Journal of Food, Nutrition and Diet Science
https://ojs.luminescience.cn/FNDS

LUMINESCENCE
https://luminescience.cn/

Original Research

Factors influencing health, food safety and hygiene practices among street food vendors in Meru town, Kenya

Johnson Mwove

Department of Food Technology, Chuka University, P. O. Box 109-60400, Chuka, Kenya
Correspondence to: Johnson Mwove, Email: jmwove@chuka.ac.ke

Abstract: Street food vending is a popular and essential aspect of urban food culture in many African cities, including Meru Town, Kenya. However, concerns about food safety and hygiene have become significant public health issues. This research aimed to investigate the factors influencing the health, food safety and hygiene practices among Street Food Vendors (SFVs) in Meru Town, Kenya. A cross-sectional study on 344 SFVs was carried out using structured questionnaires. The results revealed a clustering of SFVs in four locations within Meru town. Slightly more respondents were male (50.87%) than female (49.13%). The majority of SFVs were aged between 26-35 years old (38.66%) and had completed secondary education (50.29%). On average, the vendors had been in business for 5.13 years with an average daily income of KES 1,417.38. Age significantly ($p = 0.0335$) influenced the occurrence of health issues among SFVs, with vendors aged 26-35 years being more likely to fall sick. There was a highly significant association between education level and training on food hygiene and safety ($p < 0.0001$), training on food preparation ($p = 0.0119$), and holding a food handlers' certificate ($p < 0.0001$). Factors significantly ($p < 0.01$) influencing food hygiene practices included vending location, vendors' education level, gender, age, food handler's health certification, and vendor mobility. Poor hygiene and food handling practices were reported that 97% of vendors handled food with bare hands, 75.29% handled food without washing their hands and 92.44% did not wash their hands after handling money. Targeted interventions and awareness programs to improve food hygiene and safety among SFVs in Meru Town are needed to safeguard public health.

Keywords: Urban food culture, Public health, Street food design, Safe food, Food safety awareness

1. Introduction

The street food industry is a significant sector in many countries, impacting the economy and providing accessible and convenient food options to consumers [1, 2]. However, street foods have been marked as a public health issue in many places as they can be contaminated with toxic chemical and microbiological pollutants [3]. Furthermore, poor food safety and hygiene practices among SFVs have also been reported [4, 5]. Adane, Teka [6] discovered that food handlers in food establishments generally demonstrated better food hygiene and safety practices compared to SFVs. Biswas, Dasgpta [7] reported the presence of pathogens among food handlers in Chetla, Kolkata.

Due to poor hygiene and safety practices among SFVs, contamination of street-vended foods with microbiological and chemical contaminants has been reported [8, 9]. Mwove, Imathiu [10] reported the presence of

Received: Jul.12, 2024; Revised: Oct.15, 2024; Accepted: Nov.14, 2024; Published: Dec.13, 2024

DOI: https://doi.org/10.55976//fnds.3202512871-15

Staphylococcus aureus, Salmonella and Escherichia coli in street vended foods in Thika town, Kenya. In addition, aflatoxin B1, lead and cadmium have been detected in street vended foods in Kenya [11, 12]. These toxic chemical and microbiological hazards pose significant health risks to both SFVs and their customers. Therefore, ensuring good food safety and hygiene practices among SFVs is crucial to preventing foodborne illness and safeguarding public health [13, 14].

According to the WHO [15], approximately 600 million people fall ill from consuming contaminated food each year, resulting in 420,000 deaths. In low- and middle-income countries such as Kenya, unsafe food causes billions of losses annually in productivity and medical costs, with children under five years bearing 40% of the foodborne disease burden, leading to 125,000 deaths annually. In Meru town, consumers of street-vended foods have reported health issues from consuming these foods [16]. Thus, monitoring of SFVs is necessary to assess the current status of food hygiene and safety practices, identifying areas for improvement. Therefore, the objective of this study was to determine the factors influencing health, food safety and hygiene practices among SFVs in Meru Town, Kenya.

2. Materials and methods

2.1 Description of the Study area

The study was conducted in Meru town, Meru County, Kenya. Meru town is located in the eastern region of Kenya on the northeastern slopes of Mount Kenya in Imenti North sub-county and serves as the headquarters of Meru County. The town is situated approximately 1,500 meters above sea level and has an equatorial highland climate as it lies 8 km north of the equator. The town covers an area of approximately 150 KM2. As of 2021, it is the seventh-largest urban center in Kenya with a population of about 240,900 residents [17].

2.2 Study design

In October 2022, a cross-sectional study was conducted on 344 SFVs in Meru Town, Meru County, Kenya. The study locations included all the streets that encompass Meru Town.

2.3 Sample size and sampling procedures

The sample size for SFVs was determined using the formula described by Kothari [18] with an estimated population proportion of 0.5 for maximum variability and a desired precision level of 5% at 95% confidence level. This formula resulted in a sample size of 384.16, rounded up to 385 SFVs. In this study, SFVs were defined as people who sell ready-to-eat foods in open areas, whether mobile or stationary on the streets or in public places. Simple random sampling was used to select the vendors in this study. All SFVs were given an equal chance of being selected for this study. For each SFV encountered, a ballot constituting a yes or no response was cast. Those who received a yes were approached and requested to participate. Those who declined the interview were not included.

2.4 Research instruments and data collection

Both a questionnaire and an observation checklist were used for this study. The questionnaire was structured with three sections, including socio-demographic characteristics (6 questions), food safety aspects (7 questions) and SFV's health (1 question). The checklist comprised three sections covering personal hygiene practices (7 questions), environment and vending structures hygiene practices (8 questions) and food handling practices (7 questions). The questionnaire and the observation checklist are presented in the supplementary materials. The instruments were administered to 10 SFVs in Chuka Town, Tharaka Nithi County, bordering Meru County, as part of a pilot study. Based on the feedback received from the pilot study, enhancements were made to refine and prepare the final questionnaire. The interviews were conducted in person by trained enumerators. SFVs were notified that the interview was voluntary and thus they were free to opt out at any time. Prior to the interview, verbal consent was obtained and visual observations were made. The data was mainly collected during the day between 10:00 am and 19:00 pm.

2.5 Statistical analysis

The data obtained from the questionnaires was analyzed using the Statistical Analysis System (SAS) software, SAS OnDemand for Academics (Version 9.4). Frequencies and percentages of response occurrences were calculated for the categorical data, while the numerical data was summarized as means ± standard errors. To examine the independence between categorical variables, a Chi-square test was employed. The T-test for independent samples was used to compare the scores of two samples for gender and food hygiene practice. One-way analysis of variance was used to determine statistically significant differences in mean income and mean duration of street food vending between three or more independent groups. K-means clustering analysis was performed to form SFV clusters, which aimed to group SFVs based on their coordinates (longitude and latitude).

The scores of Food hygiene practice were calculated separately for three categories: personal hygiene practices (7 points), hygiene practices in the street food vending environment (8 points) and food handling practices (7 points). A logistic regression analysis was carried out

to describe the relationship between the food hygiene practice score categories and the following variables: cluster, gender, age, education level, availability of food handlers' certificates and vendor mobility. SFVs with good practices (e.g., with a clean apron) were scored 1, while those with poor practices (e.g., without an apron or with a dirty apron) were scored zero (0). For each SFV, total percentage scores were calculated and categorized as either good (> 50% - above average) or poor (≤ 50%). The goal of this study was to determine the tendency of SFVs to score well on hygiene practice. The overall evaluation of the models was conducted using the likelihood ratio, Wald and score tests. These tests compared the null model (model without predictors) with the model with the additional predictors. A significant test result ($p < 0.05$) indicated that the model with the added variables fits the data significantly better.

3. Results and discussion

3.1 Sociodemographic characteristics of SFVs

3.1.1 Study location

Table 1 shows the SFV clusters adopted in this study. SAS was used to perform a k-means clustering analysis on the dataset. K-means clustering is a data analysis method for partitioning a data set into K-distinct subsets, known as clusters. The goal of clustering is to ensure that the objects within the same cluster are highly similar to each other, while the objects in different clusters are as dissimilar as possible [19]. The analysis aimed at grouping the observations based on their longitude and latitude coordinates. The resulting clusters showed distinct characteristics and were statistically significant. The clustering model achieved an overall R^2 value of 0.76879, suggesting that approximately 76.9% of the variance in the data was explained by the clustering. It was found that the highest percentage of respondents fell into Cluster 4 (40.12%), followed by Cluster 1 (26.16%), Cluster 3 (14.83%) and Cluster 2 (18.90%). The clusters identified in this study represent areas within Meru town that are characterized by high prevalence of street food vending businesses. Consequently, these areas were selected as the focal points for the analysis of SFVs in our research within Meru town.

Table 1. Sociodemographic characteristics of SFVs

Characteristics	Categories	Frequency (%)
Cluster*	1 (0.05042417,37.64644734)	90 (26.16)
	2 (0.04444073,37.65368787)	65 (18.90)
	3 (0.05699551,37.64175151)	51 (14.83)
	4 (0.04611019,37.65773576)	138 (40.12)
Gender	Female	169(49.13)
	Male	175(50.87)
Education Level	No formal education	18(5.23)
	Primary education completed	125(36.34)
	Secondary education completed	173(50.29)
	College level	24(6.98)
	University level	4(1.16)
Age of street food vendor	Under 18 Years	2(0.58)
	19-25 Years	53(15.41)
	26-35 Year	133(38.66)
	36-45 Years	99(28.78)
	46-55 Years	43(12.5)
	Above 55 Years	14(4.07)

*Categories presented as cluster number (latitude, longitude)

3.1.2 Gender, age and education level of SFVs

Table 1 shows the socio-demographic characteristics of SFVs in Meru town. Only 344 SFVs consented to take part in this study and their responses were recorded. Slightly more respondents were male (50.87%) than female (49.13%). Previous research in Kenya has reported the predominance of male vendors in the street food vending business [20]. However, the results were contrary to the findings of Gichunge, Ogachi [21] and Letuka, Nkhebenyane [22] who reported a predominance of female SFVs in street food vending in Ndagani, Kenya and Maseru, Lesotho, respectively. Although cooking is seen as the preserve for females in many African communities [22], the street food environment is dynamic. Thus, men are continually stepping in for the promise of

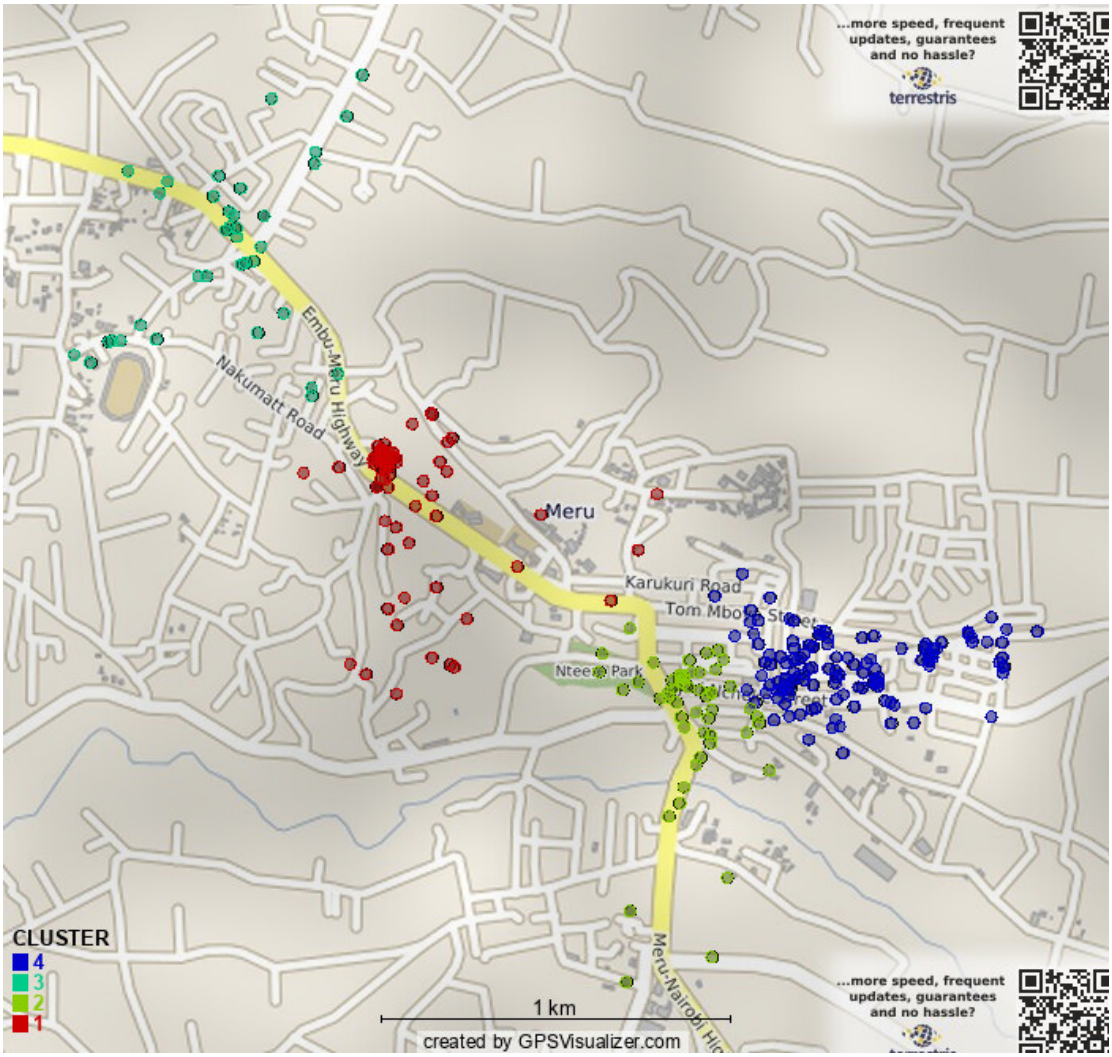

Figure 1. Map of the study area showing the 344 SFVs as dots in respective clusters

making an income.

When considering education level, the highest percentage of respondents had completed secondary education (50.29%), followed by those who had completed primary education (36.34%). The smallest percentage of respondents had obtained university-level degree (1.16%). Similar findings were reported by Letuka, Nkhebenyane [22] who found that 67% of SFVs in Maseru, Lesotho had a high school education, 24% had an elementary school education and 5% had a tertiary education.

Looking at the age of SFVs, the largest group fell within the age range of 26-35 years (38.66%), while the smallest category was over 55 accounting for 4.07% and under 18 at proportion of 0.58%. These results show that the majority of SFVs (54.07%) in this study fell within 18-35 year range, which represents the majority of working-age individuals [23]. Furthermore, the street food vending business is labor-intensive, therefore, the majority of those involved in this profession would typically fall within this age range.

3.1.3 Length of time in street food vending business

Regarding the length of time in business, respondents had been in business for an average of 5.13 years, with a range spanning 44.60 years. This is not surprising considering that street food vending has existed in African cities for a long time and contributes to income and nutrition for many people around the world [24]. This is consistent with Nirathron [25] who reported that the duration of the vending business ranged from less than five years to more than 21 years.

Table 2 shows the comparison between gender, age, education and food category with the length of time in business (years). In terms of the length of time in business, male respondents had a higher average duration (5.64 years) than female respondents (4.56 years). This could be due to societal norms and gender roles, which often place men in more permanent business roles, while women might face more interruptions due to family responsibilities or societal expectations.

According to Jabbouri, Truong [26], gender stereotypes and family responsibilities significantly impact women's entrepreneurial activities and their duration in business. In addition, Berg [27] reported that women are more likely than men or couples to own a non-permanent businesses, resulting in a lower average duration of street food vending.

Respondents above 55 years old also had the highest average duration (16.79 years), while those under 18 years old had the lowest (0.20 years). Older respondents likely have more experience and stability in their businesses, whereas younger individuals are just starting out and may still be experimenting or working temporarily, which may explain the long duration of business among older SFVs.

Respondents with no formal education had the highest average duration (16.87 years), while those with a college-level degree had the lowest duration (5.06 years). This could be due to the fact that vendors with no formal education might rely more heavily on street vending as a stable source of income [28], while those with higher education degree might occasionally treat it as a temporary income source while seeking other career opportunities.

Respondents with a plant-based food category had the highest average duration in business (5.88 years). This could be explained by the fact that plant-based foods often have a constant demand due to health trends and dietary preferences [29, 30]. Additionally, these foods typically have a lower costs and a longer shelf life compared to perishable animal-based products, contributing to more sustainable and longer-lasting business operations, which may be attractive for long-term operations.

3.1.4 Income from street food vending business

When asked about the highest daily income obtained from street food vending, respondents reported an average income of KES 1,417.38, with a range of KES 7,940.00. Thus, the monthly income was KES 42,521.40. This was higher than the findings of Karondo and Tumaini [31] who reported that the average profits for SFVs in Ilala Municipality in Dar Es Salaam, Tanzania was TZS 470,975 (equivalent to KES 23,639.32 – as of June 3, 2024). This is to be expected as different regions may have varying costs of living, market sizes, consumer spending behaviors, and economic opportunities, which may affect the income levels of SFVs.

Table 2 shows the comparison between gender, age, education and food category with the income earned by vendors per day (KES). Male SFVs had a higher average daily income (KES 1474.25) compared to female respondents (KES 1,359.59). This disparity could be attributed to several factors including gender roles, access to resources and societal norms that favor men in entrepreneurial activities [26]. For example, men may work longer hours than women, whose responsibilities for the family may bar them from extended work, hence resulting in lower income.

In terms of age, respondents above 55 years old had the highest average daily income (KES 1564.29), while those under 18 years old had the lowest (KES 350.00). This is because older vendors, who have been in business for a longer duration of time as mentioned earlier, are likely to have more experience, established customer bases, and possibly more stable business practices, which contributes to their higher income compared to younger vendors.

In terms of education, respondents with a university-level degree had the highest average daily income (KES 3,002.00), while those with no formal education had the lowest (KES 1236.67). A higher education often equips individuals with better business management skills, financial literacy, and innovative approaches, which may lead to higher profitability. Nonetheless, according to Otoo, Ibro [32], higher levels of education may not significantly contribute to the success of micro-entrepreneurs in the informal sector, so other factors may be responsible for this outcome.

When considering the food category, respondents with an animal-based food category had the highest average daily income (KES 2,006.12). Vendors selling animal-based foods tend to have higher average daily incomes than those selling plant-based foods. This could be due to the generally higher prices of animal-based products and potentially higher consumer demand in certain markets.

3.2 Health issues among SFVs

The majority of respondents (71.2%) reported that they had never fallen sick or experienced health issues after eating food in the past month. A smaller percentage reported that they had experienced health issues once (11.9%), twice (11.6%) or three times (4.4%) in the previous month. A very small proportion reported falling sick four times (0.3%) or more than four times (0.6%) during the same period. Previous research has reported the presence of toxic chemical and biological infectious elements in street vended foods in Kenya [10-12]. Since SFVs consume the food they offer to consumers, they are also potentially exposed to these contaminants. Blaise [33] reported the presence of one or more fecal-orally transmissible parasites in 45% of SFVs in Yaoundé, Cameroon. Due to limited access to water, waste disposal facilities, and inadequate hygiene awareness and practices [34], vendors are thus at risk of gastrointestinal diseases such as salmonellosis and respiratory infections including influenza and COVID-19. This is alarming considering the large number of consumers of street-vended foods in Kenya and around the world.

According to the Kenya's Public Health Act (CAP 254), food handlers are required to undergo regular medical examinations to ensure that they are fit to serve food to the public. However, since street food vending is not legalized in Kenya, it is challenging to ensure compliance, unlike established hotels that offer food. Given the

Table 2. Length of time in business (years) and income per day (KES)

Characteristics	Categories	N	Money per day (KES)	Length of time in business (years)
Gender	Female	169	1359.59 ± 1008.87[a]	4.56 ± 5.99[b]
	Male	175	1474.25 ± 1238.01[a]	5.64 ± 6.69[a]
Age	19-25 Years	53	1444.25 ± 1115.76[a]	2.46 ± 1.50[b]
	26-35 Year	133	1455.36 ± 1228.67[a]	3.35 ± 2.38[b]
	36-45 Years	99	1412.73 ± 1098.49[a]	5.59 ± 4.78[ab]
	46-55 Years	43	1287.79 ± 914.52[a]	8.65 ± 10.54[a]
	Above 55 Years	14	1564.29 ± 1194.61[a]	16.79 ± 13.89[a]
	Under 18 Years	2	350.00 ± 212.13[a]	0.20 ± 0.14[b]
Education	College level	24	2069.57 ± 1393.63[ab]	5.06 ± 3.73[b]
	No formal education	18	1236.67 ± 1093.71[b]	16.87 ± 16.56[a]
	Primary education completed	125	1133.07 ± 804.30[b]	4.37 ± 4.74[b]
	Secondary education completed	173	1518.35 ± 1195.68[b]	4.39 ± 4.29[b]
	University level	4	3002.00 ± 2311.71[a]	2.50 ± 1.91[b]
Category of food	Animal-based	42	2006.12 ± 1370.29[a]	4.53 ± 4.19[a]
	Both animal and plant-based	71	1291.55 ± 943.40[b]	3.58 ± 3.03[a]
	Plant-based	231	1352.58 ± 1111.78[b]	5.88 ± 7.60[a]

significant contribution of street food vending to nutrition and the economy, legalizing and regulating the street food vending business in Kenya is the best solution for enhancing public health. Although there is a bill in the Kenyan parliament called the Street Vendors (Protection and Livelihoods) Bill, 2022, it is yet to be deliberated and made into law. Specific policies for the sector of street food vending can ensure that basic facilities such as vending locations, water, and sanitary facilities are provided to vendors. In addition, the requirements of the Public Health Act, such as regular medical check-ups, can be effectively implemented if these changes are made.

The analysis showed that gender and education level had no significant influence on whether SFVs fell sick in the previous month. However, age was found to have a significant impact ($\chi^2 = 13.7084$, $p = 0.0335$) on the occurrence of health issues among SFVs during that period. It was observed that the highest percentage of vendors who reported having been sick more than once in the previous month fell within the 26-35 age group (6.10%). This percentage decreased slightly in the age group of 36-45 years (6.69%), over 45 years (3.49%) and under 25 years (0.58%). For the category of vendors who reported falling sick only once in the previous month, the proportion of 26-35 years old was the highest (4.65%). This percentage decreased in the age categories of 36-45 years (3.78%), over 45 years (2.33%) and under 25 years (1.16%). Thus, vendors aged 26-35 were more likely to report being sick than all other categories. This is probably because this group also had the largest number of mobile SFVs (36.63%) compared to the other age groups. It has been reported that mobile street food vending is a significant risk factor for the contamination of street foods. This high potential for contamination poses health risks not only to consumers of street food, but also to the vendors themselves who often consume these foods. Further investigation is required to explore the factors that predispose this category of SFVs to illnesses.

3.3 Food safety aspects

3.3.1 Food safety knowledge

Table 3 shows the cross-tabulation between gender, age and education level of SFVs and whether the vendors had received any training on food hygiene and safety, food preparation or had a food handlers health certificate. A larger proportion of respondents had not received any training on food hygiene and safety (90.70%), lacked training on food preparation (84.88%), and did not obtained a food handlers' certificate (88.08%). This was in line with earlier findings by Mwove, Imathiu [20] in Thika Town, Kenya where they reported that 93% of SFVs had no training in food hygiene and safety. Htway [35] reported that 81% of SFVs in Taunggyi township, Myanmar, had not received any food safety training. Letuka, Nkhebenyane [22] and Werkneh, Tewelde [36] also found comparable results that only 40% and 34.4% of their respondents in Maseru, Lesotho and Mekelle City, Northern Ethiopia, respectively, had been trained in food safety. Marutha and Chelule [37] reported that 89% of SFVs in Polokwane Central Business District, South Africa, had received no formal training in food preparation and therefore, they relied on personal observation to learn. Regarding food handlers' medical check-ups, Werkneh, Tewelde [36] reported that only 25% of the

vendors reported that they would regularly take a medical check-up. In addition, Mwove, Imathiu [20] reported that 73% of SFVs in Thika Town, Kenya, did not take regular medical checkups and thus did not have a medical certificate for food handlers. The lack of training in food preparation as well as food hygiene and safety is a safety risk for street food consumers. These results highlight a significant gap in food safety knowledge among SFVs in Meru town due to lack of necessary training for ensuring public health. Thus, there is a need for targeted training programs on food handling and food hygiene and safety for SFVs. Additionally, it would be crucial to rigorously enforce the requirement for regular medical check-ups on all individuals in the food sector, including SFVs as enshrined in the Public Health Act (CAP 254) of Kenya.

Table 3. Food preparation, food safety training and the availability of food handler's health certificate

Characteristic		Have you ever received any training on food hygiene and safety?		Do you have training on food preparation?		Do you have a food handlers health certificate		Total
		No	Yes	No	Yes	No	Yes	
Gender	Female	42.73(147)	6.4(22)	40.99(141)	8.14(28)	41.86(144)	7.27(25)	49.13(169)
	Male	47.97(165)	2.91(10)	43.9(151)	6.98(24)	46.22(159)	4.65(16)	50.87(175)
		$\chi = 5.4355$; $p = 0.0197$		$\chi = 0.5457$; $p = 0.4601$		$\chi = 2.6143$; $p = 0.1059$		
Education Level	Primary education and below	39.53(136)	2.03(7)	37.21(128)	4.36(15)	39.53(136)	2.03(7)	41.57(143)
	Secondary education completed	45.64(157)	4.65(16)	42.15(145)	8.14(28)	43.6(150)	6.69(23)	50.29(173)
	Tertiary level	5.52(19)	2.62(9)	5.52(19)	2.62(9)	4.94(17)	3.2(11)	8.14(28)
		$\chi = 20.6061$; $p < 0.0001$		$\chi = 8.8659$; $p = 0.0119$		$\chi = 27.0074$; $p < 0.0001$		
Age of street food vendor	Under 25 Years	13.95(48)	2.03(7)	12.79(44)	3.2(11)	13.66(47)	2.33(8)	15.99(55)
	26-35 Years	33.43(115)	5.23(18)	31.69(109)	6.98(24)	34.01(117)	4.65(16)	38.66(133)
	36-45 Years	27.62(95)	1.16(4)	26.16(90)	2.62(9)	25.87(89)	2.91(10)	28.78(99)
	Over 45 Years	15.70(54)	0.87(3)	14.25(49)	2.32(8)	14.54(50)	2.03(7)	16.57(57)
		$\chi = 7.9384$; $p = 0.0473$		$\chi = 4.7645$; $p = 0.1899$		$\chi = 0.6818$; $p = 0.8775$		
Total		90.7(312)	9.3(32)	84.88(292)	15.12(52)	88.08(303)	11.92(41)	100(344)

There was a significant correlation ($\chi = 5.4355$; $p = 0.0203$) between gender and training on food hygiene and safety (Table 3). Male SFVs were less likely (OR = 0.4050, 95% CI: 0.185-0.888) to have received training on food hygiene and safety compared to females. This is alarming considering that a large number of male SFVs were included in this study. When males engage in street food vending business, the training on food handling, food hygiene and safety will be required to ensure public health.

Chi-square tests revealed a highly significant correlation between education level and training on food hygiene and safety ($p < 0.0001$), training on food preparation ($p = 0.0119$), and possession of a food handlers' certificate ($p < 0.0001$). Logistic regression analysis showed that SFVs who had completed secondary school education were more likely (OR = 1.98, 95% CI: 0.786-5) to have received training on food hygiene and safety compared to those with primary education or below. Similarly, those with tertiary education were approximately 9.17 times more likely to have received such training compared to those with primary education or below (OR = 9.17, 95% CI: 3.04-27.78). Similar trends were found when comparing the level of education and the likelihood of having training on food preparation or having a food handlers' certificate. SFVs who had completed secondary education had 1.647 (OR = 1.647, 95% CI: 0.838-3.237) and 2.976 (OR = 2.976, 95% CI: 1.230-7.194) times higher odds of having training on food preparation or having a food handlers' certificate, respectively, as compared to those with primary education or below. Vendors with tertiary level education had 4.049 (OR = 4.049, 95% CI: 1.542-10.638) and 12.500 (OR = 12.500, 95% CI: 4.255-37.037) times higher odds of having training on food preparation or having a food handlers' certificate as compared to those with primary education or below, respectively. Obviously, educated vendors seemed to make better choices by getting regular medical checkups so as to obtain the food handler's certificate. In addition, they also participated in training on food handling. Higher levels of education were associated with better choices related to SFV hygiene and safety practices [38, 39]. Training on food

hygiene and safety, as well as food handling, has potential to enhance the quality and safety of street-vended foods. The knowledge gained through training is critical to food safety, as it has been shown to enhance food handlers' understanding of proper food safety and hygiene practices [40]. In addition, the enforcement of the public health act (CAP 254) of Kenya, which ensures that all food handlers, including SFVs, obtain a food handlers health certificate, can reduce the transmission of communicable diseases. This is because even seemingly healthy consumers may potentially carry infectious diseases [16]. This in turn could have a positive impact on the health of street food consumers.

There was a significant correlation ($\chi = 7.9384$; $p = 0.0473$) between the age of SFVs and whether they had received training on food hygiene and safety. Logistic regression revealed that vendors aged 26-35 had slightly lower odds (OR = 0.932, 95% CI: 0.362-2.396) of not having received training compared to those aged under 25. Vendors aged 36-45 (OR = 3.462, 95% CI: 0.955-12.556) and those over 45 (OR = 2.625, 95% CI: 0.634-10.865) had higher odds of not having received training compared to those under 25. This may be attributed to factors such as access to training, awareness, technological familiarity, perceived need for training and economic constraints. Whereas younger SFVs may be tech-savvy and thus are more aware of and willing to participate in training programs, older SFVs may prefer to rely on their personal experiences accumulated over time instead of seeking formal training. This reliance on experience can be due to a lack of technological familiarity, which makes it difficult for them to access or take advantage of training opportunities. Additionally, economic constraints may prevent older individuals, who often have greater family responsibilities, from participating in such training programs. These financial burdens and time constraints can make it difficult for them to take time off from their business activities to attend training sessions, even if they recognize the potential benefits.

3.3.2 Factors considered in the choice of raw materials

About 87.50% of SFVs sourced their raw materials from farmers' markets or farms, while 32.56% also relied on supermarkets or shops. Additionally, 20.06% of vendors reported that they sourced raw materials from their own stores or farms and 1.74% obtained materials from slaughterhouses or butcheries. Many vendors obtained raw materials from multiple sources. Every source of raw material comes with its safety concerns. The raw materials may contain physical, chemical or even microbiological hazards that pose a public health concern. Therefore, the quality of the raw materials is a very important determinant of the quality and safety of the finished ready-to-eat foods [41]. The majority (70.35%) of SFVs considered the quality attributes (freshness, colour, flavour, texture, ripeness, size, expiry date, storage) of raw materials before procurement, while a smaller proportion (29.65%) considered price as the determining factor. Amaami, Dominic [42] reported that 69% of respondents in the Techiman Municipality of Ghana only considered price before buying raw material for cooking. This was in agreement with Omemu and Aderoju [43] who argued that when purchasing raw materials, the quantity and price of food were considered more than quality aspects such as freshness and cleanliness. This suggests that the respondents in this study were more concerned with the quality of the final food products since the raw materials directly impact the quality of the final product. In many cases, ensuring high quality can lead to better consumer satisfaction, repeat business and a better reputation, which is crucial for long-term success and may have motivated SFVs to seek for better-quality products. Nonetheless, nearly a third of vendors were more concerned about the price of the foods at the expense of their quality. This is alarming, as it significantly increases the risk caused by using substandard, poor-quality, and adulterated raw materials, which can result in unsafe food. There was no significant correlation between these choices and gender, education or age, suggesting that the emphasis on quality may be a common concern. This may reflect a shared understanding of the importance of quality to food safety, taste and overall consumer satisfaction that transcends personal demographic characteristics.

3.3.3 Source of packaging materials

The results showed that the majority of respondents (72.38%) reported buying their packaging materials from shops or supermarkets (Figure 2). This suggests that most people rely on commercially available packaging options for their needs. These packaging materials may already be cleaned and safe when purchased, but due to poor storage practices on the street, they too become contaminated. Muyanja, Nayiga [44] reported that polyethylene bags are often contaminated by the food handlers themselves and that pathogens may penetrate the interior surfaces of the packaging bags during packaging due to poor handling practices by the vendors.

On the other hand, a small percentage (1.74%) reported using reusable utensils as a source of packaging materials. The hygiene and safety of reusable utensils depend on the effectiveness of cleaning and sanitization processes as well as the way they are stored. A lack of potable water on the street can affect the cleaning process, resulting in contamination and potential safety and health issues.

A significant number of respondents (14.24%) reported using packaging made from recycled materials. Other researchers have also reported the use of recycled materials in street vended foods [20, 44]. This is worrying, as recycled materials may be potential carriers of toxic substances that may be ingested during food packaging [45].

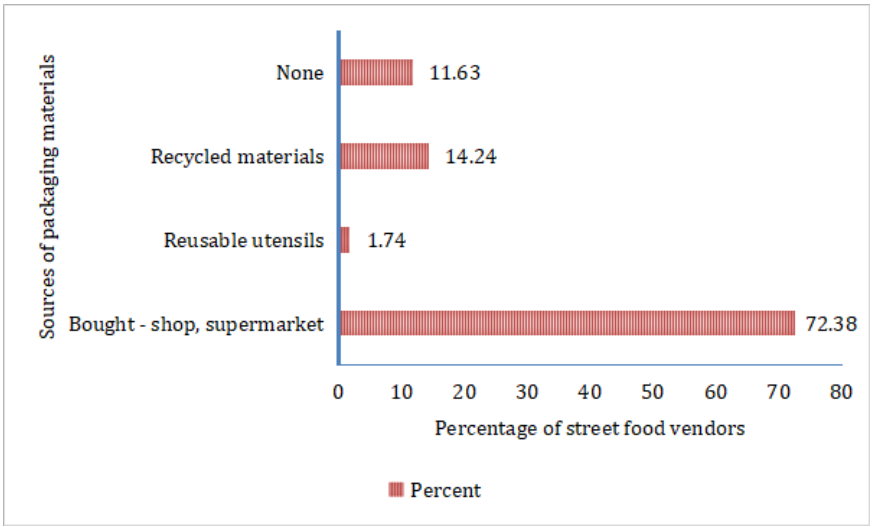

Figure 2. Sources of packaging materials

3.3.4 Source of water for food preparation

The main source of water for food preparation among respondents was tap water from the municipal supply (81.10%). Other water sources included river water (3.20%), water vendors (0.58%), rainwater/tank (0.29%) and well water (0.29%). Other respondents (14.53%) indicated that they did not have access to any specific water source for food preparation. Water determines the quality and safety of food prepared. Therefore, portable water must be used in food preparation. Municipal tap water is usually treated and monitored for safety and quality, reducing the risk of waterborne diseases. The high reliance on municipal water suggests that most respondents have access to a reliable and safer water source, which is critical for food safety. However, the alternative water sources reported in this study can vary considerably in quality and may not be subject to the same rigorous treatment and monitoring as municipal water. For instance, river water and well water in particular are more susceptible to contamination by environmental pollutants, agricultural runoff and pathogens, which poses higher safety risks.

3.4 Food hygiene practices

3.4.1 Personal hygiene practices

Table 4 shows the personal hygiene practices of SFVs in Meru town. The vast majority of SFVs (97%) did not use hand gloves while preparing or handling food. Only a small percentage of vendors (2.91%) were found to use hand gloves. In addition, approximately 78.78% of SFVs did not wear a head cover, 75.29% did not wash their hands before handling food, and the vast majority of SFVs (92.44%) did not wash their hands after handling money. This indicates that a significant majority of vendors were not adequately protecting their food from potential contamination. Previous research has reported poor personal hygiene practices among SFVs in Kenya [20, 21, 46, 47]. Therefore, there is a critical need for targeted interventions to improve the personal hygiene practices of SFVs in Meru town. Implementing comprehensive hygiene training programs, enforcing stricter regulations, and providing accessible hygiene resources could significantly mitigate these risks and enhance food safety.

3.4.2 Street food vending environment

The majority of SFVs (70.64%) were found vending at a fixed location rather than mobile (Table 4). Stationary vendors can better control the hygiene around their premises compared to mobile SFVs. However, the suitability of the vending location depends largely on the surrounding environment. Despite being stationary, these locations may still be unsuitable for food vending if the surrounding conditions are unhygienic or unsafe. In this study, most vendors were located near roads (94.48%), near gas stations (79.65%), next to sewage lines (80.23%), or near bus stations (52.03%). These different areas pose different, significant hazards to the food on sale. This is even more alarming considering that some vending locations were located near a multitude of these potentially unsafe places.

Over half of the vendors had a dustbin (54.07%), contributing to waste management at their locations, with the majority of SFVs operating in relatively clean vending environments (63.66%) and maintaining clean vending structures (69.48%). Poor environmental hygiene practices had been reported among SFVs [42, 47]. Unsanitary environmental conditions further exacerbate the public health risks associated with street food in urban settings [33]. To ensure the safety of street-vendor food, cities can incorporate street food vending areas in their planning

Table 4. Personal hygiene and food handling practices and the condition of food vending environment

	Characteristic	No	Yes	Not Applicable
Personal hygiene practices	Does the vendor have hand gloves?	97.09(334)	2.91(10)	
	Does the vendor have head cover?	78.78(271)	21.22(73)	
	Does the vendor have a face mask?	98.55(339)	1.45(5)	
	Does the vendor wash hands before handling food?	75.29(259)	24.71(85)	
	Does the vendor wash hands after handling money?	92.44(318)	7.56(26)	
	Is the vendor wearing chains, bangles or earrings?	83.72(288)	16.28(56)	
	Does the vendor have a clean apron?	31.1(107)	31.98(110)	36.92(127)
Food vending environment	Vendor mobile	70.64(243)	29.36(101)	
	Vendor near the road	5.52(19)	94.48(325)	
	Vendor near gas station	79.65(274)	20.35(70)	
	Vendor near sewage line	80.23(276)	19.77(68)	
	Vendor near bus station	52.03(179)	47.97(165)	
	Vendor has a dustbin	54.07(186)	45.93(158)	
	Vending environment is clean	36.34(125)	63.66(219)	
	Vending structures are clean	30.52(105)	69.48(239)	
Food handling practices	Does the vendor wash raw materials before cooking?	36.63(126)	29.65(102)	33.72(116)
	Ready-to-eat food and raw materials are separated	23.84(82)	76.16(262)	
	Ready-to-eat food is covered	44.48(153)	55.52(191)	
	Food under heat while being served	41.28(142)	58.72(202)	
	Food packaging materials are properly covered	48.84(168)	51.16(176)	
	Food packaging materials mixed/ stored together with food	72.97(251)	27.03(93)	
	Food prepared along the street	12.5(43)	87.5(301)	

and provide the necessary facilities to ensure safe food production and promote public health. Essential facilities, such as portable water supplies, waste collection bins, waste disposal systems, washrooms and clean vending environments, significantly contribute to maintaining hygiene standards among SFVs. Such attempts have already been made elsewhere. For instance, the "Street 306 Dokki" project in Cairo [48] and others [49].

3.4.3 Food handling practices

A majority of SFVs (36.63%) did not wash the raw materials before cooking (Table 4). However, a significant proportion of vendors (76.16%) made an effort to separate ready-to-eat foods from raw materials. Additionally, most vendors (55.52%) covered their ready-to-eat foods, indicating a moderately high level of concern for food hygiene. Although 51% of vendors had properly covered the food packaging materials, 27% of vendors stored their packaging materials together with the food, which may contribute to contamination. Interestingly, the majority of vendors (87.5%) prepared the food along the street, indicating the common practice of street food preparation. However, this raises potential concerns considering the location of street food vending businesses mentioned in this study. Preparing food along the roads and near sewage sites may result in contamination and potential public health issues. This is even more alarming considering that 64.24% of SFVs had exposed packaging materials, which may have implications for the hygiene and safety of the food. Preparing and vending food in open spaces exposes food to microorganisms and other contaminants present in the environment, which jeopardizes food safety [37].

3.4.4 Factors influencing food hygiene practices

The overall evaluation of the three models using the likelihood ratio test, the Wald test and the score tests indicated a significant improvement ($p < 0.0014$) in the logistic models compared to the model with no predictors. Having ever received training on food hygiene and safety or training on food preparation did not significantly affect the scores on food hygiene practices. This was different from expectations and possibly due to the fact that the SFVs who were trained in food preparation, food hygiene and safety did not know about their training. According to Azanaw, Engdaw [50] in their study on food hygiene knowledge and practices of SFVs in Gondar city, Ethiopia,

vendors who had food hygiene training had better food hygiene practices compared to untrained SFVs. Thus, there is a need for training and retraining SFVs to enhance their knowledge and practice in food hygiene and safety. Vendors in cluster 1 to 3 were less likely ($p < 0.0001$) to have a good personal hygiene score compared to vendors in cluster 4. Cluster 4 included the farmers market and the commercial bus stop. These were areas heavily frequented by many people and therefore attracted more SFVs. About 40.12% of SFVs in this study were located in cluster 4. Furthermore, the majority of fixed SFVs (25.29%) were located in cluster 4, which might account for better personal hygiene practices, as fixed vendors had significantly higher ($p = 0.0006$) hygiene practice scores as shown in Figure 3.

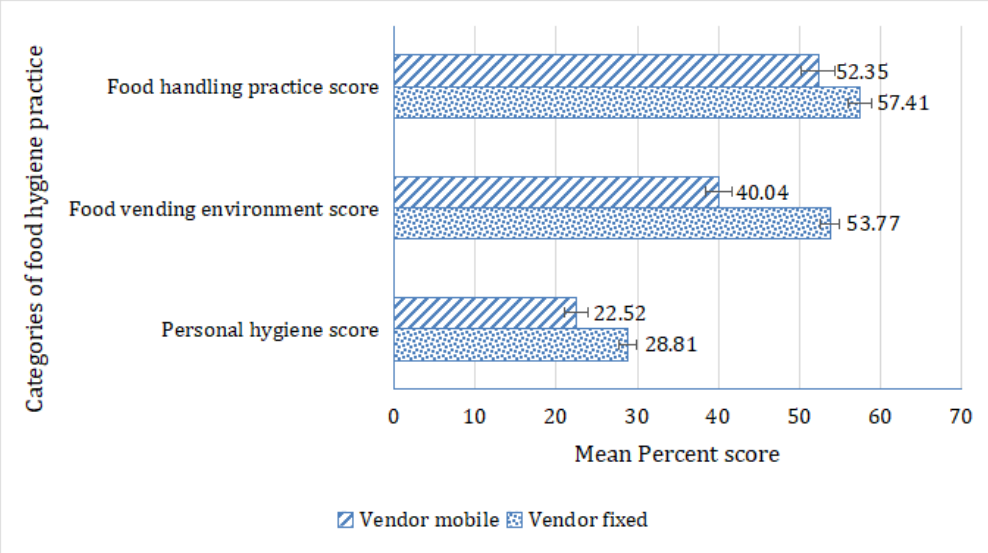

Figure 3. Comparison of food hygiene practice scores between fixed and mobile SFVs

Having a tertiary education degree significantly ($p < 0.001$) increased the odds of achieving a good score on personal hygiene practice. Completing formal education significantly increased the odds of getting good scores on food vending environment ($p = 0.0123$) and food handling practice ($p = 0.0007$), with vendors who had tertiary education degree being 6 times and 14 times, respectively, more likely to have a good score compared to those who did not complete formal education, as shown in Table 5. Similar findings were reported by Mwove, Imathiu [38] who reported that the lack of formal education can potentially negatively impact food safety, as well as hygiene awareness and practices.

Females SFVs were 2.16 and 1.94 times more likely to have a good score, respectively, on food vending environment ($p = 0.0019$) and food handling practice ($p = 0.0054$) compared to male SFVs. In this study, as discussed above, male SFVs were less likely (OR = 0.4050, 95% CI: 0.185-0.888) to have received training on food hygiene and safety compared to females. Therefore, females might have paid more attention to cleanliness, which could lead to better scores obtained in maintaining a good food vending environment. However, it was contrary to the research finding by Lema, Abuhay [51] who reported that male food handlers in Gondar, Northwest Ethiopia had a better food hygiene practice than females.

Vendors aged between 26 and 45 were over 5 times more likely ($p < 0.0001$) to have a good personal hygiene score compared to vendors over 45 years old who had significantly lower odds for a good score. Vendors between 26-45 were more active and able to cope with the laborious task involved in street food vending operations. Older vendors might therefore be unable to keep up with the hygiene requirements. In addition, older vendors were less likely to have received training on food safety compared to younger vendors, which may also explain the low scores on personal hygiene practice among older vendors.

Those without food handlers' health certificate had significantly lower odds of getting high score ($p = 0.0007$) on food hygiene practices, or getting high score ($p = 0.0019$) on food handling practice compared to those who had certificates. A food handlers' health certificate holder might be more likely to realize the importance of food hygiene and safety. This is true, since the average score for vendors with a food handlers' health certificate was significantly ($p < 0.01$) higher in terms of food hygiene practice as shown in Figure 4.

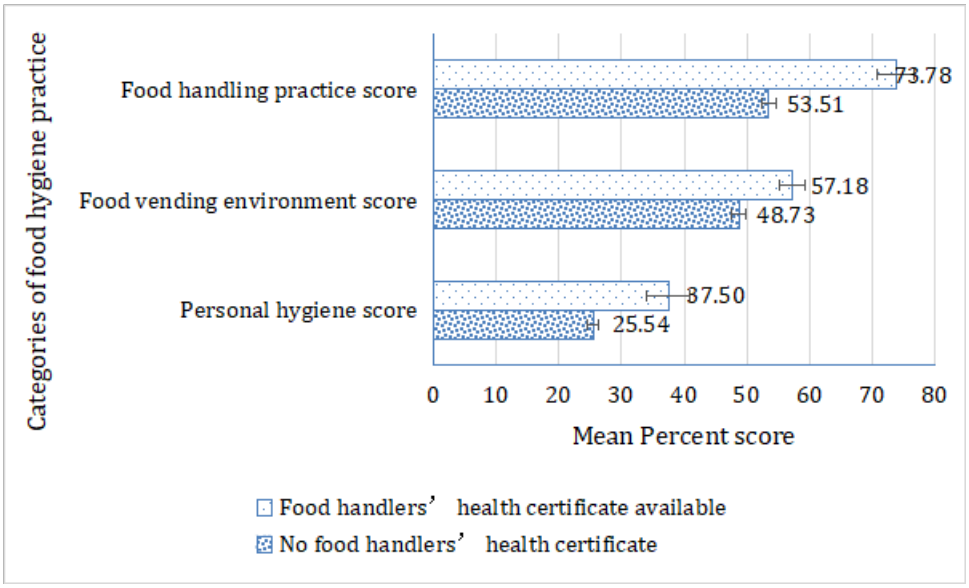

Figure 4. Comparison of food hygiene practice scores between SFVs with or without food handlers' health certificate

Table 5. The odds ratio estimates with 95% Confidence Limits for food hygiene practices score categories used in logistic regression

		Personal hygiene score	Food vending environment practice score	Food handling practices score
Cluster	1 vs 4	0.934(0.292-2.985)		
	2 vs 4	0.553(0.147-2.078)		
	3 vs 4	< 0.001 (< 0.001-< 0.001)		
Gender	Female vs Male		2.159 (1.33-3.505)	1.939 (1.218-3.088)
Education level	No formal education vs Tertiary education	< 0.001 (< 0.001-< 0.001)		
	Primary education completed vs Tertiary education	0.541 (0.136-2.146)		
	Secondary education completed vs Tertiary education	0.236 (0.064-0.87)		
	Primary education completed vs No formal education		2.142(0.579-7.923)	1.334(0.41-4.341)
	Secondary education completed vs No formal education		3.693(1.017-13.412)	2.573(0.808-8.195)
	Tertiary education vs No formal education		6.375(1.447-28.096)	14.507(2.652-79.35)
Age	26-35 Year vs 25 Years and Below	5.117 (0.437-59.934)		
	36-45 Years vs 25 Years and Below	5.705 (0.411-79.166)		
	46-55 Years vs 25 Years and Below	2.22 (0.096-51.11)		
	Above 55 Years vs 25 Years and Below	< 0.001 (< 0.001-0.001)		
Vendor has food handlers' certificate	No vs Yes	0.132 (0.041-0.42)		0.248 (0.103-0.596)
Vendor mobility	Vendor mobile vs Vendor fixed		0.239 (0.134-0.426)	

Mobile vendors were less likely ($p < 0.0001$) to have a good practice score on food vending environment. Vending from a designated location allows for a better control over various aspects of street food vending, including the sanitary conditions of the surrounding environment, the personal hygiene of SFVs and their food handling practices [38].

Conclusion

This study revealed the significant public health concerns associated with street food vending in Meru town. Health issues were reported among 28.8% SFVs, with younger vendors reporting more frequent occurrences of illnesses,

likely due to a higher mobility and resultant exposure to contamination. The knowledge and practices of food safety were found to be inadequate among most vendors, with a significant lack of training on food hygiene and safety, as well as insufficient possession of food handlers' certificates. The practices of personal hygiene and food handling were suboptimal, which potentially poses significant health issues to consumers of street-vending foods. Therefore, there is a need for targeted training programs, stricter enforcement of food safety regulations, and improved access to hygiene facilities for SFVs to ensure the safety of street-vended foods. Legalizing and regulating street food vending, providing essential facilities and incorporating designated vending areas into urban planning could significantly enhance the hygiene and safety of street foods and help mitigate the associated risks to public health.

Ethical approval and consent to participate

The ethical review and approval for this research were undertaken by the Chuka University Institution Ethics Review Committee (NACOSTI/NBC/AC-0812). The permission for this study was obtained from the National Commission for Science and Technology (NACOSTI), (License No: NACOSTI/P/22/15200), Kenya. Before data collection from the SFVs, they were notified that the interview was voluntary and that they were free to opt-out at any time. Verbal consent was obtained from SFVs involved in this research before conducting the interview and making visual observations.

Funding information

The author received funding from Chuka University Internal Research Fund to facilitate data collection and analysis.

Conflicts of interest

The author declares that there is no conflicts of interest related to this research.

Availability of data and materials

Data used in this study is available on request from the author.

Supplementary material

The questionnaire and the observation checklist are available at https://file.luminescience.cn/Questionnaire%20and%20Checklist.pdf.

References

[1] Zhou G, Ali S. Street food consumer behaviour decoded: analysing decision-making styles, risk factors and the influential power of social media celebrities. *British Food Journal*. 2024; 126 (4). doi:10.1108/BFJ-07-2023-0654.

[2] Misiko AJ, Kisiang'ani RI. Effects of the Informal Street Food Vendors' Operations on the Socio-cultural and Economic Wellbeing of Nyeri Town Public. *African Journal of Tourism and Hospitality Management*. 2024; 3(1): 30-55. doi: 10.37284/ajthm.3.1.1778.

[3] Moges M, Rodland EK, Argaw A. Sanitary condition and hygienic practice of street food vendors in selected towns of Ethiopia: A cross-sectional study addressing public health concern. *Journal of Agriculture and Food Research*. 2024;15:100857. doi: 10.1016/j.jafr.2023.100857.

[4] Prabakaran B. A Community Study To Assess The Personal Hygiene Among Food Vendors. *International Journal of Life Sciences, Biotechnology and Pharma Research*. 2024;13(2).

[5] Magqupu S, Katiyatiya CL, Chikwanha OC, Strydom PE, Mapiye C. Street Pork Vendors' Hygiene and Safety Practices and Their Determinants in the Cape Metropole District, South Africa. *Journal of Food Protection*. 2024; 87(1): 100197. doi: 10.1016/j.jfp.2023.100197.

[6] Adane M, Teka B, Gismu Y, Halefom G, Ademe M. Food hygiene and safety measures among food handlers in street food shops and food establishments of Dessie town, Ethiopia: A community-based cross-sectional study. *PloS One*. 2018; 13(5). doi: 10.1371/journal.pone.0196919.

[7] Biswas A, Dasgpta A, Bhattacharyya S, Banik A, Roy S, Ghosh P, et al. Microbial Contamination and Poor Hygienic Practices among Food Handlers in a Slum of Kolkata: A Matter of Concern. *RFP Indian Journal of Hospital Infection*. 2023; 5(2): 45-53.

[8] Islam R, Banik A, Anjum H, Hossain MI, Abir R. Microbial characterization of street food collected from Dhaka city, Bangladesh. *GSC Biological and Pharmaceutical Sciences*. 2024; 26(1): 107-113. doi: 10.30574/gscbps.

[9] Odikeme E, Ephraim-Emmanuel B. Microbiological Quality of Street-vended Ready-to-Eat Ekpainkpoto (Plantain Pudding) in Bayelsa State, Nigeria. *South Asian Journal of Parasitology*. 2024; 7(1): 10-16.

[10] Mwove J, Imathiu S, Orina I, Karanja P. Microbial Quality and Safety of Ready-to-Eat Street-Vended Foods Sold in Selected Locations in Kenya. *Journal of Food and Dietetics Research*. 2022; 1(2): 34-40.

doi: 10.48165/JFDR.2021.1202.
[11] Mwove J, Imathiu S, Orina I, Karanja P. Environmental Exposure Assessment of Lead and Cadmium in Street Vended Foods Sold in Selected Locations in Kenya. *Food Science & Nutrition*. 2023; 11(6): 2610-2619. doi: 10.1002/fsn3.3344.
[12] Mwove J, Imathiu S, Orina I, Karanja P. Determination of total aflatoxin and aflatoxin B1 in groundnuts and cereal-based street vended foods sold in selected locations in Thika Town, Kenya: Total aflatoxin and aflatoxin B1 in street vended foods. *Journal of Food and Dietetics Research*. 2022; 2(3):1-7. doi: 10.48165/jfdr.2022.2.3.1.
[13] Rakha A, Fatima M, Bano Y, Khan MA, Chaudhary N, Aadil RM. Safety and quality perspective of street vended foods in developing countries. *Food Control*. 2022; 138:109001. doi: 10.1016/j.foodcont.2022.109001.
[14] Rosales AP, Linnemann AR, Luning PA. Food safety knowledge, self-reported hygiene practices, and street food vendors' perceptions of current hygiene facilities and services-An Ecuadorean case. *Food Control*. 2023;144:109377. doi: 10.1016/j.foodcont.2022.109377.
[15] World Health Organization. *Food safety: World Health Organization*. Available from: https://www.who.int/news-room/fact-sheets/detail/food-safety [Accessed 10th October 2024].
[16] Mwove JK, Orwa JD, Njoki JW, Irungu FG, Kiruki FG. Factors influencing consumer choices and food safety awareness in street-vended foods: A case study of Meru town, Kenya. *Journal of Food, Nutrition and Diet Science*. 2024; 2(1): 94-106. doi: g/10.55976//fnds.22024125794-106.
[17] WSH-MEDS. Meru Town Municipality, Kenya. Water Sanitation and Hygiene Department for Measurement Evidence and Dissemination (WSH-MEDS), Bill and Melinda Gates Foundation (BMGF). Bill and Melinda Gates Foundation; 2022. Available from: https://www.susana.org/_resources/documents/default/3-5057-7-1662111398.pdf. [Accessed 27th November, 2024].
[18] Kothari CR. *Research methodology: Methods and techniques*. 2nd Revised Edition. New Delhi, India: New Age International Publishers; 2004.
[19] Ashabi A, Sahibuddin SB, Salkhordeh Haghighi M. (eds.) The systematic review of K-means clustering algorithm. In: *Proceedings of the 2020 9th International Conference on Networks, Communication and Computing*. 2021: 13-18. doi: 10.1145/3447654.3447657.
[20] Mwove J, Imathiu S, Orina I, Karanja P. Food safety knowledge and practices of street food vendors in selected locations within Kiambu County, Kenya. *African Journal of Food Science*. 2020; 14(6):174-185. doi: 10.5897/AJFS2020.1929.
[21] Gichunge C, Ogachi S, Kiboi W, Mukhwana ES. Vending Environment and Hygiene Practices of Street Food Vendors in an Out of Campus Food Environment in Kenya. *International Journal of Community Medicine and Public Health*. 2023; 10(3): 1005-1010. doi: 10.18203/2394-6040.ijcmph20230614.
[22] Letuka Po, Nkhebenyane J, Thekisoe O. Street food handlers' food safety knowledge, attitudes and self-reported practices and consumers' perceptions about street food vending in Maseru, Lesotho. *British Food Journal*. 2021;123(13): 302-316. doi: 10.1108/BFJ-07-2020-0595.
[23] Ali H, Adamu B. Role of Informal Sector in Unemployment Reduction in Adamawa North Senatorial District. *International Journal of Research and Innovation in Social Science*. 2020; 4(9):424-430.
[24] Kowalczyk A, Kubal-Czerwińska M. Street food and food trucks: Old and new trends in urban gastronomy. In: Kowalczyk, A., Derek, M. (eds.) *Gastronomy and Urban Space*. The Urban Book Series. Springer, Cham. 2020:309-327.
[25] Nirathron N. Street food vending in Bangkok. In: *Street Vendors in the Global Urban Economy*. Routledge India; 2012. p. 144-183.
[26] Jabbouri R, Truong Y, Issa H. The impact of local entrepreneurial initiatives on women entrepreneur empowerment: the case of cooperative social ventures in Morocco. *International Journal of Entrepreneurial Behavior & Research*. 2024; 30(7): 1838-1866.doi: 10.1108/IJEBR-04-2023-0427.
[27] Berg Mvd. *Gender and MSMEs in the food environment in Viet Nam*. Washington, D.C. USA: International Food Policy Research Institute; 2023 3rd June 2024.
[28] Oladipo-Adekeye OT, Tabit FT. The food safety knowledge of street food vendors and the sanitary compliance of their vending facilities, Johannesburg, South Africa. *Journal of Food Safety*. 2021; 41(4): e12908. doi: 10.1111/jfs.12908.
[29] Aimutis WR. Plant-based proteins: The good, bad, and ugly. *Annual Review of Food Science and Technology*. 2022;13:1-17. doi: 10.1146/annurev-food-092221-041723.
[30] Beacom E, Bogue J, Repar L. Market-oriented Development of Plant-based Food and Beverage Products: A Usage Segmentation Approach. *Journal of Food Products Marketing*. 2021; 27(4): 204-22. doi: 10.1080/10454446.2021.1955799.
[31] Karondo JV, Tumaini UJ. The Role of Street Food Vending to the Vendors' Household Welfare in Ilala Municipality in Dar es Salaam, Tanzania. *Business Education Journal*. 2021;1(11): 1-9.
[32] Otoo M, Ibro G, Fulton J, Lowenberg-Deboer J. Micro-entrepreneurship in Niger: Factors affecting the success of women street food vendors. *Journal of African Business*. 2012; 13(1): 16-28.
[33] Blaise NYH. An assessment of hygiene practices and health status of street-food vendors in Yaoundé, Cameroon. *International Journal of Tropical Disease*

& Health. 2014; 4(11): 1153-70. doi: 10.9734/IJTDH/2014/10265.

[34] Sepadi MM, Nkosi V. Environmental and occupational health exposures and outcomes of informal street food vendors in South Africa: A quasi-systematic review. *International Journal of Environmental Research and Public Health*. 2022; 19(3): 1348. doi: 10.3390/ijerph19031348.

[35] Htway TAS. Factors associated with food safety knowledge and practice among street food vendors in Taunggyi Township, Myanmar: a cross-sectional study. *Malaysian Journal of Public Health Medicine*. 2020; 20(3): 180-188. doi: 10.37268/mjphm/vol.20/no.3/art.822.

[36] Werkneh AA, Tewelde MA, Gebrehiwet TA, Islam MA, Belew MT. Food safety knowledge, attitude and practices of street food vendors and associated factors in Mekelle city, Northern Ethiopia. *Heliyon*. 2023; 9(4): e15126. doi: 10.1016/j.heliyon.2023.e15126.

[37] Marutha KJ, Chelule PK. Safe food handling knowledge and practices of street food vendors in Polokwane Central Business District. *Foods*. 2020; 9(11): 1560. doi: 10.3390/foods9111560.

[38] Mwove J, Imathiu S, Orina I, Karanja P. Multinomial Logistic Regression Analysis of Factors Influencing Food Safety, Hygiene Awareness and Practices Among Street Food Vendors in Kiambu County, Kenya. *Current Research in Nutrition and Food Science*. 2020; 8(3). doi: 10.12944/CRNFSJ.8.3.26.

[39] Hossen MT, Ferdaus MJ, Hasan MM, Lina NN, Das AK, Barman SK, et al. Food safety knowledge, attitudes and practices of street food vendors in Jashore region, Bangladesh. *Food Science and Technology*. 2020; 41:226-39. doi: 10.1590/fst.13320.

[40] Jores D, Arif MT, Rahman MM. Factors associated with food hygiene practices among street food vendors in Padawan, Sarawak. *Borneo Journal of Resource Science and Technology*. 2018; 8(1): 56-65. doi: 10.33736/bjrst.824.2018.

[41] Soon JM, Brazier AK, Wallace CA. Determining common contributory factors in food safety incidents–A review of global outbreaks and recalls 2008–2018. *Trends in Food Science & Technology*. 2020; 97:76-87. doi: 10.1016/j.tifs.2019.12.030.

[42] Amaami AJ, Dominic D, Collins D. Factors associated with poor food safety compliance among street food vendors in the Techiman Municipality of Ghana. *African Journal of Food Science*. 2017;11(3): 50-7. doi: 10.5897/AJFS2016.1510.

[43] Omemu A, Aderoju S. Food safety knowledge and practices of street food vendors in the city of Abeokuta, Nigeria. *Food Control*. 2008; 19(4): 396-402. doi:10.1016/j.foodcont.2007.04.021.

[44] Muyanja C, Nayiga L, Brenda N, Nasinyama G. Practices, knowledge and risk factors of street food vendors in Uganda. *Food Control*. 2011; 22(10): 1551-8. doi: 10.1016/j.foodcont.2011.01.016.

[45] Jadhav S, Sonone SS, Sankhla MS, Kumar R. Health risks of newspaper ink when used as food packaging material. *Letters in Applied NanoBioScience*. 2021;10(3): 2614-23. doi: 10.33263/LIANBS103.26142623.

[46] Were L, Were G, Aduol KO. Hygiene Practices and Microbial Contamination of Street-vended Foods in Kenyatta University's Environs. *European Journal of Agriculture and Food Sciences*. 2020; 2(5). doi: 10.24018/ejfood.2020.2.5.105.

[47] Birgen BJ, Njue LG, Kaindi DM, Ogutu FO, Owade JO. Determinants of Microbial Contamination of Street-Vended Chicken Products Sold in Nairobi County, Kenya. *International Journal of Food Science*. 2020; 2020. doi: 10.1155/2020/2746492.

[48] Adel Rifaat A, Mahmoud Moustafa Y, Mohamed Fikry Elazzazy M. Latest Street Food Vending Organization Attempts in Cairo: An Evaluation of the "Street 306" Model. *Engineering Research Journal*. 2022; 173:16-36.

[49] Warlina L, Yusuf M, Ramadhani S, Ohoitimur G. Planning for relocation area of street food vendor in Bandung City. *International Journal of Design (INJUDES)*. 2021;1:37-42. doi: 10.34010/injudes.v1i1.4831.

[50] Azanaw J, Engdaw GT, Dejene H, Bogale S, Degu S. Food hygiene knowledge, and practices and their associated factors of street food vendors in Gondar city, Northwest Ethiopia, 2021: A cross-sectional study. *Heliyon*. 2022; 8(11): e11707. doi: 10.1016/j.heliyon.2022.e11707.

[51] Lema K, Abuhay N, Kindie W, Dagne H, Guadu T. Food hygiene practice and its determinants among food handlers at University of Gondar, Northwest Ethiopia, 2019. *International Journal of General Medicine*. 2020:1129-37. doi: 10.2147/IJGM.S262767.