)
S1.2. Age (Years)	18–25 years	43 (10.8)
	26–35 years	136 (34.1)
	36–45 years	109 (27.3)
	46–55 years	71 (17.8)
	56–65 years	39 (9.8)
	66–75 years	1 (0.3)
S1.3. Ethnicity	Black	398 (99.7)
	White	0 (0)
	Coloured	1 (0.3)
	Asian/others	0 (0)
S1.4. Marital status	Married	157 (39.3)
	Unmarried, but living with a partner	103 (25.8)
	Unmarried, but living without a partner	92 (23.1)
	Separated	11 (2.8)
	Divorced	1 (0.3)
	Widowed	35 (8.8)
S1.5. Level of education	Tertiary level	66 (16.5)
	High school level (Grade 10–12)	182 (45.6)
	Secondary school level (Grade 7–9)	36 (9.0)
	Senior primary (Grade 4–6)	37 (9.3)
	Junior primary (Grade 1–3)	28 (7.0)
	No formal education	50 (12.5)

Table 2. Food service training credentials of respondents (N = 399).

Variables	Answer options	Number of respondents (%)
S1.6. How long (years) have you been selling food at this place?	Less than 5 years	186 (46.6)
	5–10 years	127 (31.8)
	11–15 years	55 (13.8)
	More than 15 years	29 (7.8)
S1.7. Possession of food service/ hospitality diploma/degree?	Yes	92 (23.1)
	No	311 (77.9)
S1.8. Have you ever attended any food safety training course?	Yes	88 (22.1)
	No	311 (77.9)
S1.9. If yes, when last did you attend the food safety training?	Less than 6 months ago	7 (8.0)
	Between 7 months and 1 year	18 (20.5)
	More than a year	63 (71.6)
S1.10. Have you ever received food safety training while selling at this street food vending site?	Yes	80 (20.1)
	No	319 (79.9)
S1.11. Is this the first place you have worked as a street food vendor?	Yes	277 (69.4)
	No	122 (30.6)
S1.12. Which of the following represent your average monthly income generated from street food vending?	Less than R5000	236 (59.1)
	R5001-10000	152 (38.1)
	R10001-15000	3 (0.8)
	Above R15000	8 (2)
S1.13. Is the selling of street food your main source of income?	Yes	348 (87.2)
	No	51 (2.8)

been found to dominate street food vending activities in studies conducted in Gauteng, South Africa (Martins, 2006) and in Benin City, Nigeria (Hill et al., 2019).

The majority, 46.6 %, of the respondents have been selling street-vended food at the current street food vending site for less than five years and 31.8 % of the respondents have been selling street-vended food at the current street food vending site for more than five years (Table 2). An explanation for this might be that the street food vending business is a small-scale business and temporal, with regard to its nature of operation, and it requires low start-up costs, which ensures ease of entry into the market for first-time street food vendors (Imathiu, 2017). Street food vending, through its supply of ready-made meals, offers a flexible self-employment opportunity for individuals who cannot afford the high cost of operating a formal store (Ghatak and Chatterjee, 2018; Soon, 2019).

The vast majority (77.9 %) of respondents were not in possession of a food service/hospitality qualification and the majority (77 %) of them had not attended any food safety training courses. Of the few who have attended a food safety training course, 71.6 % have completed this course more than a year ago (Table 2). This could be due the fact that food safety training is not offered at high school. Street food vendors requires food safety training to boost knowledge and skills on food safety implementation (Apanga et al., 2014). An explanation why vendors had not attended a food safety course recently can be attributed to the low frequency of available training courses and the high fees of food safety training courses (Madaki and Bavorova, 2019; Webb and Morancie, 2015). This suggests that the relevant authorities should prioritise street food safety training by designing a hazard analysis critical control point (HACCP) inclusive training manual targeting street food vendors, to protect customers from food hazards involved in the street food vending environment (Ma et al., 2019; McKay et al., 2016). In a research carried out in Dhaka, Bangladesh, trained food handlers were found to possess improved food safety knowledge (Al Mamun et al., 2013).

The majority (69.4 %) of the street food vendors indicated that they started off their business at the current street food vending site and 59.1 % of them generated an average monthly income of less than R5 000, while 38.1 % generated an average monthly income in the range of R5 001-R10 000. The main means of income by the vast majority (87.2 %) of the respondents was from street food vending (Table 2). Street food vending businesses only generating marginal profits, but, for many, it is their only income, which they rely on to sustain their households (Lucan et al., 2013; McKay et al., 2016).

3.2. Characteristics of the street food vending facilities

Only 34.6 % of the respondents sold food at a permanent facility/ premise, while 47.4 % sold their food in a makeshift shelter and 17.8 % sold their goods in the open, with no shelter/premise. The majority (52.9 %) of street food vendors prepared food at their vending site and most (64.9 %) of them provided both take-away and eating-on-site food services (Table 3). In order to acquire proper street food vending facilities, vendors would be required to secure substantial financial resources, and this is often not possible with many of them (McKay et al., 2016; Sekhani et al., 2019). The reason why most of the street food vendors prepare the food at their vending sites, providing both take-away and eating on-site food services was to boost sales and profit, often under inadequate hygiene conditions (Choudhury et al., 2011; Samapundo et al., 2015). Food borne diseases due to the contamination of ready to eat food with microorganisms such as Norovirus, *Escherichia coli*, *Salmonella*, and *Staphylococcus aureus* has been associated to food preparation facilities with poor sanitary conditions (Lues et al., 2006).

3.3. The food hygiene knowledge of street food vendors

Only 30.8 % of the respondents correctly indicated that the correct procedure for washing their hands, when preparing and serving food, is to use soap and warm running water, and to wipe them dry with a clean dry cloth (Table 4). This could be attributed to the fact that many of the street food vendors often have not been trained in food hygiene practices and most street food vending sites often lack a portable water supply (Al Mamun et al., 2013; Singh et al., 2016). Inadequate personal hygiene knowledge or unsafe food handling procedures can result in food

Table 3. Location and characteristics of food service vending facilities of respondents (N = 399).

Variables		Number of respondents (%)
S2.1. In which of the following areas is your food vending facility located?	Ulundi	200 (50.1)
	AbaQulusi	199 (49.9)
S2.2. Which of the following best define your street food-vending facility?	Roadside in the open with no shelter/premise	71 (17.8)
	Roadside with makeshift shelter	189 (47.6)
	In a permanent facility/premise	138 (34.6)
S2.3. Where is the food you sell at this vending facility being prepared?	Prepare food at home	79 (19.8)
	Buy and sell pre-cooked foods	27 (6.8)
	Prepare food at the vending facilities	211 (52.9)
	Both 1 and 3	82 (20.6)
S2.4. Which of the following types of food service do you provide at this street food vending facility?	Take-away foods	124 (31.1)
	Eating on site	16 (4)
	Both take away and eating on site	259 (64.9)

Table 4. The personal hygiene knowledge of street food vendors (N = 399).

Variables	Answer options	Number of respondents (%)
S3.1. Which of the following is the correct way to wash your hands during the preparation and serving of foods?	Wash hands with warm running water and wipe dry with a clean cloth	97 (24.3)
	Wash hands with cold running water and wipe dry with a clean cloth	65 (16.3)
	Wash hands with soap and cold running water and then wipe dry with a clean cloth	31 (7.8)
	Wash hands with soap and warm running water and then wipe dry with a clean cloth	**123 (30.8)**
	Both 3 and 4 above are correct	83 (20.8)
S3.2. As a food handler, which of the following compels you to wash your hands when you are involved in the preparation and serving of food?	After visiting the toilet only	74 (18.5)
	After picking your nose	58 (14.5)
	None of the above	2 (0.5)
	All of the above	**265 (66.4)**
S2.3.1 As a food handler, I must not handle food when I have diarrhoea, even if I wash my hands regularly.	**True**	**258 (64.7)**
	False	141 (35.3)
S3.3.2 As a food handler, I must not handle food and money when I have flu, colds, cough or catarrh.	**True**	**304 (76.2)**
	False	95 (23.8)
S3.5. As a food handler, which of the following is the correct thing to do if you have a wound on your hands?	**Cover the wound with water-proof dressings/bandage**	**374 (93.7)**
	Do nothing, if it is not painful	25 (6.3)

The correct response under answer options is in bold

contamination, which may lead to food borne diseases in consumers (Liu et al., 2014; Trafialek et al., 2018). The majority (66.4 %) of respondents correctly identified that food handlers are compelled to wash their hands when they have visited the toilet or after they have picked their noses. The majority of respondents correctly indicated that food should not be handled when they have diarrhoea, even if their hands were washed regularly (64.7 %), and food and money should not be handles when they have flu, colds, a cough or catarrh (76.2 %). The vast majority (93.7 %) of respondents correctly indicated that, if you have a wound on their hands, it should be covered with waterproof dressings/a bandage (Table 4). Despite not knowing the correct hand washing procedure, most of the street food vendors possessed basic domestic personal hygiene practices that should be practiced to avoid the contamination of food (Kothe et al., 2016; Samapundo et al., 2015).

Regarding general food hygiene knowledge, only a few (25.1 %) of the respondents correctly indicated that a food display container should be clean, and dust and rust free, while only a small percentage (4 %) of them correctly indicated that protein-rich foods that are made from milk, and meat and fish, which have been exposed to non-refrigeration temperatures for more than two hours, should be discarded. Similarly, only a few (17 %) of the respondents knew that the safest way to thaw frozen perishable protein-rich foods, such as meat, fish, dairy and poultry products, is to thaw them in the refrigerator (Table 4). The lack of key general food hygiene knowledge is concern, given that the use of containers that are dirty can lead to food contamination by pathogens (Ghatak and Chatterjee, 2018; Loukieh et al., 2018; Samapundo et al., 2016). The lack of knowledge on temperature control for food safety is a also a concern as bacteria can propagate to harmful levels in food that are not stored in the correct temperatures (Akabanda et al., 2017). This finding highlights that street food vendors require training on safe food handling temperatures (Akabanda et al., 2017; Ma et al., 2019). Only the minority (43.1 %) of the respondents correctly indicated that the safest way to use cutting boards, to avoid cross-contamination, is to use separate cutting boards for meat and salad and wash them in between use (see Table 5). This can be attributed to the insufficient knowledge on the use of chopping boards and the prevention of cross-contamination between raw material, utensils and food preparation surfaces (Moreb et al., 2017). It is important to note that cross-contamination can lead to the transmission of microorganism from one food material to another (Bou-Mitri et al., 2018; Christison et al., 2008).

3.4. Microbial food safety knowledge

The majority (79.4 %) of the street food vendors were aware that microorganisms could cause foodborne diseases that may lead to death. This implies that street food vendors possessed some foundational

Table 5. The microbial hygiene knowledge of street food vendors (N = 399).

Variables	Answer options	Number of respondents (%)
S3.6. Which of the following best describe correct qualities of a display container, where prepared foods should be stored prior to selling?	Clean display container, dust free	126 (31.6)
	Clean display container, rust free	58 (14.5)
	Clean display container in direct contact with the floor	29 (7.3)
	All of the above	86 (21.6)
	Only 1 and 2 are correct	**100 (25.1)**
S3.7. Which of the following is the correct thing to do if protein-rich foods made from milk, and meat and fish are exposed to non-refrigeration temperatures (below 5 °C) for more than 2 h?	Quickly put perishable food back into the refrigerator	162 (40.6)
	Discard perishable food	**16 (4)**
	Quickly cook the perishable food	83 (20.8)
	Both 1 and 2 are correct	79 (19. 8)
	All of them are correct	59 (14.8)
S3.9. Which of the following is the safest way to thaw perishable foods such as meat, fish, dairy and poultry products?	Allow perishable foods to thaw on a table	72 (18)
	Allow perishable foods to thaw in hot water	130 (32.6)
	Allow to thaw on the upper shelve of the refrigerator	**68 (17)**
	Both 2 and 3 are correct	128 (32.1)
	None of the above is safe	1 (0.3)
S3.10. Which of the following is the safest way to use cutting boards to avoid cross-contamination?	**Use separate cutting boards for meat and salad and wash them in between usage**	**172 (43.1)**
	Use any cutting boards for meat and salad, but wash them between use	68 (17)
	Use the same cutting board for meat and salad, but wash them between use	66 (16.5)
	All of the above ways are correct	90 (22.6)

The correct response under answer options is in bold

knowledge on microbial foodborne diseases (Moreb et al., 2017). This is encouraging in the sense that the acquisition of food borne diseases from contaminated food remain a concern for most street vended food consumers (Asiegbu et al., 2016). Listeria was the best known of the pathogens, however, only 36.3 % indicated that they have heard about it. The recent listeriosis outbreak in South Africa recorded from 01 January 2017–20 June 2018 is still fresh in the mind of most street food vendors hence a possible explanation why *Listeria* was the most known of the pathogens by street food vendors (Department of Health, 2018). More than 84 % of the respondents had not heard about Salmonella (84.5 %), Campylobacter (88 %), Clostridium (93.2 %) and *Staphylococcus* (87.7 %) (Table 6). The reason for this could be the fact that street food vendors were not familiar with specific names of each enlisted food microorganism, possibly due to the lack of formal training on foodborne pathogens or foodborne diseases (Al-Kandari et al., 2019; Sani and Siow, 2014; Woh et al., 2016). The level unawareness of common foodborne pathogens can only aggravate the safety of street vended foods as well as emphasises on the need for a comprehensive food safety education for all street food vendors (Omari et al., 2018).

Table 6. Knowledge on foodborne bacteria of street food vendors (N = 399).

Variables	Answer options	Number of respondents (%)
S3.8.1. Are you aware that some microorganisms can cause foodborne diseases to you may lead to death?	Yes	317 (79.4)
	No	82 (20.6)
If your answered is "Yes", continue to the following		
S3.8.2. Have you ever heard of *Salmonella*?	Yes	62 (15.5)
	No	337 (84.5)
S3.8.3. Have you ever heard of *Campylobacter*?	Yes	48 (12)
	No	351 (88)
S3.8.4. Have you ever heard of *Listeria*?	Yes	145 (36.3)
	No	254 (63.7)
S3.8.5. Have you ever heard of *Clostridium*?	Yes	27 (6.8)
	No	372 (93.2)
S3.8.6. Have you ever heard of *Staphylococcus*?	Yes	49 (12.3)
	No	350 (87.7)

3.5. Knowledge of cooking and holding temperatures of food

Only the minority of street food vendors correctly indicated 78 °C (25.1 %) and 57 °C (33.8 %) as the correct minimum internal cooking temperature for stuffed chicken and vegetables/fruits, respectively. Similarly, only a few street vendors correctly indicated for salad and beef and chicken stew as 5 °C (41.1 %) and 63 °C (35.6 %) as the correct holding temperature for ready-to-eat foods such as salad and beef and chicken stew respectively (Table 7). This again can be attributed to the lack of formal training on internal cooking temperatures and holding temperatures for foods (Akabanda et al., 2017). Food contamination can take place in any step of in the food chain production, therefore, the lack of knowledge of cooking and holding temperatures means consumers are likely to consume food that is cooked at the right temperature or are being held at critical temperatures (5 °C–57 °C) to avoid microbial multiplication prior to being served (Ricci et al., 2020). Many

Table 7. The knowledge of food cooking and handling temperatures of street food vendors (N = 399).

Variables	Answer options	Number of respondents (%)
S3.11. Which of the following is the correct minimum internal cooking temperature for stuffed chicken?	90 °C	69 (17.3)
	65 °C	142 (35.6)
	100 °C	88 (22.1)
	78°C	**100 (25.1)**
S3.12. Which of the following is the correct minimum internal cooking temperature for vegetables and fruits?	87 °C	69 (17.3)
	77 °C	69 (17.3)
	67 °C	126 (31.6)
	57°C	**135 (33.8)**
S3.13. Which of the following is the correct holding temperature guideline for cold ready-to-eat foods such as salad?	At about 25 °C	76 (19)
	At about 10 °C	158 (39.8)
	At about 5°C	**159 (41.1)**
S3.14. Which of the following is the correct holding temperature for hot ready-to-eat foods such as beef and chicken stew?	At about 100 °C	102 (25.6)
	At about 63°C	**143 (35.6)**
	At about 25 °C	153 (38.8)

The correct response under answer options is in bold

Table 8. The monitoring and enforcement of food hygiene regulations at the food service sites of street food vendors (N = 399).

Variables	Answer options	Number of respondents (%)
S4.1.1 Has this street food vending facility been authorised or issued with a license to sell foods by local authorities?	Yes	223 (55.9)
	No	176 (44.1)
S4.1.2. Has this street food vending business been registered with Companies and Intellectual Property Commission (CIPC) of South Africa?	Yes	107 (26.8)
	No	292 (73.2)
S4.2. Has this street food vending facility been inspected by a health inspector?	Yes	258 (64.7)
	No	141 (35.3)
S4.3. If your facility has been inspected, how often is your facility being inspected?	Monthly	29 (11.2)
	Quarterly	141 (54.7)
	Yearly	88 (34.1)
S4.4 If your facility has been inspected, have you ever received a penalty/warning for non-compliance?	Yes	124 (31.1)
	No	275 (68.9)

street-vended food products are highly susceptible to microbial contamination and growth, if correct handling temperatures are not adhered to (Okumus et al., 2019).

3.6. An overall assessment of the food safety knowledge of street food vendors

The vast majority (76 %) of street food vendors had low levels of safety knowledge, while a few of them had moderate levels of food safety knowledge (23 %) and a marginal number had high levels of food safety knowledge (1 %). This can be attributed to a lack of training opportunities for street vendors on food safety measures (Yu et al., 2018). This inadequate levels of food safety knowledge imply that street food vendors are unlikely to produce safe food to consumers (Webb and Morancie, 2015). Continuous food safety training which creates awareness and improve favourable food safety practices among street food vendors and this, in turn, can result in the delivery of safe food to consumers (Jubayer et al., 2020; Trafialek et al., 2017). The findings of this study are consistent with that of a study conducted in the city of Cotonou and its outskirts, in Benin, where the food safety knowledge levels among street food vendors were found to be low (Ohin et al., 2018).

3.7. The monitoring and enforcement of food hygiene regulations

The majority of street food vendors (55.9 %) indicated that their street food vending facilities have been authorised or issued with an operating license and only a few (26.8 %) of them indicated that their street food vending businesses have been registered with Companies and Intellectual Property Commission (CIPC) of South Africa (Table 8). This points to inadequate organisation of the street food vending business in this Zululand district. For monitoring and enforcement of food hygiene regulations to be effective, all food street food vending business should be registered and assigned to a physical address to facilitate frequent visits by health inspectors and accountability in cases of noncompliance (Mari et al., 2013). Many (64.7 %) of the respondents indicated that health inspectors had inspected their street food vending sites. Out of those whose street food vending sites had been inspected, 54.7 % were inspected quarterly, while 34.1 % were inspected yearly and 11.2 % were inspected monthly. Furthermore, out of inspected street food vending facilities, 31.1 % of the respondents received a non-compliance penalty/warning, while 68.9 % did not receive any non-compliance penalty/warning (Table 8). The rapid rise of unemployment and the rapid growth of the informal food trade sector due to rapid urbanization of sub-urban areas means government policies must favour the protection of consumers and ensure the implementation and enforcement of the regulations governing hygiene requirements for food premises and the transport of food and related matters in South Africa (South African Government Gazette, 2015). The low level of monitoring means is being done to ensure that the street food supply chain is safe for consumers and meets local regulatory requirements and standards (Rodrigues et al., 2019). Inspection by skilled food and health inspectors can be an effective tool to monitor street food safety, but it must be implemented in a workable manner (Czarniecka-Skubina et al., 2018).

3.8. Compliance of street food vending sites to sanitary requirements

Overall, only a few street food vending sites (14 %) had high compliance with sanitary requirements while 50 % of them had moderate compliance, followed by 36 % with low compliance to the sanitary requirements. The low sanitary compliance of street food vending facilities can be attributed to the fact that most of the vendors were using make shift facilities and most of them did not have the financial capital to start their businesses in a formal structure (Cortese et al., 2016). Furthermore, sanitary requirements to which less than 50 % of the street food vending sites complied with, starting with those below 30 % compliance were: there is electricity power supply (24 %), sufficient illumination (25 %), there is a tap water supply (27.5 %) and the windows and doors are cleaned and free from dirt or damage (29.5 %).

Table 9. Sanitary requirements for which there was compliance by less than 50 % of street food vending sites (n = 200).

Sanitary requirements		Compliance with requirements (%)	
1	There is electricity power supply at the vending facility (Q30)	48	(24)
2	There sufficient illumination for all food handling areas (Q26)	50	(25)
3	There is a tap water supply in the facility (Q31)	55	(27,5)
4	The windows and doors are cleaned and free from dirt or damage (Q29)	59	(29,5)
5	Storage rooms are separated from food service area (Q27)	66	(33)
6	Displayed foods not in direct contact with floor or ground surface (Q12).	71	(35,5)
7	Food storage containers not damaged or prone to rust (Q15).	73	(36,5)
8	There is a dedicated garbage disposal bins with lid at the vending site (Q21)	83	(41,5)
9	There is sufficient space for hygienic storage of food, utensils and separate area for storage of refuse (Q24).	83	(41,5)
10	Food handlers washing their hands in clean water each time before the handling, preparation and serving of food (Q2).	86	(43)
11	Food preparation site is effectively cross-ventilated (Q25)	89	(44,5)

Similarly, four sanitary requirement had between 40-45 % compliance and these compliances are; effectively cross ventilated on vending sites (44.5 %), food handlers wash their hands in clean water each time before the handling, preparation and serving of food (43 %), there is sufficient space for hygienic storage of food, utensils and separate area for storage of refuse (41.5 %) and there is there is a dedicated garbage disposal bins with lid at the vending site (41.5 %). Alternatively, three sanitary requirements had only between 33-37 % compliance and these compliances are; food storage containers not damaged or prone to rust (36.5 %) and storage rooms are separated from food service area (33 %) (Table 9). It is obvious from the data that many of the street food vending facilities do not conform with the regulations governing hygiene requirements for food premises and the transport of food and related matters in South Africa (South African Government Gazette, 2015). The government should therefore address the infrastructure and resource problems in the street food vending economy to and ensure there is total compliance to relevant food safety regulation (Singh et al., 2016). The availability of these resources would lead to safe food production, resulting in a reduced incidence of foodborne outbreaks (Ghatak and Chatterjee, 2018; Singh et al., 2016). Due to the high number of non-compliant street food vending infrastructures, the government should ensure the implementation of a food stall systems that is well resourced to ensure proper control and compliance with relevant food safety regulations (Hashanuzzaman et al., 2020; Malasan, 2019). The permit and licensing tools should also be used efficiently to control access and manage public spaces to ensure a safe and control environment for street food vending especially in areas where there is rapid urbanisation (Song, 2020).

4. Conclusions

This research investigated the food safety knowledge of street food vendors and the sanitary conditions of their street food vending environment in the Zululand District, South Africa. The study demonstrates that street food vending activities constitute a food safety risk to the consumers and the public at large in communities where there is rapid urbanisation. This primarily due to the possession of inadequate food safety knowledge of street food vendors, non-compliant street food vending infrastructure, and inadequate monitoring and controls by competent authorities. In order to remedy the situation, it is recommended that, authorities should implement the food stalls/food caravans equipped with adequate food preparation and sanitation resources and use the licensing and permit tool to ensure control and adherence to food safety regulations. Thereafter, street food vendors and health inspectors should be trained on safe food handling principles and practice. More research needs to be conducted to understand the response of street food vendors to food safety training.

Declarations

Author contribution statement

Nelly Virginia Nkosi: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Frederick Tawi Tabit: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data associated with this study has been deposited at the University of South Africa Data Repository.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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