

Full Length Research Paper

Food safety knowledge and practices of street food vendors in selected locations within Kiambu County, Kenya

Johnson Mwove^{1,2*}, Samuel Imathiu³, Irene Orina³ and Paul Karanja³

¹Department of Human Nutrition Sciences, School of Food and Nutrition Sciences, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya.

²Department of Plant Sciences, Faculty of Agriculture and Environmental Studies, Chuka University, Chuka, Kenya.

³Department of Food Science and Technology, School of Food and Nutrition Sciences, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya.

Received 16 March, 2020; Accepted 3 July, 2020

The safety of street foods remains a public health concern especially in developing countries like Kenya where foodborne illnesses associated with these foods have often been reported. This study determined the food hygiene and safety knowledge and practices of 345 street food vendors (SFVs) in selected locations within Kiambu County, Kenya. Data collection was accomplished through face-to-face interviews using structured questionnaires and extensive observation using an assessment tool for observation of personal hygiene and food handling practices of SFVs and the condition of the vending environment. The results indicated that the majority of the SFVs were male (63.2%) with 38.1% of them having attained secondary school education. About 93% of the SFVs had not received any formal training on food hygiene and safety. Majority of SFVs handled food with bare hands (96.8%) or handled money while serving food without washing hands (86.1%). Few also practiced preservation with 78.3% storing foodstuff that required refrigeration at ambient temperatures while 22.3% stored leftovers without any form of preservation and sold them the following day. Whereas public health officers' visits were found to significantly ($P < 0.0001$) motivate SFVs to obtain a food handler's medical certificate, only about 27% had obtained it. These findings suggest that street vended foods sold in this study area may pose a significant potential hazard to public health due to the poor hygiene and handling practices reported.

Key words: Street vended food, food safety, food hygiene, public health, street food legislation.

INTRODUCTION

Street vended foods are ready-to-eat (RTE) foods and beverages that are sometimes prepared by vendors in the streets and other public places, and mostly sold to

consumers for immediate or later consumption without any further preparation or processing (Imathiu, 2017). The vast growing urban population in developing

*Corresponding author. E-mail: jmwove@chuka.ac.ke. Tel: +254714273101.

countries has stimulated a rise in the number of street food vendors (SFVs) in many cities so as to satisfy the demand for affordable and readily accessible RTE meals. Most of the town dwellers rely on such foods because they are convenient (Moussavi et al., 2016). Not only are street foods valued for their convenience and affordability, they also make a significant contribution to the country's economy, the preservation of society's cultural and social heritage, and maintaining and enhancing of people's nutritional status (Hill et al., 2019). Street food enterprises are distinguished by their low capital requirement, which makes it easier for SFVs to enter the market (Rane, 2011).

SFVs, who are usually untrained in food handling and sanitation, often operate their businesses informally with minimal regulation from the government (Alimi, 2016; IFRA, 2016; Imathiu, 2017; Muinde and Kuria, 2005). This gives an opportunity for activities that may severely impair the wholesomeness of street foods with the potential to cause serious food safety concerns to consumers. Published reports especially from developing countries generally indicates that SFVs primarily sell from crowded places such as open air markets and bus terminus so as to attract consumers (Kariuki et al., 2017). Thus, the vending sites are often unsanitary lacking basic infrastructures such as toilets, potable water supply, handwashing facilities, waste disposal systems, and good drainage systems. Vending sites such as those close to waste disposal sites provide ideal breeding sites for rodents and insects which can easily contaminate the foods with food safety hazards (Imathiu, 2017). Similarly, foods sold on the roadsides which are often dusty and contaminated with exhaust fumes from vehicles may easily be contaminated with chemical food safety hazards such as polycyclic aromatic hydrocarbons, as well as lead and arsenic which have been found to be carcinogenic (Omari and Omari, 2019).

Due to the informal nature of these businesses, compliance with food laws as well as the enforcement of the same may not always be possible. Thus, the hygiene and sanitary condition of vending structures as well as the vending environments may be compromised with the possibility of foodborne diseases posing public health risks to the consumers of these foods (Okojie and Isah, 2014; WHO, 2015). In Kisumu County in Kenya, Ouma et al. (2019) reported the presence of *Staphylococcus aureus* in water used by SFVs. These deficiencies in street food vending environments have been linked to numerous foodborne disease outbreaks, especially microbial illnesses (Alimi, 2016; Cortese et al., 2016). Furthermore, the chance of adulteration of food with unlicensed harmful substances or the sale of uncertified low quality, low priced food substances is high which can pose further food safety risks to the consumers of street vended foods (Kumar et al., 2019). Therefore, the quality and safety of street vended foods are of great concern for public health, as consumers are constantly exposed to

the risk of illness every time, they consume these foods.

Due to the unsafe practices reported among SFVs, the scarce funds in the developing countries that could have been utilized for infrastructural growth are being harnessed to treat disease outbreaks that could have been prevented through the provision of safe foods (Alimi, 2016). However, there are minimal reports on the handling practices and the level of food safety knowledge among SFVs in Kenya, especially in the fast-growing towns such as Thika town. On several occasions, especially through media, cases of microbial foodborne illnesses have been reported in these areas. Therefore, there is a need to determine the food hygiene practices and food safety knowledge of SFVs so as to identify gaps where interventions can be recommended and/or applied in order to ensure provision of quality and safe street vended foods and help alleviate incidences of foodborne diseases.

MATERIALS AND METHODS

Study design and study site

A cross-sectional descriptive study was conducted on SFVs in six street food vending locations in Kiambu county, Kenya between June and July 2019. The study locations included the area surrounding Thika Level 5 Hospitals: Juakali, Kiandutu, Makongeni, Ngoigwa, and Thika Town center.

Sampling procedure for street food vendors

Since the total population of SFVs in the study site was unknown, determination of the number of SFVs to be used in this study was carried out using the formula described by Kothari (2004) (Equation 1). This equation yielded 385 SFVs. The SFVs were randomly selected from among the individuals who were found vending street foods at the time of data collection. No prior notification had been sent to the SFVs to inform them of the data collection exercise.

$$n = \frac{z^2 p(1-p)}{d^2} \quad (1)$$

Where: n is the sample size, z is the z statistic at 95% confidence level (z = 1.96), p is the estimated population proportion, taken as P=0.5 (maximum variability), e = the desired precision level of ±5% at 95% confidence level.

In this study, street vendors were defined as individuals selling RTE foods in open places whether mobile or in stationary locations along the streets or in public places. The inclusion criteria were as follows: (a) vendors must be on the street, mobile or located in standard locations with temporary structures and (b) vendors must be selling any RTE foodstuff that does not require further processing by the consumer prior to consumption. Out of the total number of identified SFVs, only 345 consented to take part in this study.

Questionnaire design and SFV interviews

The questionnaire designing process was guided by relevant information from previous literature and the guidelines provided by

Table 1. Demographic characteristics of SFVs in selected locations in Thika sub-county, Kiambu county, Kenya.

Parameter		Frequency	Percentage
Gender	Female	127	36.8
	Male	218	63.2
	Total	345	100.0
Age category	Below 18 years	2	0.6
	Between 18 - 25 years	113	32.9
	Between 26 - 35 years	158	46.1
	Between 36 - 45 years	46	13.4
	Above 45 years	24	7.0
	Total	343 [‡]	100.0
Education level	No formal education	10	2.9
	Incomplete primary school	26	7.7
	Completed primary school	78	23.0
	Incomplete secondary school	61	18.0
	Completed secondary school	129	38.1
	College education	27	8.0
	University education	8	2.4
	Total	339 [‡]	100.0

[‡]Some vendors did not reply to certain questions.

WHO (1996) regarding street food vending hygiene and safety practices. The questions covered the sources of raw materials or RTE foodstuffs sold, storage and or preservation of raw materials and RTE foodstuffs during sale as well as food preparation and temperature control. In addition, the questions also covered hygiene and sanitation knowledge and practices, awareness of the potential food safety hazards in the food products, knowledge of food safety standards and food contamination. The questionnaire was pretested and administered through a face-to-face interview by six appointed individuals.

Assessment tool for observation of street food vendor practices

An assessment tool for observation of SFVs' practices was administered to each vendor to determine their compliance with the essential hygiene and safety requirements for SFVs outlined by WHO (1996). The checklist was used to collect information regarding personal hygiene practices, food handling practices and the condition of the vending environment. For each vendor, the hygiene and sanitary status of the vending place, the garbage collecting bin, and the vending environment was determined subjectively using a 3-point rating scale as follows: "good" if it was found to be extremely clean, "average" if the place of vending was moderately clean with efforts put in place to clean the place and "poor" if the place of vending was dirty. The checklist was filled through observation by the 6 appointed data collectors immediately after the interview for each SFV was completed.

Consent to collect information from street food vendors

Permission to carry out this study was obtained from the National Commission for Science and Technology (NACOSTI) and from the county Commissioner for Kiambu county, Kenya (Research permit number: NACOSTI/P/19/87469/31129). In the actual survey, the participants were notified of the objective of the study and that the

information they were going to provide would be held confidential. They were further notified that participation was entirely voluntary and that they could opt-out of the survey at any time during the interview.

Statistical analysis

The data obtained were analyzed using the statistical package for social sciences (SPSS) software, version 25. For categorical data, frequencies and percentages of occurrence of responses were calculated while numerical data were summarized as means \pm standard error. A Chi-square test of independence was used to test whether there were significant relationships between the categorical variables. All tests were carried out at $P=0.05$ level of significance.

RESULTS AND DISCUSSION

Socio-demographic characteristics of street food vendors

There were more male SFVs (63.2%) compared to female vendors (36.8%) (Table 1). Although food preparation is regarded in African society as the preserve for females, men are stepping up and picking up roles that were traditionally set aside for females, especially to gain income. This may explain the high proportion of male vendors in street food vending in this study. These results are in agreement with those of Cortese et al. (2016) who reported more male (58%) than female (42%) in street food vending business in Brazil. However, contrary to this study, Odundo et al. (2018) and Da Silva et al. (2014) reported female dominance in street food vending at 60 and 55.9% in Kenya and Brazil,

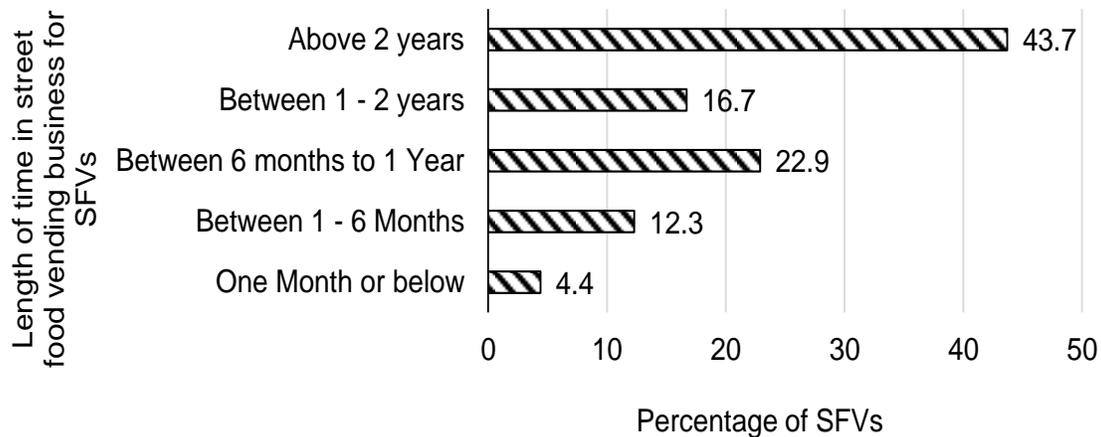


Figure 1. Street food vendors' length of time in street food vending business.

respectively. This is not surprising since the extent to which different communities adhere to perceived gender roles is greatly influenced by many factors especially when the socio-economic aspects of life are considered. Thus, even though certain roles are played by women, men may step in to undertake such roles so as to earn a living as reported in this research.

About a third of the SFVs (32.9%) were between 18-25 years old (Table 1). This category constitutes the relatively young and economically vibrant workforce who may be able to cope up with the laborious tasks involved in street food vending (Adama, 2020). Similar results were reported by Odundo et al. (2018) in Mombasa county, Kenya in a study investigating food safety practices among SFVs where the most predominant age group was found to be 19-28 years accounting for 49% of the SFVs.

The study revealed that 38.1% of the SFVs had obtained secondary school education with 10.4% having received college or university training. Only 10.6% of the vendors had not either completed primary school education or attained any formal education (Table 1). Having completed secondary education level as well as college and university training may imply that SFVs are offering better quality and safe food since the level of the SFVs' formal schooling is one of the factors that contribute to food safety (Rebouças et al., 2017). Generally, higher levels of education imply higher food hygiene and safety knowledge (Ma et al., 2019). The findings of this study differed with those of Ma et al. (2019) who reported that the majority of SFVs (68%) in Handan, China, were either illiterate or having attained primary or middle school education (level of education between high school and primary school). This may be because most SFVs may lack the opportunity to pursue secondary, college or university education possibly due to lack of funds. Nevertheless, some vendors may consider street food vending as an opportunity to begin their entrepreneurial endeavors. This shows that street

food vending is dynamic and may appeal not only to persons who are less educated but also to those who have attained college or university education.

Length of time in street food vending business

The length of time spent in street food vending business may positively correlate with the level of food hygiene and safety knowledge that the vendor has gathered over time. Vendors who have been in business for a long time are therefore expected to have better food hygiene and safety knowledge, although this is not always the case (Gamieldien and Van Niekerk, 2017). The mean duration of time in business was 3.3 ± 0.2 years with a median of 2 years. The median time of 2 years means that at least 50% of the vendors in this study had been in business for 2 years and below. Thus, there are many entrants into street food vending businesses in Kiambu county, Kenya and that this business may not be a permanent career for most SFVs. This is clearly shown by the large proportion of almost 40% of vendors who had been in business for one year and below (Figure 1). This differs from the findings of Da Silva et al. (2014) who reported that the median time spent working in street food vending in their study investigating the socioeconomic and food safety perspectives of SFVs at the coast of Salvador, Bahia, Brazil was 9 years. This meant that at least 50% of the vendors had been in business for at least 9 years which is higher than the median time reported in this study of 2 years.

There were significantly ($P < 0.001$) more vendors aged between 18 to 25 years who had been in business for one year and below as compared to those in the other age categories (Figure 2). This age group comprises the young and most vibrant persons who may have probably completed their secondary or tertiary education and in need of a job to earn a living. Street food vending being an inexpensive venture to start provides an avenue for them to start.

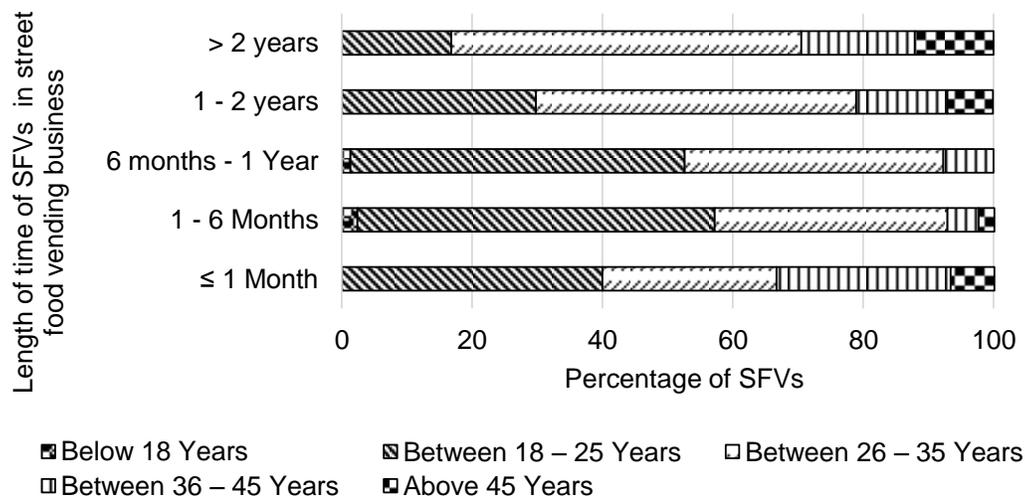


Figure 2. Relationship between age category and the duration of time in business.

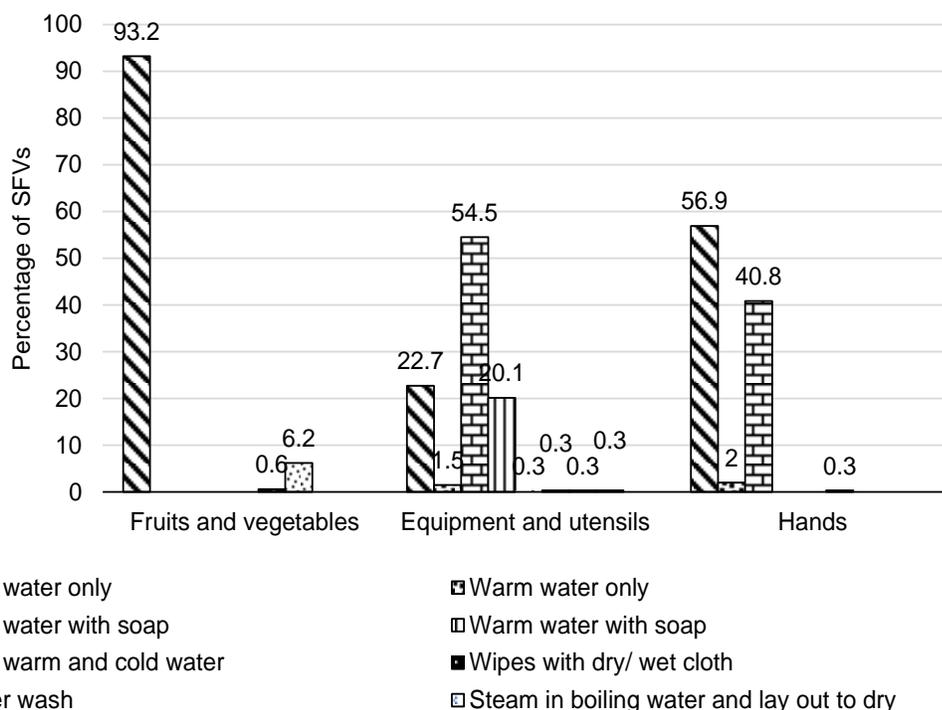


Figure 3. Washing practices for hands, equipment and fruits and vegetables.

Washing practices for hands, equipment and utensils

Washing practices for hands, equipment, utensils, and foodstuff among the SFVs are shown in Figure 3. Most vendors (56.9%) washed their hands using cold water only. Only 40.8% used cold water with soap to wash their hands. Regarding washing of equipment and utensils, 54.5% of SFVs washed them using cold water and soap

and only 20.1% used warm water with soap. According to the WHO (1996), essential food safety guidelines for SFVs, vendors should wash their hands with water and soap every time they engage in any activity that may introduce physical, biological or chemical hazards in food. Thus, washing hands and utensils with cold water only may not be sufficient in removing all food safety hazards unlike washing with water and soap (Shukla et al., 2019).

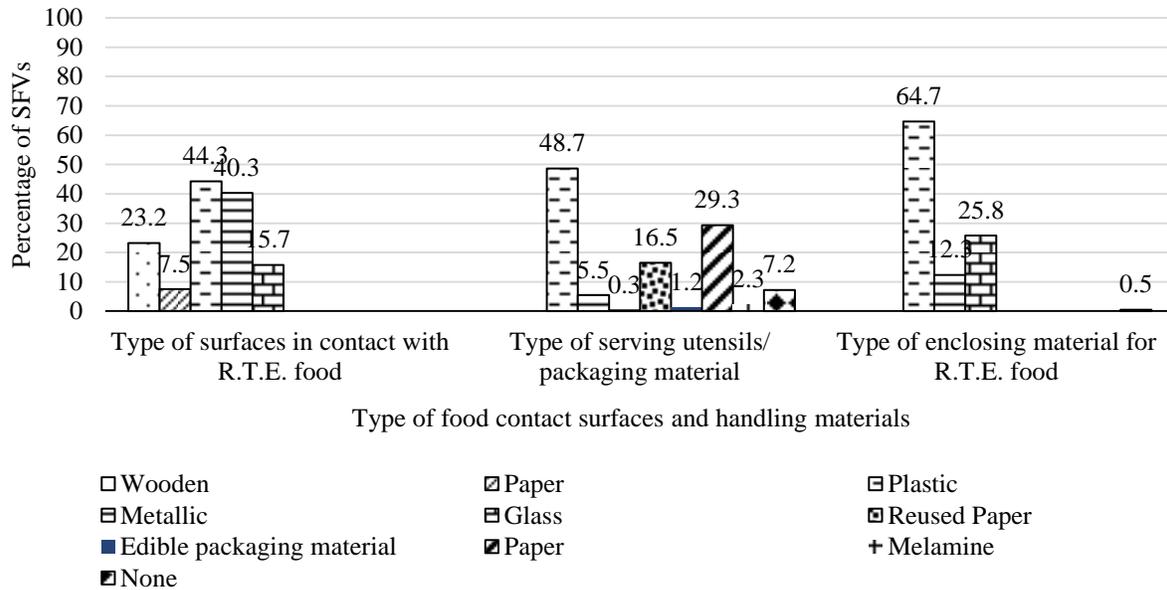


Figure 4. Type of materials used for working surfaces, closures, serving utensils and/or packaging materials. Percentages are above 100% due to SFVs who used multiple packaging and food handling materials.

This implies that there is a high potential for contamination of street vended food due to insufficient hand and utensils washing practices. These results were consistent with the results reported by Muyanja et al. (2011) who studied the practices, knowledge and risk factors of SFVs in Uganda where 76.9% of SFVs used cold water and soap, 7.6% used cold water only while 2.2% and 7.6% used hot water only or hot water with soap, respectively to wash their utensils. SFVs must possess good hand, equipment, and food washing practices involving the use of water and soap to ensure the safety of RTE food (Dudeja and Singh, 2017).

Handling of ready-to-eat food, utensils and packaging materials by street food vendors

About 48.7% of the vendors had plastic serving utensils or packaging materials, while 29.3% were found to be using paper. Reused papers such as papers used to cover other food or non-foodstuff were found in use to wrap foodstuffs in 16.5% of the SFVs (Figure 4). The use of recycled packaging materials can contaminate food with food safety hazards such as pathogenic microorganisms or chemical residues that may be hazardous to the public (Proietti et al., 2014). For instance, recycled paper has been reported to contribute to the exposure of consumers to thousands of toxicants including endocrine-disrupting chemicals such as bisphenol-A, dibutyl phthalate, as well as di-2-ethylhexyl phthalate (Geueke et al., 2018; Lopez-Espinosa et al., 2007). In Ethiopia, Eliku (2016) reported that over 90% of SFVs used recycled paper for packaging food.

Storage and preservation practices of ready-to-eat food by street food vendors

It was found that some vendors would store their stock, including the foodstuff that required refrigeration at ambient temperatures (78.3%) awaiting preparation and eventual sale. Most RTE foods (38.6%) were also stored at ambient temperatures. Temperature abuse by exposing food to ambient conditions encourages a wide range of spoilage and pathogenic microorganisms to proliferate causing infections and intoxications when the food is consumed (Obaji et al., 2018; Ouma et al., 2019; Shiningeni et al., 2019). Similar results were reported by Muhonja and Kimathi (2014) in Nakuru county, Kenya while assessing the hygiene and food handling practices among SFVs where cooked foods were stored at ambient temperatures exposed to the environment during sale which posed significant safety concerns.

SFVs used various methods to handle leftover food from the days' sales as shown in Figure 5. About 25.5% of the vendors indicated that they would consume the leftovers while 22.3% stored the foodstuffs without any form of preservation and sold them the following day. Leftover food can easily be contaminated by especially pathogenic microorganisms when stored under ambient temperatures posing safety concerns to the consumers (Obaji et al., 2018). This is worrying considering the poor handling and storage practices that the foods are exposed to during the day. In case the food was contaminated with pathogens, storage at ambient temperatures allows the pathogens to proliferate to levels that can cause disease or produce toxicants that cause disease when the food is consumed. Similar results were

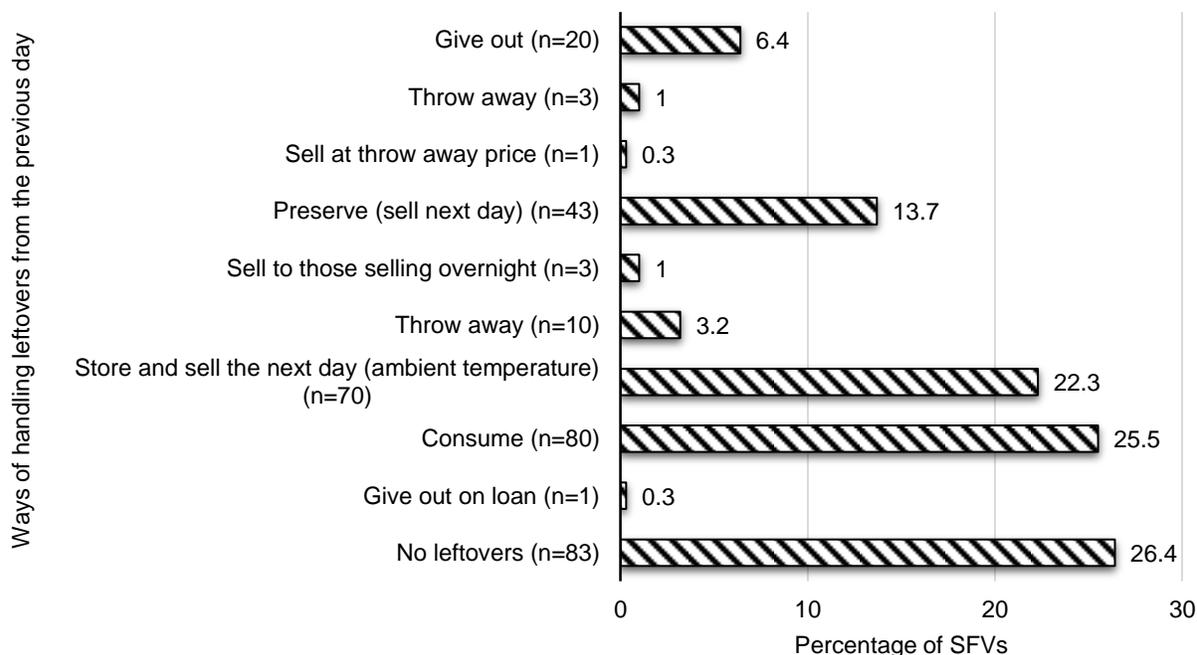


Figure 5. Street food vendors' ways of handling leftovers from the previous day.

reported by Muhonja and Kimathi (2014) in Nakuru county, Kenya, while studying the hygiene and food handling practices among SFVs who found out that SFVs mostly stored leftover foods at ambient temperatures.

Personal hygiene of street food vendors

Poor hygiene and sanitary practices were observed among most of the SFVs as shown in Figure 6. For instance, 86.1% of the vendors handled money while serving food without washing hands. The continuous exchange of money between individuals has potential for contamination with hazards, especially pathogenic microorganisms. Handling the money while serving RTE food can potentially result in contamination of these foods. In a study carried out to determine the microbial contaminants in banknotes obtained from food outlets sampled from 10 different countries, Vriesekoop et al. (2010) reported the presence of *Escherichia coli*, which is indicative of fecal contamination of the money. Furthermore, *Salmonella* and *S. aureus* were also isolated. Similar results were observed by Da Silva et al. (2014) who reported that 80.2% of the SFVs admitted to handling money and food simultaneously in Brazil.

Only 56.8% of the vendors wore aprons of which, only 58.1% had clean aprons. Almost all SFVs (96.8%) in this study handled food with bare hands while about 70.6% had not covered their hair. Clearly, most vendors in Kiambu county overlook basic hygiene practices that have the potential to contaminate food with hazardous

substances. According to WHO (1996), street vendors should wear clean aprons, handle food using clean gloves, cover their hair and wash their hands every time before handling food. Similar results were reported in Ethiopia by Eliku (2016) on their study investigating food hygiene and sanitary practices of SFVs in the city of Addis Ababa. In their study, they reported that 88.6% of vendors did not wear aprons, 95% had uncovered hair while all street vendors (100%) handled money with bare hands while serving food. This shows that street vended foods could be a public health concern considering the safety issues that could be posed to the consumers of these foods.

Long nails (20.9%) as well as nail polish (15.5%) were found among SFVs in this study. Since long nails may harbor pathogenic microorganisms (Ansong, 2015), these can end up contaminating food, considering that almost all vendors (96.8%) in this study handled food with bare hands. Muyanja et al. (2011) reported similar findings in their study on the practices, knowledge and risk factors of SFVs in Uganda where 68.6% of the vendors had uncut nails while 75.7% had unclean nails in one of their study locations. A few vendors were found to be smoking (2.0%) or spitting, sneezing or coughing near RTE food (6.2%). These practices heighten the chance for contamination of food with physical, chemical or biological food safety hazards. They can also be avenues for the transfer of communicable diseases from ailing SFVs to the many consumers of street vended foods. Smoking among SFVs was reported by Ma et al. (2019) in Handan, China, where it was reported in 30% of the

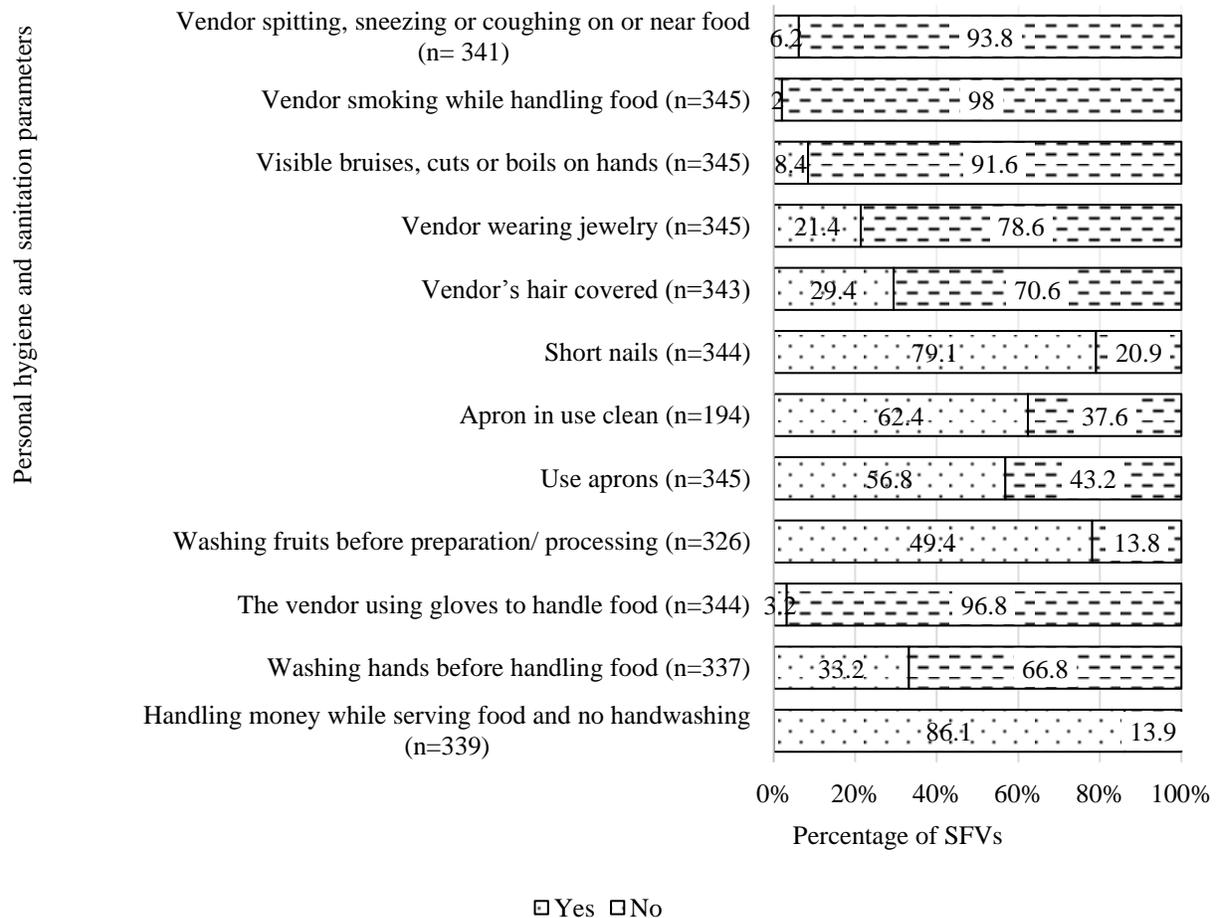


Figure 6. Observations on personal hygiene and practices of SFVs.

vendors.

Condition of the vending environment and the vending structures

Most vendors had temporary stalls constructed (44.2%) or used trolleys (24.7%) to display their foodstuff. Others utilized carts, tables, wheelbarrows or car trunks to sell their foodstuffs. Most vendors sold foodstuff in dirty surroundings (54.7%) and only 45.3% were in clean areas. The choice of vending structures, as well as vending location, can impact the quality and safety of street vended foods (Bormann et al., 2016). Selling RTE food using uncovered structures such as wheelbarrows, carts, tables and car trunks located in unhygienic environs may result in contamination of food with food safety hazards during preparation or service. Vending sites such as those close to waste disposal sites provide ideal breeding sites for rodents and insects which can easily contaminate the foods with food safety hazards especially pathogenic microorganisms (Imathiu, 2017).

Similarly, foods sold on the roadsides which are often dusty and contaminated with exhaust fumes from vehicles may easily be contaminated by chemical hazards such as polycyclic aromatic hydrocarbons, lead and arsenic (Omari and Omari, 2019).

There was a highly significant relationship ($P=0.0001$) between the hygiene and sanitary status of the vending structures, and the condition of the surrounding environment. Almost all the vendors (98.6%) selling around dirty environments had vending structures with poor hygiene and sanitary status. Therefore, dirty surroundings would result in unclean working surfaces and vending structures that were rated as having poor hygiene and sanitary status.

Garbage collecting bins were only found in 53.8% of the vendors of which only 36.4% were adequately covered and 20.9% were overfilled. Poor waste management results in contamination of the environment which in turn increases the chance of contamination of the RTE food during handling (Reddy et al., 2020; Tamnekar et al., 2008). As expected, vendors working without a dustbin were more likely to be in dirty

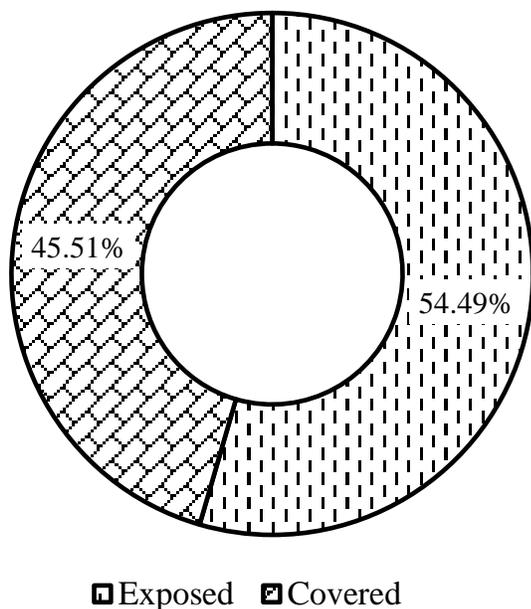


Figure 7. Proportion of SFVs whose serving utensils or packaging material were exposed.

surroundings than those who had dustbins ($P=0.0001$). The lack of waste management results in the dumping of wastes around the vending premises. The waste attracts flies and other crawling insects that were noted in about 52.4% of the SFVs' premises in this research. These, in turn, may contaminate the working surfaces, utensils as well as the exposed RTE food. In this research, more than half of the vendors left the packaging materials or serving utensils exposed (Figure 7). Similar results were reported in Benin city, Nigeria in a study on the sanitary conditions of vending sites where waste bins were found in 43.4% of the SFVs (Okojie and Isah, 2014). Okojie and Isah (2014) also reported the presence of flies in 41.3% as well as rodents and cockroaches in 2.4% of the SFVs' premises. This shows that insect control is an important aspect of street food vending business. This is because the presence of insects as well as rodents have been reported to increase the chance of having contaminated food among SFVs (Amaami et al., 2017). While studying environmental factors and food handling practices associated with food contamination among SFVs in Nairobi county, Kenya, Amaami et al. (2017) found out that the presence of pests or rodents around street food vending sites was significantly associated with food contamination ($P<0.001$), with SFVs who reported presence of pests or rodents having a 5.9-fold risk of having contaminated foods.

Training in food hygiene and safety of street food vendors

About 93% of SFVs have no training in food hygiene and

safety. Training of SFVs on food hygiene and safety is expected to equip them with the right knowledge that will enhance the quality and safety of the foods sold. The lack of training for most of the vendors greatly contributed to the vendor's poor knowledge of food safety and unhygienic behavior. With this gap in knowledge, vendors hardly pay attention to the cleanliness of the surrounding area or the safe handling practices for RTE food. The results were comparable to those reported by Okojie and Isah (2019) in their study on food hygiene knowledge and practices of SFVs where 73.9% of SFVs in Benin City, Nigeria had no formal food safety training. This explains the need for training SFVs on food hygiene as well as food safety to preserve and protect the health of consumers. Training interventions on SFVs have been reported to be effective in changing their attitudes to food safety knowledge as well as the practices (Choudhury et al., 2011).

When vendors were asked if street vended food could be a source of pathogenic microorganisms, about 40.1% strongly agreed; 16.7%, neither agreed nor disagreed; while 39.8 and 3.5% disagreed or strongly disagreed, respectively. Although about 40.1% of the vendors knew that pathogenic microorganisms could be found in street food, a substantial proportion (59.9%) of the SFVs was not aware of this possibility. This shows that most SFVs may be operating without the knowledge that foods could be sources of pathogens that can cause diseases in humans. With this gap in knowledge, SFVs would hardly put effort into reducing or eliminating contamination of RTE foods with pathogenic bacteria. For instance, in the case of fruit juices that have the potential for contamination during preparation, most vendors (87.5%) in this study did not subject them to heat treatment (Figure 8). This further makes street vended foods a significant public safety concern in Kenya.

Enforcement of food safety regulations among street food vendors

Seventy-three percent of the SFVs had not obtained a food handlers' medical certificate. For the vendors who had a food handler's medical certificate, 42% of them never renewed it while about 1% of them renewed it within 3 months, 30% within 6 months and 27% within 12 months. This is possibly due to factors such as ignorance, or weak enforcement of this requirement by the local government authority concerned (Okojie and Isah, 2019). Undertaking a medical fitness examination or the screening for communicable diseases for any food handler is a requirement outlined in the public health Act, Chapter 242, 2012 of Kenya. Having a medical health certificate is important as it confirms that the handler has no communicable diseases and that the consumer is not at the risk of contracting such diseases. Although mandatory, most SFVs evade taking the examination

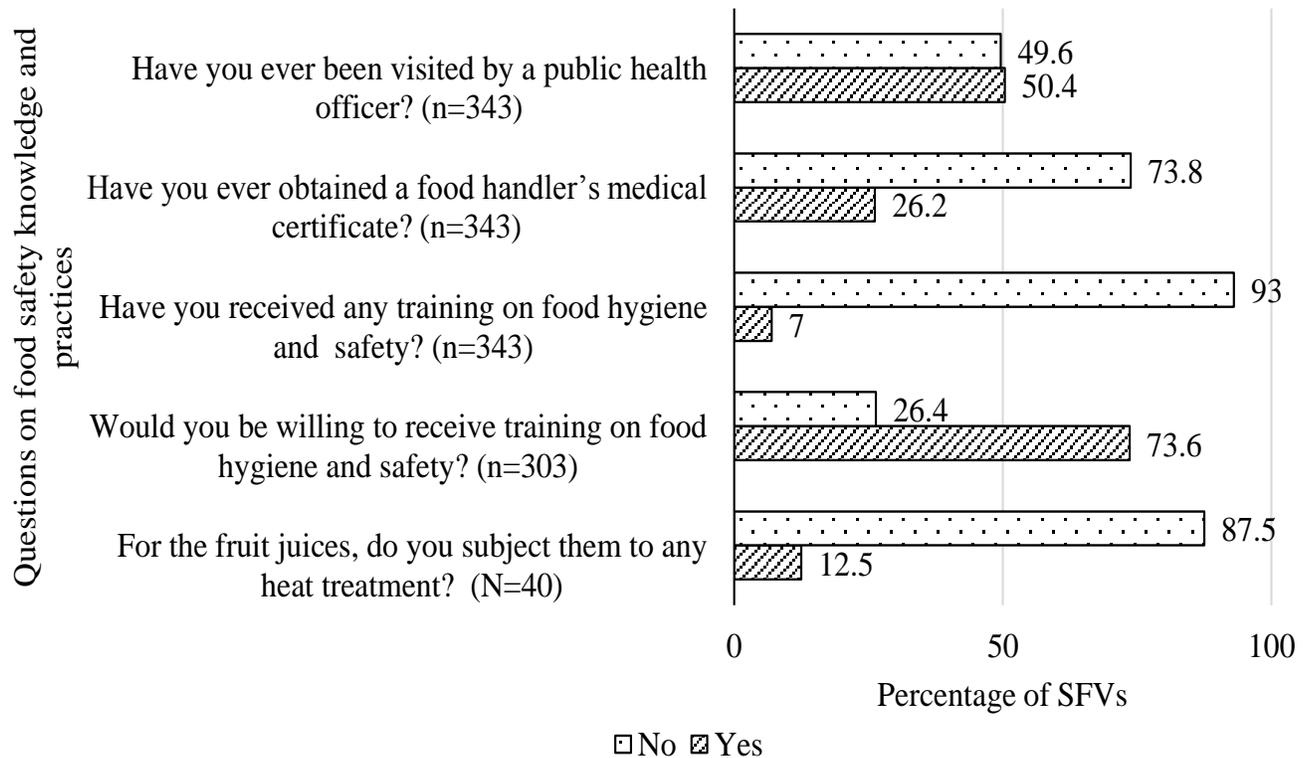


Figure 8. Food safety knowledge and practices.

possibly because it requires the commitment of not only money but also time (Apaassongo et al., 2016). This shows that SFVs may opt to sell foods even when they are not medically fit to handle food which poses food safety concerns due to the possibility of the spread of communicable diseases. Improved public health control can enhance compliance with food hygiene and safety guidelines in street food vending.

About 50% of the vendors indicated that they had never been visited by public health officials. Lack of oversight on street vended foods presents an opportunity for vendors to sell food even when they are not medically fit to handle food. It may also increase the chance for adulteration of food with unlicensed harmful substances or the sale of uncertified low-priced food substances that may be harmful to the unsuspecting public. The vendors who received visits from the public health officers were more likely to have a food handler's medical certificate ($P < 0.0001$). This underlines the importance of public health officers' oversight on food vending businesses. Continuous surveillance as suggested by Obaji et al. (2018) is therefore required as a strategy towards improved street food safety.

Conclusion

The findings of this study demonstrate that street vended

foods sold in Kiambu County, constitute a significant potential hazard to public health. Majority of SFVs were educated to secondary school level and had not received any formal training on food hygiene and safety. The lack of training for most of the vendors may have contributed to their unhygienic behavior and poor knowledge of food hygiene and safety. Of particular concern were the findings that almost all SFVs handled food with bare hands, and handled money and food at the same time without washing hands after. Storage and preservation practices were poor as most vendors stored the RTE food including leftovers at ambient temperature. For most vendors, the condition of the vending environment, as well as the vending structures, were also poor. Considering the benefits of the street vending business, including the provision of income and employment for many young people, the inclusion of these businesses in street design may not only benefit the SFVs but also the consumers of street foods through the provision of high quality and safe foods. Continuous provision of food hygiene and safety training to the SFVs, and enforcing the implementation of appropriate food hygiene and safety practices has the potential to improve street food quality and safety. Policies specific for the street food vending sector may streamline the sector and facilitate control and regulation by public health officials. Further research on the microbial and chemical quality and safety of street vended food is required taking into account the

poor hygiene and safety practices reported in this study.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGMENTS

The authors thank the German Academic Exchange Service (Deutscher Akademischer Austauschdienst – DAAD) for financial support.

REFERENCES

- Adama O (2020). Abuja is not for the poor: Street vending and the politics of public space. *Geoforum* 109:14-23.
- Alimi BA (2016). Risk factors in street food practices in developing countries: A review. *Food Science and Human Wellness* 5(3):141-148.
- Amaami AJ, Dominic D, Collins D (2017). Factors associated with poor food safety compliance among street food vendors in the Techiman Municipality of Ghana. *African Journal of Food Science* 11(3):50-57.
- Ansong RA (2015). Factors Contributing to the 2014 High Cases of Cholera in the La Dade-Kotopon Municipality, Accra (Doctoral dissertation), University of Ghana.
- Apaassongo IL, Aidoo R, Ohene-Yankyera K (2016). Securing safe food, order in cities and protected urban livelihoods: Modelling of preference for regulations of informal street food trade in Kumasi. *World Development Perspectives* 3:1-6.
- Bormann F, Adzinyo O, Letsa L (2016). Safety and hygiene status of street vended foods in Ho, Ghana. *Journal of Hospitality Management and Tourism* 7(2):25-32.
- Choudhury M, Mahanta L, Goswami J, Mazumder M, Pegoo BJFC (2011). Socio-economic profile and food safety knowledge and practice of street food vendors in the city of Guwahati, Assam, India. *22(2):196-203*.
- 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.
- Da Silva SA, Cardoso RdCV, Góes JAW, Santos JN, Ramos FP, de Jesus RB, da Silva PST (2014). Street food on the coast of Salvador, Bahia, Brazil: A study from the socioeconomic and food safety perspectives. *Food Control* 40:78-84.
- Dudeja P, Singh A (2017). Food handlers. In *Food Safety in the 21st Century* (pp. 269-280): Elsevier.
- Eliku T (2016). Hygienic and Sanitary Practices of Street Food Vendors in the City of Addis Ababa, Ethiopia. *Food Science and Quality Management* 50(2016):32-38.
- Gamielien F, Van Niekerk L (2017). Street vending in South Africa: An entrepreneurial occupation. *South African Journal of Occupational Therapy* 47(1): 24-29.
- Geueke B, Groh K, Muncke J (2018). Food packaging in the circular economy: Overview of chemical safety aspects for commonly used materials. *Journal of Cleaner Production* 193:491-505.
- Hill J, McHiza Z, Puoane T, Steyn NP (2019). The development of an evidence-based street food vending model within a socio-ecological framework: A guide for African countries. *PloS One* 14(10).
- IFRA (2016). Urbanization and Street Vending: How street vending, an individual and a collective resource, can be integrated into the urban governance? . Retrieved from The French Institute for Research in Africa, Nairobi: http://ifra-nairobi.net/wp-content/uploads/2016/12/Report-Urbanization-and-Street-Vending_edited_online_99dec.pdf.
- Imathiu S (2017). Street Vended Foods: Potential for Improving Food and Nutrition Security or a Risk Factor for Foodborne Diseases in Developing Countries? *Current Research in Nutrition and Food Science Journal* 5(2):55-65.
- Kariuki EN, Waithera Ng'ang'a Z, Wanzala P (2017). Food-handling practices and environmental factors associated with food contamination among street food vendors in Nairobi County, Kenya: A cross-sectional study. *EA Health Research Journal* 1(1):62-71.
- Kothari CR (2004). *Research methodology: Methods and techniques: New Age International*.
- Kumar R, Kharya P, Jain PK (2019). Your daily life covered with harmful chemicals: A review on food adulteration. *Progressive Agriculture* 19(2):262-265.
- Lopez-Espinosa MJ, Granada A, Araque P, Molina-Molina JM, Puertollano MC, Rivas A, López C (2007). Oestrogenicity of paper and cardboard extracts used as food containers. *Food Additives and Contaminants* 24(1):95-102.
- Ma L, Chen H, Yan H, Wu L, Zhang W (2019). Food safety knowledge, attitudes, and behavior of street food vendors and consumers in Handan, a third tier city in China. *BMC Public Health* 19(1):1128.
- Moussavi P, Liguori K, Mehta K (2016). Street Foods in Central Kenya: Actors, Trends, and Opportunities. *International Journal for Service Learning in Engineering, Humanitarian Engineering Social Entrepreneurship* 11(2): 87-100.
- Muhonja F, Kimathi GK (2014). Assessment of hygienic and food handling practices among street food vendors in Nakuru Town in Kenya. *Science Journal of Public Health* 2(6):554-559.
- Muinde OK, Kuria E (2005). Hygienic and sanitary practices of vendors of street foods in Nairobi, Kenya. *African Journal of Food, Agriculture, Nutrition* 5(1).
- Muyanja C, Nayiga L, Brenda N, Nasinyama G (2011). Practices, knowledge and risk factors of street food vendors in Uganda. *Food Control* 22(10):1551-1558.
- Obaji M, Oli AN, Enweani I, Udigwe I, Okoyeh JN, Ekejindu IM (2018). Public Health challenges associated with street-vended foods and medicines in a developing country: A mini-review. *The Journal of Medical Research* 4(6):283-287.
- Odundo A, Okemo P, Chege P (2018). An Assessment of Food Safety Practices among Street Vendors in Mombasa, Kenya. *International Journal of Health Sciences and Research* 8(5):235-243.
- Okojie PW, Isah EC (2014). Sanitary conditions of food vending sites and food handling practices of street food vendors in Benin City, Nigeria: Implication for food hygiene and safety. *Journal of Environmental and Public Health* pp. 1-6.
- Okojie PW, Isah EC (2019). Food hygiene knowledge and practices of street food vendors in Benin City, Nigeria. *International Journal of Consumer Studies* 43(6): 528-535.
- Omari R, Omari P (2019). The nutrition, safety and health implications of food hawking in traffic. *UNSCN Nutrition*, P. 26.
- Ouma FA, Oyango DM, Kakai R (2019). Source Tracking and Antibiotic Resistance Patterns of Selected Pathogenic Bacteria Isolated from Street Vended Food in Kisumu County, Kenya. *EC Pharmacology and Toxicology* 7:585-596.
- Proietti I, Frazzoli C, Mantovani AJF, Toxicology C (2014). Identification and management of toxicological hazards of street foods in developing countries. *Food and Chemical Toxicology* 63:143-152.
- Rane SJ (2011). Street vended food in developing world: Hazard analyses. *Indian Journal of Microbiology* 51(1): 100-106.
- Rebouças LT, Santiago LB, Martins LS, Menezes ACR, Araújo MdPN, de Castro Almeida RC (2017). Food safety knowledge and practices of food handlers, head chefs and managers in hotels' restaurants of Salvador, Brazil. *Food Control* 73:372-381.
- Reddy AA, Ricart S, Cadman T (2020). Driving factors of food safety standards in India: Learning from street-food vendors' behaviour and attitude. *Food Security: The Science, Sociology and Economics of Food Production and Access to Food*, pp. 1-17.
- Shiningeni D, Chimwamurombe P, Shilangale R, Misihairabgwi J (2019). Prevalence of pathogenic bacteria in street vended ready-to-eat meats in Windhoek, Namibia. *Meat Science* 148:223-228.
- Shukla N, Roy M, Hirpurkar S, Prakash O (2019). Assessment of community knowledge, Attitude and practices on Milk Hygiene and milk borne zoonosis in tribal area of the Surajpur District of Chhattisgarh. *International Journal of Chemical Studies* 7(3):

- 3082-3085.
- Tambekar DH, Jaiswal VJ, Dhanorkar DV, Gulhane PB, Dudhane MN (2008). Identification of microbiological hazards and safety of ready-to-eat food vended in streets of Amravati City, India. *Journal of Applied Biosciences* 7:195-201.
- Vriesekoop F, Russell C, Alvarez-Mayorga B, Aidoo K, Yuan Q, Scannell A, Otokunefor K (2010). Dirty money: an investigation into the hygiene status of some of the world's currencies as obtained from food outlets. *Foodborne Pathogens and Disease* 7(12):1497-1502.
- WHO (1996). Essential safety requirements for street-vended foods. Geneva, Switzerland: Food Safety Unit, Division of Food and Nutrition, World Health Organization.
- WHO (2015). WHO estimates of the global burden of foodborne diseases: foodborne disease burden epidemiology reference group 2007-2015. Retrieved from http://www.who.int/iris/bitstream/10665/199350/1/9789241565165_eng.pdf.