Review

Exploring Factors Influencing Environmental Sanitation and Hygienic Practices in Street Food Markets: A Scoping Review

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Exploring Factors Influencing Environmental Sanitation and Hygienic Practices in Street Food Markets: A Scoping Review

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Highlights

Public health relevance—How does this work relate to a public health issue?

- Street food vending is a widespread commercial activity in busy urban locations globally which pose a potential risk of foodborne illnesses when sanitation and hygiene practices are inadequate.
- The study conducted a scoping review to synthesise evidence on factors influencing environmental sanitation and hygiene in street food markets.

Public health significance—Why is this work of significance to public health?

- Keys determinants influencing environmental sanitation and hygienic practices among street food vendors were socioeconomic and demographic factors; environmental and infrastructural influences; personal and behavioural influences on hygiene practices; food handling and safety practices, and regulatory compliance and oversight.
- Compliance with food safety measures to improve hygiene standards, reduce contamination risks, and promote safer food handling practices

Public health implications—What are the key implications or messages for practitioners, policy makers and/or researchers in public health?

- Public health strategies should include development of preventive measures and targeted interventions that can help reduce health risks associated with the consumption of street food
- Policy makers and research should use the findings to design and implement regulations that enhance environmental sanitation standards and promote hygienic practices among SFVs.

Abstract

Background: Street food vending is a prevalent commercial activity in busy locations worldwide. Street-vended meals may potentially cause foodborne illnesses, especially if environmental sanitation and hygienic measures are lacking during handling. *Objective:* This scoping review explored and synthesised existing evidence regarding factors influencing environmental sanitation and hygienic practices in street food markets. *Methodology*: The review was performed using the Arksey and O'Malley approach. A systematic search was conducted in four databases: Scopus, Science Direct, Web of Science, and the Sabinet African Journals databases, and 570 articles were retrieved. After removing three duplicate articles, two independent reviewers screened 567 articles using the Rayyan software tool. A total of 16 articles were included in the final sample and data were extracted using a pre-existing table. A synthesis matrix was used to compile findings that addressed the review questions from each source and their existing interconnections. *Data analysis*: Furthermore, the data

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were analysed using the Taguette software and guided by Braun and Clarke's six steps of data analysis. *Results:* The evidence revealed that factors influencing environmental sanitation and hygiene practices in street food markets are socioeconomic and demographic factors, environmental and infrastructural influences, personal and behavioural influences on hygiene practices, food handling and safety practices, and regulatory compliance and oversight. *Conclusion***:** These factors influence environmental sanitation and hygiene practices in street food markets. These influences highlight the need for targeted interventions to enhance hygiene standards, mitigate contamination risks, and promote safer food handling procedures.

Keywords: environmental sanitation; hygienic practice; cleanliness; street food; food markets; food stalls; street food vendor

1. Introduction

Street food markets (SFMs) play a significant role in addressing the nutritional requirements of urban populations globally [1]. SFMs often offer diverse, affordable, and culturally rich food options. The presence of street food serves as a reflection of the nation, area, and individual identities [2]. Furthermore, street food diversity allows residents, including those with limited financial resources, to access a variety of meals, contributing to a balanced and culturally inclusive diet. Moreover, the convenience of street food is unparalleled. These markets are strategically located in busy areas, providing quick and accessible meals for people on the go [3].

Furthermore, SFMs serve as culinary hubs, showcasing the rich tapestry of cultural and culinary diversity within urban environments. They offer an array of dishes that reflect the multicultural nature of cities, allowing residents to explore and appreciate different cuisines [4]. Street food vendors (SFVs), often local entrepreneurs, contribute to the economic vibrancy of urban areas [5]. Their businesses create employment opportunities and stimulate local economies.

Although SFMs address the nutritional needs of urban populations, their unregulated nature raises legitimate concerns about environmental sanitation and hygienic practices. The informal and often ad hoc nature of street food vending can pose challenges related to food safety, public health, and the overall well-being of consumers [6]. SFMs are frequently characterised by a lack of stringent regulatory oversight compared with formalised food establishments [7]. The absence of comprehensive regulations may result in varying hygiene standards, potentially exposing consumers to foodborne risks. Foodborne diseases and health risks have become a worldwide public health issue because of globalisation in food supply chains [8]. Unsafe food causes 420 000 fatalities and 600 million cases of foodborne illness annually worldwide [9]. Furthermore, World Health Organization reported that approximately 33 million life years are lost annually worldwide because of the consumption of hazardous food [9].

Another concern is that many SFVs operate in environments with limited infrastructure for proper waste disposal, water supply, and sanitation facilities. Inadequate infrastructure hampers vendors' ability to maintain hygienic practices, increasing the risk of contamination [10]. Other contributory factors to outbreaks of foodborne diseases include unsafe food sources, contaminated raw food items, inadequate food storage practices, substandard personal hygiene throughout food preparation, insufficient cooling and reheating of food products, and extended breaks during food preparation and consumption [11].

Additionally, the mobile and transient nature of street food vending presents challenges for consistent monitoring and enforcement of hygiene standards. Vendors may operate in different locations, making it difficult for regulatory authorities to ensure compliance with sanitation requirements [12]. SFVs, particularly in informal settings, may have limited access to training programs on food safety and hygiene practices. A lack of resources, both financial and educational, can hinder their ability to implement and adhere to best practices [13]. The risk of contamination is exacerbated by the challenges associated with maintaining appropriate food management practices

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and limited storage facilities. Factors such as improper temperatures, cross-contamination, and inadequate protection from environmental contaminants may compromise food safety [13].

Despite the increasing body of literature on SFMs and their impact on urban food systems, the literature suggests that inadequate hygiene practices remain a substantial risk factor contributing to the prevalence of foodborne diseases [14]. The present scoping review provides a comprehensive picture of the current level of knowledge on the elements affecting environmental sanitation and sanitary practices in the food street sector. By exploring the multidimensional aspects of this topic, the review aims to inform policymakers, researchers, and practitioners on strategies for improving food safety and hygiene in these dynamic settings.

2. Materials and Methods

The current scoping review was conducted following the existing framework proposed by two authors [15,16]. The steps of the framework include composing the review question, developing a search strategy, screening, extracting data, synthesising data, and analysing data.

2.1. Composing Review Question

The review question was formulated according to the PCC mnemonic elements (P-participants, C-concept, C-context) [17]. In application, participants were SFVs, the concept was environmental sanitation and hygienic practice, and the context was a street market.

Therefore, the composed question was: "What evidence exists on factors influencing environmental sanitation and hygiene practices among food vendors in street markets?"

2.2. Literature Search Strategy

Initially, a preliminary search was conducted to prevent redundancy in exploring the same topic. The keywords for the current review encompassed environmental sanitation, hygiene practice, street food, and food markets. Synonyms were incorporated to construct a comprehensive search string using MeSH with the assistance of a University of Johannesburg (UJ) librarian [18]. The search was conducted by the student with the assistance of a UJ librarian from March to April 2024. Boolean operators ("OR" and "AND") were used when exploring databases to connect and define the relationships between search terms [19]. The database search yielded a significant collection of 570 articles, highlighting a variety of sources relevant to the research topic. Fifteen papers were obtained from Sabinet African Journals, 25 from Science Direct, two from Scopus, and a substantial majority (n=528) from Web of Science. No additional records were identified in the World Health Organization library or various university repositories during the grey literature search, including dissertations, theses, and reports.

Inclusion criteria for this review were articles published from 2014 were considered. To ensure scientific integrity, it was recommended that the literature analysed be less than 10 years old [20]. Additionally, articles written in English were considered to ensure that language barriers do not hinder the understanding of the articles and the review process. The included articles focused on environmental sanitation and hygienic practices (concept) in SFMs (context) operated by vendors (participant), ensuring that they are related to the topic under investigation. For this study, the exclusion criteria were articles published before 2014 and those published in any language other than English.

2.3. Screening

All retrieved articles (n=570) were imported into the Rayyan software application by the first author [RA] for screening and organised storage. Rayyan's automatic duplicate detection feature identified duplicated articles (n=3), resulting in 567 articles eligible for further screening. The first author and independent reviewer performed double screening to reduce biases and ensure consistency [21]. Of the 567 articles, 548 were excluded due to irrelevance based on their titles and

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abstracts. Of the 19 articles included for full-text screening, three were excluded, and 16 were included in the final sample for data extraction. All disagreements during screening were resolved through discussion. The screening process is illustrated in the below Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) diagram (see Figure 1).

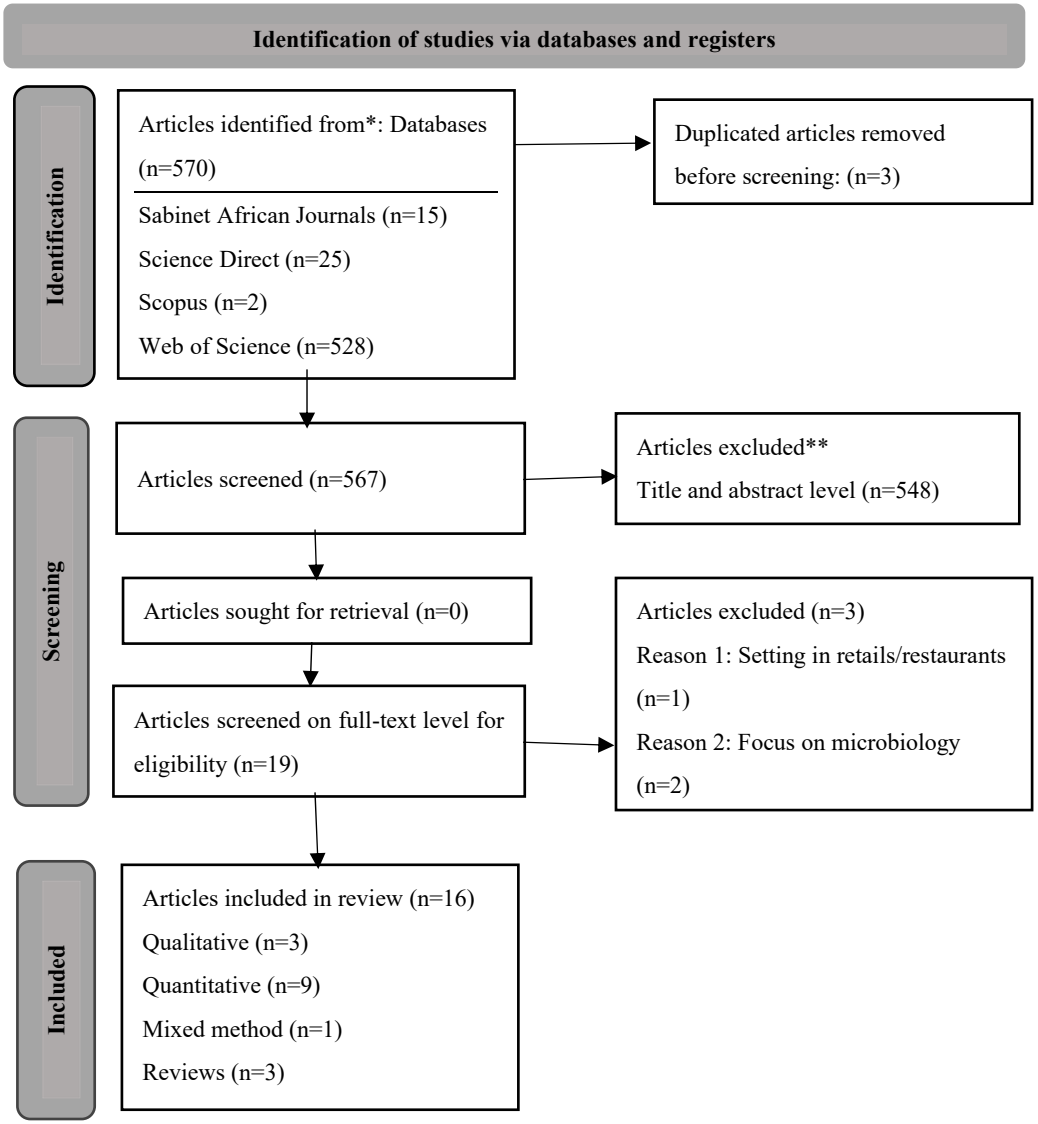

Figure 1. PRISMA diagram [22].

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2.4. Extraction of Data

A pre-existing extraction table was deployed as a data collection tool to ensure accuracy and consistency [23]. The data extraction table was piloted using a sample of five articles that formed part of the data to be analysed [24]. The two reviewers worked independently to extract data from all the included studies [25]. Assigning two independent reviewers to extract data was a robust approach that helped ensure consistency and reliability in the data extraction process. Any data extraction inconsistencies that arose between the two reviewers were resolved through discussion [26]. The extracted data encompassed study characteristics (author, study title, setting, design, and sample), methods (data collection data analysis, and ethics), and findings, as outlined in Table 1.

Table 1. Data Extraction.

	STUDY CHARACTERISTICS		METHODS		FINDINGS
1	**Author**	Kalitanyi, 2021	**Data collection**	**Data analysis**	• Understanding" green practices. • Of all the participants, eight (80%) said that they swept the area and cleaned the tables that were used to pack fruits and vegetables. Of the 80%, some added that they cleaned their places whenever it was dirty, while others said that they cleaned every morning before unpacking their produce and selling it to customers. • A female participant stated that she washed the produce at home and threw away the ones that were getting old, while a male participant added that he always had a bottle filled with water and sprinkled the fruits now and then, and the vegetables were packed in plastic. • Most (seven out of ten, 70%) of the participants did not know if there were any formal regulations to follow, and some were not sure. A participant said, "I did not know", but according to her knowledge, she was aware that she needed to stay clean at all times because in this line of business (street vending), customers have too many options and Therefore, they always consider cleanliness over all else.
	Title	Assessing green practices awareness among fruit and vegetable street vendors in Johannesburg	Semi-structured interviews	Coding	
			Ethics		
	Design	Qualitative: Exploratory research design	Not mentioned		
	Setting	Johannesburg			
	Sample	10 participants			

	STUDY CHARACTERISTICS		METHODS		FINDINGS
2	**Author/s**	Negessa et al., 2023	**Data collection**	**Data analysis**	• At the time of our observation, only approximately 2.8% of the SFVs washed their hands with clean water before handling or serving food. Most (384, 98.5%) SFVs did not have an apron. Approximately 255 (65.4%) of the SFVs' clothes were not (partially) clean and presentable. Nearly all (386, 99%) SFVs handled money while serving ready-to-eat foods. In contrast, hardly any (5.1%) of these washed their hands. Almost a quarter (26.7%) of the SFVs washed their hands after sneezing, coughing, or touching their face, nose, or other parts of their body. • Approximately 317 (81.3%) of the environments near the stalls were not clean; 87.7% of vending sites lacked access to water; and 95.4% had no adequate handwashing facilities, such as soap, detergents, water, or sinks. All (100%) vending sites had no waste storage or disposal facilities. More than three-quarters (76.7%) of the stalls or vending sites were near rubbish. More than half (51.8%) of the vending sites were close to open
	Title	Food Hygiene Practices and Associated Factors Among Street Food Vendors in Urban Areas of Gedeo Zone, Southern Ethiopia	Structured questionnaire and observational checklists	Data were analysed using International Business Machine's Statistical Package for Social Sciences (IBM SPSS) version 25	
			Ethics		

	Design	Quantitative: Community-based cross-sectional analytical study	The Institutional Ethical Review Board of Dilla University College of Medicine and Health Sciences provided ethical clearance (IRB 014/20-10)	drains that were not far from wastewater (53.8%). Flies were observed at over 77.9% of the vending sites. • Compared to SFVs who did not have regular inspection by healthcare workers, those who had regular inspections were 13.15 times more likely to practice food hygiene (Adjusted Odds Ratio (AOR)=13.15; 95% Confidence Interval (CI): 2.76-62.66).
	Setting	Gedeo Zone, Southern Ethiopia		
	Sample	390 participants		
	STUDY CHARACTERISTICS	**METHODS**		**FINDINGS**
	Author	McKay et al., 2016	**Data collection**	**Data analysis**
	Title	Street vendors in Patna, India: Understanding the socio-economic profile, livelihood and hygiene *practices*	Structured interviews	Not mentioned
3	**Design**	Qualitative (type not mentioned)	**Ethics**	
	Setting	Patna, India	Approval for the study was obtained from the Deakin University Ethics Committee	• Only eight participants had received formal hygiene training offered by the National Association of Street Vendors of India (NASVI) at the time of this study; however, most of the remainder were scheduled to complete the training at some point in the future. • Despite the small number of formally trained participants, most SFVs had some form of waste disposal (usually a rubbish bin or bag) nearby, and most had water near their food preparation area. This water is typically in the form of bore water stored in a large plastic drum. Additionally, four participants reported that they paid rupees (Rs) 30 each day for this water. • Most participants had soap available, either their own or shared with a neighbour, and were able to describe the link between unhygienic food and illness.
	Sample	31 participants		
	STUDY CHARACTERISTICS	**METHODS**		**FINDINGS**
	Author	Salamandane et al., 2020	Data collection	Data analysis
	Title	Handling of Fresh Vegetables: Knowledge, Hygienic Behaviour of Vendors, Public Health in Maputo Markets, Mozambique	Interview and observational analysis	IBM SPSS (IBM Corp, New York [NY], United States of America [USA]) version 26
4	**Design**	Qualitative (type not mentioned)	Ethics	
	Setting	Maputo	Not mentioned	• Most markets do not have access to tap water but to a well. Others have none of these resources; therefore, as an alternative, they buy water near the markets, at schools, or in the vicinity. However, a downtown market supplies tap water every day. • Regarding product behaviour, 46.7% of the SFVs do not wash the vegetables before selling them. Of those who wash their products before selling, only 7.5% use tap water, while the other 92.5% wash them in plastic containers using untreated water. • According to municipal entities, the cleaning of the markets is the responsibility of the SFVs at each vending stand; however, the Municipal City Council is responsible for waste collection throughout the city via the Procuradoria-Geral da República de Moçambique (PGRSS) department. For markets and fairs, the Health and Social Actions (PSAS) has designated large containers for depositing waste, which will be transported to the municipal disposal site. Garbage containers were observed in all the markets visited. These markets have a scheduled day of the week on which SFVs collect trash and clean the market according to market rules before opening to the public.
	Sample	75		

					• Most SFVs (82.7%) preferred to fill the trash bag after cleaning and throw it away in the garbage container at the end of the day, and 14.7% preferred to throw the trash in the garbage containers immediately after cleaning. • The Maputo City Council is the higher entity responsible for the management of markets and fairs through the Market and Fairs (PMF) department. A short interview with a team from this department revealed that they find it difficult to work with SFVs because of their resistance to change. For example, the PMF trained the SFVs in Maputo's new fish market but realised that they are averse to applying the new concepts of hygiene and quality that should exist in a high-quality market. • Once in the market, SFVs clean their place of sale or stand and usually store vegetables under different security risk conditions.
	STUDY CHARACTERISTICS		**METHODS**		**FINDINGS**
5	**Author**	Huynh-Van et al., 2022	Data collection	Data analysis	• In the central market, 100% of the interviewees said they stored their products below their stalls. In contrast, in the Fajardo market, 21.4% preferred to keep their products in the market behind the stalls, and another 21.4% preferred to take the products home. Most (42.9%) preferred to keep the products in private warehouses outside the market, paying daily fees. The remaining SFVs (14.3%) preferred to store their products in a private warehouse within the market. • Regarding food safety practices, only 15 of the 254 (5.9%) fixed SFVs and two of the 146 (1.4%) mobile SFVs stored food samples at 4–8 °C for 24 h, as required in terms of food safety investigations. Only 72 of the 254 (28.4%) fixed SFVs and 26 of the 146 (17.8%) mobile SFVs wore face masks. • Among the fixed food SFVs, the two criteria that were fulfilled by over 90% of SFVs were having adequate clean water (Criterion 1) and protecting food from dust, insects, and direct sunlight by placing it on tables or shelves at least 60 cm above the ground (92.1%, Criterion 8). • Multivariate Poisson regression showed that the compliance with the 10-food safety and hygiene criteria was associated with education level, total business capital, total area in use for business and mobile vending type. These factors, together with food safety training, continued to be significantly associated with compliance with the 10 food safety and hygiene criteria. Both multivariate models were statistically significant ($p < 0.01$) with R2 values of 20.9% and 34.4%, respectively. • SFVs with higher levels of education were more likely to achieve all 10 criteria for food safety ($p = 0.015$). The compliance score of SFVs who had received food safety
	Title	Factors associated with food safety compliance among street food vendors in Can Tho city, Vietnam: implications for intervention activity design and implementation	A structured questionnaire and an observational checklist	EpiData software version 3.1 (The EpiData Association, Odense, Denmark) and SPSS version 19.0	
	Design	Quantitative: Cross-sectional study	Ethics		
	Setting	Can To city	Department of Science and Technology of Can Tho City under the People Committee of Can Tho City, Vietnam, No. 12/HD-SKHCN		
	Sample	400 participants			

				training was almost five times higher than that of SFVs who had not received food safety training. • Up to 85.8% of fixed SFVs regularly used plastic bags instead of newspapers, used, or recycled paper to package food, while 76.7% of mobile SFVs sometimes followed this practice. • There was a significant difference in access to clean water at food vending sites between fixed and mobile SFVs, with 99.2% of fixed SFVs and 67.4% of mobile SFVs supplying their vending sites with sufficient clean water, respectively.
STUDY CHARACTERISTICS		**METHODS**		**FINDINGS**
6	**Author**	Lui et al., 2024	Data collection / Data analysis	• The data revealed that 80% of respondents had a licence, 64% had a health permit, and only 6% received food safety training organised by local authorities. • The survey showed that although inspections were widely performed, routine food safety supervision and inspection were not 100% effective, many inspectors lacked food safety knowledge and food industry experience, and there was an urgent need for qualified SF safety inspectors. • Most of the SFVs had a low level of personal hygiene. For example, 90% of the SFVs touched food with bare hands during food preparation and service, which is acceptable to the public. However, 82% washed their hands before handling food, and 62% wore an apron or overall, while only 4% regularly wore a hat. Moreover, 46% were observed to have improper practices, such as a lack of hand washing after using the toilet or handling contaminated materials. Some respondents had bad habits, such as picking their nose, spitting, or sneezing when there were no customers. • Unsanitary handling of SFVs may be another source of food contamination. The survey showed that improper handling of raw materials, which may be contaminated with foodborne pathogens and chemicals (WHO, 2007), was widely identified during the preparation stage. It was a common practice (98%) among SFVs that raw materials were not adequately washed; some were unwashed. For example, unwashed raw meat and Chinese cabbage were directly cut into small pieces to make dumpling fillings. Additionally, 79% of the respondents kept vegetables and raw meat together, 48% cut raw meat and vegetables on the same cutting board and used the same knife, and 88% did not wash their utensils properly before and after each use.
	Title	Urban street foods in Shijiazhuang city, China: Current status, safety practices and risk mitigating strategies	Questionnaire / SPSS version 12.0	
	Design	Quantitative (type not mentioned)	Ethics	
	Setting	Shijiazhuang city	Not mentioned	
	Sample	50 SFVs		
STUDY CHARACTERISTICS		**METHODS**		**FINDINGS**
7	**Author**	Rakha et al., 2022	Data collection / Data analysis	• SFVs display uncovered food to enhance sales and attract customers in busy areas. Common food vending sites are near schools, bus stops, parking areas, construction sites, public places, and nearby hospitals. Pushcarts, display wooden tables, aluminum
	Title	Safety and quality perspective of street-	Not mentioned / Not mentioned	

		vended foods in developing countries		trays, bowls, or chop bars are examples of mobile or stationary vending that employ open or protected primitive constructions.
	Design	Narrative review	Ethics	• The temperature used during the cooking and frying of street foods is sufficiently high to destroy vegetative cells; however, spore-forming microorganisms can survive under such conditions. However, the manner in which street foods are prepared, handled, and vended predisposes them to recontamination, cross-contamination, and transmission of pathogens or foodborne illnesses.
	Setting	Not applicable	Not mentioned	
	Sample	Not mentioned		• Most SFVs use non-disposable utensils and cutlery for serving food items. They often wash plates and cups with a detergent solution and rinse them with stored cold water, while in some cases, they clean utensils with towels. Although some SFVs may change the washing or rinsing liquids a few times, others use the same liquid for the entire day. These practices create a favourable environment for the contamination of street-vended foods. The use of the same set of cutleries (not properly cleaned after each use) leads to cross-contamination and transmission of infectious diseases among unsuspecting consumers. • Other inappropriate handling practices of SFVs include the use of a charcoal stove to keep cooked food items hot for an extended period, which is insufficient to control the proliferation of toxic microbes. It is believed that continuous reheating of cooked meals at temperatures below 40 °C may enhance Salmonella contamination. • Street foods are often prepared several hours before consumption. They are placed on carts without appropriate temperature control, leading to microbial contamination. In Africa, raw meat cuts are placed in the open because SFVs do not have adequate washing and storage facilities; this leads to the accumulation of airborne microbial contamination.
STUDY CHARACTERISTICS			**METHODS**	**FINDINGS**
8	**Author**	Hill et al., 2019	Data collection / Data analysis	• Most SFVs, regardless of their level of education, fell within the average food and knowledge categories. However, the highest prevalence (83%) of those who obtained average food and knowledge scores had a diploma, with none of these SFVs falling in the low food and knowledge category. • Approximately 15% of SFVs obtained good food and knowledge scores; of these, 57.3% obtained average food and knowledge scores, and 28% obtained low food and knowledge scores. More females than males fell into the good food and nutrition knowledge categories (17.2% vs. 11.8%, respectively).
	Title	Food sold by street food vendors in Cape Town and surrounding areas: a focus on food and nutrition knowledge as well as practices related to food preparation of street food vendors	Questionnaire and observation checklist / Microsoft Access 2010, IBM SPSS version 19, ATLAS.ti version 7.0.83	

	Design	Quantitative: Cross-sectional study	Ethics		• In contrast, most non-South Africans (62.4%) had permits to sell food, with 7.4%, 2.7%, and 0.7% having a certificate of acceptability, a lease to sell food, and a concession letter, respectively. • Food was not covered by 56.7% of SFVs. A total of 39% used their hands to pick up food items, with only 6% wearing gloves. • This study clearly showed that the hygiene practices of SFV handlers were not optimal. The handlers were not properly clothed, and many of their practices could lead to microbial contamination of food, which could place the public at risk of food poisoning and other disease conditions. • Additionally, many SFVs lack running water, electricity, refrigerators, and waste disposal systems. Major sources of possible contamination include food preparation practices, lack of cooking and serving utensils, handling of raw and cooked foods, storage methods, temperature abuse of cooked foods, and poor personal hygiene of SFV operators.
	Setting	Cape Town	University of the Western Cape's Ethics Committee Registration no: 14/4/17). Human Sciences Research Council (Protocol No REC13/20/02/13). Permission from the City of Cape Town (ID No. 10341)		
	Sample	831 participants			
	STUDY CHARACTERISTICS		**METHODS**		**FINDINGS**
9	**Author**	Cortese et al., 2016	Data collection	Data analysis	• SFVs (29, 67%) reported washing their hands on average four times a day while working, whereas 33% (14) did not wash their hands at all during working. Of those who washed their hands, 24% (seven) reported using water only. • During observations, it was also identified that 95% (41) of the SFVs cross-manipulated money and food without sanitising their hands.
	Title	Food safety and hygiene practices of vendors during the chain of street food production in Florianopolis, Brazil: A cross-sectional study	Observation and structured interviews	Microsoft Office Excel and the statistical program Stata® 11.0 (StataCorp, College Station, TX, USA)	
	Design	Quantitative: Cross-sectional study	Ethics		
	Setting	Florianopolis, Brazil	This study was approved by the Ethics Committee in Research with Human Beings (CEPSH) of the Federal University of Santa Catarina (UFSC) (protocol 2306).		
	Sample	43 participants			
	STUDY CHARACTERISTICS		**METHODS**		**FINDINGS**
10	**Author**	Moges et al., 2024	Data collection	Data analysis	

	Title	Sanitary condition and hygienic practice of street food vendors in selected towns of Ethiopia: A cross-sectional study addressing public health concern	Questionnaire and observational checklist	SPSS version 23.	• Only 42% of the respondents had knowledge of foodborne diseases, as assessed by asking the respondents to mention at least two types of foodborne diseases. • Most (77%) of the SFVs' vending stalls were not clean. However, 68% of the SFVs had functional handwashing facilities, while 80% of the vending stalls had no access to toilets. • Trained food handlers were twice as likely to have good food safety practices than non-trained food handlers (AOR = 2.4, 95% CI = 1.6–3.5). Food handlers who had a medical checkup were 1.5 times more experienced in hygienic practices than their counterparts (AOR = 1.5, 95% CI =1.1–2.3). • Men were 1.6 times more experienced in good hygienic practices than women (AOR = 1.6, 95% CI = 1.1–2.6). The difference between male and female SFVs could be attributable to the higher proportion of men who received food safety and hygienic practice training (27%) than that of women (16%). Food handlers with little experience were 3.6 times more likely to have good hygienic practice than workers who had more years of experience (AOR = 3.6, 95% CI = 1.5- 8.6). • The overall 'good knowledge' level of the respondents was 89.6% CI (0.88, 0.91). Regarding hygienic practices, 93% of respondents had frequent handwashing habits with soap and water before starting food preparation, and 97.8% practiced handwashing after using the toilet.
	Design	Qualitative: cross-sectional study	Ethics		
	Setting	Ethiopia	Ethical clearance was obtained from the Jimma University Institute of Health Institutional Review Board		
	Sample	1168 participants			
	STUDY CHARACTERISTICS		**METHODS**		**FINDINGS**
11	**Author**	Hassan & Fweja, 2020	Data collection	Data analysis	• Among SFVs, food covering was moderately practiced (57.4%); however, protection of food from flies and dust, as well as serving food hot or reheating, were not observed by many SFVs, at 60% and 64.9%, respectively. • The findings on environmental hygiene of SFMs indicated that only two environmental hygiene indicators (availability of waste bins and absence of rats and/or cockroaches) were complied with by half or more than half of the SFVs. The compliance of SFVs with the other indicators (clean environment at vending sites, presence of refuse site, and hand washbasin and soap) was below 50%. • It was established that SFMs are poorly maintained, and SFVs exercise moderate adherence to both food safety measures and hygienic practices. The greatest risk is food exposure to the temperature danger zone, serving food with bare hands, and low compliance with regulations requiring soap and water for handwashing in restaurants by a significant fraction of surveyed SFVs after a toilet visit. • Data on environmental hygiene at the vending sites indicated that fewer than 50% of the sites had both a washbasin and soap, and only 50.2% and 42.6% of the vending
	Title	Food Hygiene Practices and Safety Measures among Street Food Vendors in Zanzibar Urban District	Questionnaire and observation	The data analysis was conducted using IBM SPSS Software version 20.0 (Armonk, NY, USA)	
	Design	Quantitative: descriptive cross-sectional	Ethics		
	Setting	Tanzania	Not mentioned		
	Sample	265 participants			

					sites had waste bins and/or refuse receptacles, respectively. Adherence to safe food handling practices was reflected in the adequate protection of food from flies and dust (40.8%), cold storage of food (28.3%), saving food hot or reheating before sale (35.1%), dishing out food with a spoon/ladle (53%), and food covering (57.4%). • Hygienic and sanitary practices among SFVs demonstrated the following levels of adherence: washing hands with soap after toilet use ('always' 33.2%, 'sometimes' 46.8%), washing hands with soap before preparing food ('always' 63%, 'sometimes' 34%), keeping fingernails clean (98.5%), protecting hair (33.6%), and using an apron (29%). • The results indicate poor environmental sanitation and waste handling practices, moderate adherence to food handling practices, safety measures, and hygiene. • Based on these results, it is suggested that food safety and hygiene training should be a prerequisite for starting a food-vending venture and be complemented with regular monitoring.
	STUDY CHARACTERISTICS		**METHODS**		**FINDINGS**
12	**Author**	Nizame et al., 2019	Data collection	Data analysis	• At the time of spot checks, about one-third of the 600 SFVs (190, 32%) had a handwashing location with water only, whereas only 11% (68) had soap and stored water. SFV stalls with a stipulated location were more likely to have water at handwashing stations (46%, 159 of 345) than ambulant SFVs (12%, 31 of 245; $P < 0.001$). • In the qualitative study, some SFVs (five of 32) reported that carrying soap and water is not possible during food service periods as they frequently move locations. • In the qualitative study, the majority (45 of 64) of the respondents perceived that customers select an SFV based on the tastiness of the food, whereas no one mentioned the need to maintain hygiene during food handling. • The lack of facilities affected the rates of handwashing with soap; 13 SFVs confirmed that during structured observations, especially at SFVs' stalls where both water and soap were rarely present. • Between 5% and 45% of the food served by SFVs was covered. • Most SFVs, regardless of their level of education, fell within the average food and knowledge categories. However, the highest prevalence (83%) of those who obtained average food and knowledge scores had a diploma, with none of these SFVs falling in the low food and knowledge category.
	Title	Hygiene in Restaurants and among Street Food Vendors in Bangladesh	Interviews and a questionnaire	Qualitative: Thematic analysis. Quantitative: Not specified	
	Design	Mixed method (type not mentioned)	Ethics		
	Setting	Bangladesh	The protocol for this study was reviewed and approved by the Institutional Review Board		
	Sample	Qualitative: 16 participants; Quantitative: 600 participants			
	STUDY CHARACTERISTICS		**METHODS**		**FINDINGS**
13	**Author**	Sepadi & Nkosi, 2022	Data collection	Data analysis	

	Title	Environmental and Occupational Health Exposures and Outcomes of Informal Street Food Vendors in South Africa: A Quasi-Systematic Review	Data extraction table	Descriptive analysis	• Other difficulties encountered by SFVs, as noted by Studies 1 to 7, included a lack of access to services such as water, ablutions, and waste disposal facilities, as well as the use of communal water points instead of those found within their stalls. • SFVs reported difficulties owing to limited access to municipal services, such as water availability and accessibility, as well as waste management. • Owing to a lack of access to water, proper food preparation equipment, and wash-up facilities, informal SFVs face difficulties complying with various local government regulations, such as street trading by-laws and regulations R638 of 22 June 2018 which focus on public health and ensuring food safety, as well as food premises' structural compliance. • Street or outdoor workplaces with no formal building structure, such as tents, boxes, or mobile food trailers, are common for informal SFVs. These SFVs operate in public spaces (for example, storefronts, sidewalks or pavements, and public outdoor markets) near downtown streets, markets, or parks.
	Design	A quasi-systematic review	Ethics		
	Setting	South Africa	Not applicable		
	Sample	Nine articles			
STUDY CHARACTERISTICS			**METHODS**		**FINDINGS**
14	**Author**	Aluko et al., 2024	Data collection	Data analysis	• The handling of utensils, used in serving cooked whole meals to customers, revealed that most SFVs (129, 80.6%) washed and re-used serving spoons periodically. The study further revealed that only 34 (21.2%) 'always' separated raw food materials from cooked food, while six (3.8%) respondents 'always' stored food in the refrigerator. However, the length of time that food was stored by most respondents (105, 65.6%) varied between half a day and one week. In addition, well over half (121, 75.6%) of respondents did not refrigerate food, while approximately a quarter of respondents (26, 16.2%) did not have facilities for food storage. • In addition, only a few respondents (27, 16.9%) 'always' practiced handwashing after using the toilet, while others washed hands 'often' (126, 78.8%) and 'occasionally' (seven, 4.3%). Moreover, most respondents (123, 76.9%) dried their hands with a general reusable towel after handwashing. • Most respondents (142, 88.8%) were aware that food can cause illnesses, while 146 (91.2%) associated diarrhoea with foodborne infections. • In this study, most respondents (70.6%) had manually operated hand-dug wells (HDWs) that supplied water continuously throughout the year and were located within 10 m of food vending premises. • Open defaecation by 49.4% SFVs, coupled with the fact that only 16.9% of respondents"" always' wash their hands after toilet use, predisposes food to contamination in the food chain, even if sound food processing methods are followed.
	Title	Evaluation of food safety and sanitary practices among food vendors at car parks in Ile Ife, southwestern Nigeria.	Questionnaire	SPSS version 16	
	Design	Quantitative: Cross-sectional study	Ethics		
	Setting	Ile Ife, southwestern Nigeria.	Not mentioned		
	Sample	160 participants			

				• However, a major concern was that 45.6% of respondents continued working despite having foodborne illnesses, probably to avoid income loss during the treatment period and due to poor knowledge of the possibility of food contamination from food vending activities when sick.
	STUDY CHARACTERISTICS		**METHODS**	**FINDINGS**
15	**Author**	Tuglo et al., 2021	Data collection: Questionnaire; Data analysis: Microsoft Excel 2016 spreadsheet and IBM SPSS version 24	• Almost all (381; 93.6%) of the street vendors of cooked food knew about the need to wash their hands for one minute using water and soap before handling food. • Most (239; 58.7%) SCFHs knew that an uncooked meal should be kept individually from a prepared meal; 363 (89.2%) knew that treated water should be used for cooking; 363 (89.2%) knew that cockroaches and house flies should not be allowed into the kitchen; and 274 (67.3%) knew that wiping cloths can spread microorganisms and cause disease • Most (313; 76.9%) SCFHs knew that the same chopping board should not be used for uncooked and prepared foods if it appears washed; 336 (82.6%) knew that a cooked meal should stay hot before serving (more than 60 °C); and 275 (67.6%) knew that excess food should be kept at a zone temperature and eaten by the following mealtime. • However, most (235; 57.7%) SCFHs did not know that food cooking utensils should not be cleaned using tap water only. Additionally, 202 (49.6%) SCFHs did not know that fresh meat should not be stored anywhere in the refrigerator once it has cooled.
	Title	Food safety knowledge, attitude, and hygiene practices of street-cooked food handlers in North Dayi District, Ghana		
	Design	Quantitative: Descriptive cross-sectional study	Ethics	
	Setting	North Dayi District, Ghana	Approval was sought from the Ghana Health Service, North Dayi District Health Directorate	
	Sample	407 participants		
	STUDY CHARACTERISTICS		**METHODS**	**FINDINGS**
16	**Author**	Salamandane et al., 2023	Data collection: Microsoft Excel; Data analysis: Not specified	• Approximately 60% to 90% of these SFVs have never benefited from training on good production and handling practices for ready-to-eat (RTE) foods. • The combination of factors, such as poor hygiene practices by food handlers and the lack of facilities, namely, potable water, inadequate infrastructure, food storage at temperatures that favour microbial growth, and exposure of food to animals, including rodents and insects, is often listed as a major problem. • Many SFVs opt for reusable plates, underlining their commitment to environmental sustainability. However, due to the lack of facilities, mainly the lack of tap water and dishwashing facilities, these utensils are usually washed in a basin with standing water, which prevents them from being cleaned correctly. • The perception of street food quality results from a comparison between customer expectations and perceived performance. This perception is based on the type of service, including the organisation of the point of sale, cleanliness, and consumer safety (in terms of health), among other aspects.
	Title	The Socioeconomic Factors of Street Food Vending in Developing Countries and Its Implications for Public Health: A Systematic Review		
	Design	A systematic review	**Ethics**	
	Setting	Not applicable	Not applicable	
	Sample	50 articles		

	• Most street food consumers in Ho Chi Minh City, Vietnam, have poor knowledge about food safety and do not associate food safety with possible outbreaks of diarrhea-causing diseases.
The end.	

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2.5. Data Synthesis and Analysis

In this scoping review, data analysis and synthesis were conducted simultaneously. Applying the six steps of data analysis [27], Step 1 involved the reviewer and co-reviewer thoroughly reading and re-reading the extracted data to gain familiarity with its content and context. This step allowed both reviewers to gain a deep understanding of the dataset; Step 2 involved labelling segments of the data with descriptive or interpretive codes that capture the essence of the content. In total, there were 19 descriptive codes. In Step 3, the reviewer and co-reviewer searched for patterns, similarities, and differences in the coded data. Recurring patterns of meaning or topics were clustered into five groups (theme identification). Data synthesis was incorporated in this step (developing themes) because both processes involve grouping recurring patterns of meaning or topics that emerge from the data. After theme identification, both reviewers revised the themes and codes to ensure they accurately represented the data. This also involved the removal of redundant codes, rearrangement of themes, and merging of similar themes to refine the analysis. Finally, five themes were defined and named to answer the review question. This step involved providing a clear description of what each theme represents and how it relates to the research question.

3. Results

3.1. Study Characteristics

The current scoping review included a total of 16 articles, with three studies conducted in South Africa (including one review), two studies in Ethiopia, two studies in India, and one each in Mozambique, Vietnam, China, Brazil, Tanzania, Nigeria, and Ghana. The last two reviews lacked a setting. Of the 16 studies considered, three were qualitative, nine were quantitative, one employed a mixed method, and three were literature reviews. All the examined papers had at least one aspect that influenced environmental sanitation and hygienic practices in SFMs. Five emerged themes were, namely 1.) Socioeconomic and demographic factors, 2.) Environmental and infrastructural influences, 3.) Personal and behavioural influences on hygiene practices, 4.) Food handling and safety practices, and 5.) Regulatory compliance and oversight are presented in the diagram below (see Table 2).

Table 2. Main themes and sub-themes.

MAIN THEMES	SUBTHEMES
Socioeconomic and demographic factors	• Gender • Education level
Environmental and infrastructural influences	• Availability and accessibility of water • Waste disposal management • Street food vending storage facility • Location of vending stalls
Personal and behavioural influences on hygiene practices	• The knowledge of SFVs on street food safety • Customer-centric preference • SFVs' personal hygiene practices
Food handling and safety practices	• The influence of food preparation and serving practices on hygiene and safety • The role of equipment in ensuring food hygiene and safety
Regulatory compliance and oversight	• Licensing SFVs • Inspections of vending stalls • Training of SFVs

The above themes and subthemes are presented in detail in the following section.

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3.2. Socioeconomic and Demographic Factors

The ability and willingness of street food market vendors to adhere to proper environmental sanitation and hygiene practices is influenced by socioeconomic and demographic factors, including gender and educational level.

Including gender and educational level.

3.2.1. Gender

Gender plays a significant role in influencing environmental sanitation and hygiene practices, with studies highlighting that female street vendors outperform their male counterparts in terms of hygiene performance and food knowledge. Studies have shown that gender has significant influences on environmental sanitation and hygiene practices among SFMs [28,29]. For example, female street vendors were reported to have better food hygiene practice performance than their male counterparts [28]. Furthermore, female vendors were found to have exhibited better food and nutritional knowledge than male vendors [2.

3.2.2. Educational Level

These studies shed light on the correlation between education levels and both hygiene practices and food knowledge among SFVs. Two studies reported on the relationship between education level and food hygiene practice, while the other two studies highlighted the relationship between education level and food knowledge. According to two studies, SFVs with higher levels of education performed well in terms of food hygiene practices [30,31]. For instance, both studies indicated that SFVs with college-level education and above were three and five times more likely to practice good food hygiene than those with no formal education. Although other authors did not compare the likelihood of food hygiene practice performance, they noted that SFVs with low levels of education had little knowledge of good hygiene practices when handling food [14,29].

3.3. Environmental and Infrastructural Factors

Environmental and infrastructural factors play an important role in ensuring the success of environmental sanitation and hygiene practices in street food vending. In this review, environmental and infrastructural factors include the availability and accessibility of water, waste disposal management, street food vending storage facilities, and the locations of vending stalls, as elaborated below.

3.3.1. Availability and Accessibility of Water

Availability and accessibility of water is an essential requirement for food street vendors to ensure food hygiene practice and environmental cleanliness. A study indicated that vendor behaviour regarding food safety depends on daily resources, such as water [32]. For example, vendors from central markets with access to tap water washed their products every day before selling [32]. Additionally, more than 90% of SFVs who had access to water complied with food safety [29]. Despite the importance of water, as demonstrated by two studies [31,32], one study indicated that SFVs still experience water shortages [33]. Two other studies stated that some vendors with no available water at their stalls resorted to buying from nearby markets or vicinities [34,35].

3.3.2. Waste Disposal Management

Effective waste disposal management is important for maintaining public health and ensuring the safe operation of SFVs, as it enhances environmental sanitation and promotes hygienic practices. Three studies explored the availability and types of waste management methods used by vendors operating in SFMs [32–34]. For example, two studies indicated that vendors used trash bags to manage waste [32,34]. This finding raises concerns about the ultimate disposal of these bags; are they

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collected by municipal services or improperly discarded? In contrast, another study noted that vendors had no form of waste disposal facility in their stall [33], highlighting a significant gap in infrastructure and support that may lead to environmental hazards and health risks.

3.3.3. Street Food Vending Storage Facility

Proper storage facilities ensure the quality and safety of food in SFMs. While efficient storage helps vendors maintain the freshness of ingredients and prevent contamination, the included studies noted that vendors lacked storage facilities and relied on improvisation to store their products or food [30–32,35]. For example, two studies observed that vendors had no food storage facilities [30,35], while one study stated that vendors stored food below the stand used for display [31]. Lastly, one more study stated that vendors stored food under unhealthy conditions, but did not specify those conditions [32].

3.3.4. Location of Vending Stalls

The location of vending stalls is a critical factor influencing not only the success and sustainability of SFVs but also environmental sanitation and hygiene practices. Findings from various studies reveal significant challenges and patterns in this context [30,33,36,37]. For instance, fixed stalls were found to provide better access to essential amenities, such as handwashing stations, than mobile stalls [36]. This result highlights a clear advantage of stationary stalls in fostering hygiene and safer vending practices. However, despite these advantages, studies have noted that most vendors operate using mobile vending setups, such as carts, tents, boxes, and trailers [33,37]. Another study stated that most street food stalls were near waste and open water drains, exposing vendors and consumers to health risks and compromising the overall appeal and safety of the street food market [30].

3.4. Personal and Behavioural Influences on Hygiene Practices

Personal and behavioural factors influence hygiene practices, especially in the food industry. In this review, these factors include vendors' knowledge of street food safety, customer-centric preferences, and vendors' personal hygiene practices, as elaborated below.

3.4.1. The Knowledge of Vendors on Street Food Safety

The safety of street food is significantly dependent on the knowledge and awareness of vendors regarding hygiene practices. Most articles in this review highlighted those vendors possessed knowledge of food hygiene practices, which prompted them to implement measures that reduced cross-contamination [28,29,34–36,38,39]. For example, three articles indicated that vendors were aware of and could describe the association between food and illness, such as the link between diarrhoea and foodborne illnesses [34,35] and were able to mention two common foodborne illnesses [28]. Additionally, two other articles reported on the awareness of cleanliness, highlighting aspects such as personal cleanliness [38] and maintaining environmental cleanliness [39]. Finally, two other articles indicated that vendors had average knowledge of food hygiene [29,36].

3.4.2. Customers Centric Preference

Customer-centric preferences play a vital role in shaping food hygiene practices by encouraging vendors to uphold hygiene practices and creating a competitive environment for those who satisfy customer expectations. Two studies in this review reported that consumers are more likely to buy food from vendors who maintain a clean environment and exhibit good personal hygiene [14,38]. For instance, one study reported that customers prefer cleanliness over everything [38], while another highlighted that customers' expectations are cleanliness, well-organized stalls, and safety [14]. In contrast, one study indicated that customers chose vendors based on food presentation and tastiness, without mentioning anything regarding the maintenance of food hygiene during handling [36].

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3.4.3. Vendors Personal Hygiene Practices

Personal hygiene plays a fundamental role in food safety, as vendors are directly involved in food preparation and services. In this review, personal hygiene practices, such as handwashing, wearing clean attire, and using gloves, are significant measures that lessen the risk of contamination.

Several studies have indicated that handwashing practices among vendors exhibited varied levels of compliance and hygiene awareness [30,40–42]. For example, a study revealed that few vendors in Ethiopia washed their hands with clean water prior to food handling [30]. Notably, another study indicated that most vendors in China washed their hands properly before handling food [41]. Another study reported that some vendors washed their hands four times a day during work, while others did not wash their hands at all, and some used water only [42]. Moreover, another study showed varied toilet-related hygiene practices, stating that some vendors always washed their hands after toilet use, while others did so sometimes [40].

In addition to handwashing, other studies have pointed out inconsistencies in the use of aprons, head coverings, facial masks, and gloves, revealing gaps in adherence to hygiene practices critical for minimising contamination risks [29–31,40,41]. A study conducted in Ethiopia reported that most vendors did not wear aprons while working [30]. In contrast, a study conducted in China indicated that more vendors used aprons [41], whereas another study noted lower compliance [40]. Head protection among food vendors exhibited noticeable differences as well; minimal compliance noted [41], while another study observed a higher rate [40]. Facial mask usage was equally concerning, with lower adherence among fixed and mobile vendors reported [31]. Finally, another study documented that few food vendors used gloves [29].

3.5. Food Handling and Safety Practices

In this review, food handling and safety practices involve implementing stringent hygiene measures, using appropriate equipment, and adhering to established protocols to safeguard food from contamination, as presented below.

3.5.1. The Influence of Food Preparation and Serving Practices on Hygiene and Safety

The manner in which food is prepared and served significantly impacts its hygiene and safety. In this review, the articles included indicate that SFVs have contaminated the food they serve to consumers through various means [29,30,35,41,42]. For instance, food contamination among street vendors has been attributed to several practices that could significantly increase the risk of foodborne illnesses, such as vendors working while ill [35], handling food with bare hands [29,41], and vendors handling both money and food without sanitising their hands [30,42].

3.5.2. The Role of Equipment in Ensuring Food Hygiene and Safety

The equipment used during food preparation significantly impacts food hygiene and safety. Four studies examining the role of equipment in food preparation highlighted that SFVs used non-disposable utensils, which contributed to and supported environmental sustainability [14,35,37,41]. However, two studies noted incorrect ways vendors used to wash these reusable utensils [14,37]. For example, one study revealed that SFVs washed their reusable utensils using standing water, leading to inadequate cleaning, as standing water can harbour bacteria and other pathogens [14]. Furthermore, another study reported that some SFVs used cold water and towels to clean utensils, which is less effective in removing contaminants [37]. In addition to these unsafe washing techniques, one more study stated that vendors cross-used utensils, such as chopping boards and knives, for cutting raw meat and vegetables without washing them in between [41]. One study did not report on the specifications of how the utensils were washed [35].

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3.6. Regulatory Compliances and Oversight

Maintaining environmental sanitation and hygiene practices in SFMs depends on regulatory compliance and oversight, which ensures customer health and safety and helps vendors follow the municipal and governmental rules in which they operate. In this review, regulatory compliance and oversight include licencing SFVs, inspecting vending stalls, and training SFVs.

3.6.1. Licensing Street Food Vendors

Licencing ensures that SFVs operate legally and responsibly, as it involves issuing permits that confirm vendors meet requirements for hygiene, infrastructure, and operational standards. In countries such as China, most SFVs possess licences compared to vendors operating in South Africa. For example, a study conducted in China indicated that more than 80% of the street vendors in Shijiazhuang city had licences, with 64% of them having permits to operate [41]. In contrast, a study in South Africa revealed that among the street food vendors who were operating, only 64.2% non-South Africans had permits, 7.4% had certificates of acceptability, and 0.7% had concession letters [29]. It is worth noting that among 16 included articles, only two studies reported licencing of SFVs [29,41].

3.6.2. Inspections of Vending Stalls

Regular inspections of street vending stalls are essential in ensuring adherence to health and safety protocols as well as identification of potential risk and prompt mitigation. Inspectors assess factors like cleanliness, storage, and food handling practice which remain the responsibility of the vendors to help sustain public health standards [32]. A study conducted in Ethiopia revealed that vendors subjected to inspections were more likely to adhere to excellent food hygiene practices than vendors without inspections [30]. Another study indicated that inspections were regularly conducted; however, it did not report on the influence of these inspections on vending practices [41]. In contrast, two studies revealed difficulties in compliance during inspections. One study reported that due to a lack of water, toilets, and waste bins, vendors were unable to adhere to the regulations [33], while the other study indicated that the compliance rate was below 50%, but did not reveal the reason for low compliance [40].

3.6.3. Training of Street Food Vendors

Training courses provide SFVs with the knowledge and skills required to follow food safety practices. Two studies found that food hygiene procedures were better among street vendors who underwent training than among those without such training [28,31]. For example, trained vendors were found to be twice as likely to follow proper food safety practices as untrained vendors [28]. Additionally, the food safety compliance score of vendors who got training was reported to be five times higher than that of untrained vendors [31]. In contrast, two studies reported on the deficiencies of training; however, they did not state the impact of these deficiencies on food handling practice and safety [14,34]. For example, a study reported that only eight participants were trained at the time of the study, and the remainder were scheduled to receive training [34]. According to another study, most vendors received no training on good production and handling practices [14].

4. Discussion

In this review, five main themes that were discussed are socioeconomic and demographic factors, environmental and infrastructural influences, personal and behavioural influences on hygiene practices, food handling and safety practices, and regulatory compliance and oversight.

In the current review, studies have indicated that female vendors are reported to have better performance of good food hygiene practice and have better food knowledge than male vendors. These findings corroborate studies conducted in Kenya [43], Malaysia [44], Nigeria [45], and the Philippines [46]. The reason for female vendors to exhibit good food hygiene practice and knowledge

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may be attributed to the fact that in many cultures, women are known to be responsible for cooking and preparing food at home; this means men may not have the same rooted practice of hygiene. Women's familiarity with food hygiene practices, such as proper handwashing, cooking, and storage techniques, helps ensure the safety and quality of the food they serve. This home experience may improve their skills and knowledge regarding food hygiene practices. Moreover, women may be more influenced by societal norms and expectations in terms of hygiene and cleanliness, leading to better practices. However, research has indicated that male vendors may prioritise speed and efficiency more than hygiene, especially in busy places where quick service is essential [47]. These insights highlight the need for targeted interventions to support male vendors in improving their food hygiene practices.

Although sex significantly affects food hygiene procedures among SF vendors, the level of education was also shown to be a factor influencing their knowledge and compliance with food safety standards. Studies included in this review reported that more educated SF vendors often follow hygienic standards better than those with lower educational levels. Other studies also reported similar findings [47,48]. These findings could be due to the fact that vendors with higher levels of education are more likely to grasp food safety requirements, correct food handling, and the consequences of poor hygiene, which results in better compliance with hygiene protocols. Conversely, less educated vendors are more likely to engage in unsanitary behaviours because they may lack official food safety training. In contrast, studies conducted in India and China suggest that education does not have a significant impact on vendors' knowledge and attitudes toward food safety practices [49,50]. These findings challenge the assumption that formal training alone is sufficient to improve compliance, highlighting the potential influence of other factors, such as experience, cultural norms, and economic pressures.

The findings of this review revealed that vendors with access to water complied with food safety measures such as washing the produce prior to selling. These findings support those previously reported which state that water is used as an instrument to maintain hygiene and sanitation throughout the food production chain until consumption [51,52]. These studies complement each other by showing consistent evidence that water availability strengthens adherence to hygiene protocols and plays a vital role in food safety management. However, other findings indicated that vendors continued to experience water shortages during their vending operations. Similarly, in Vietnam, a study noted the lack of clean water in vending stalls [53]. The similarities among the studies may be attributed to economic constraints that affect vendor operations and shared infrastructural deficiencies. To counter this shortfall, it is recommended that local governments and municipalities prioritise the implementation of portable water distribution systems by expanding piped water to vending stalls.

Building on the important role of water access in food safety compliance, another significant factor influencing hygiene standards in SFMs is waste disposal management. The findings of this review indicate that vendors had no formal waste disposal facilities, while some attempted to manage waste through trash bags. In support of these findings, the lack of proper waste management and use of trash bags was previously echoed in previous studies [54,55]. In contrast, a study conducted in the Philippines, Dipolog City, found that vendors had appropriate garbage containers, separated their waste, and then covered their trash bins to prevent pest infestation [56]. The reason for this difference may be due to the implementation of Ordinance 123-City Sanitation Code, which serves as a regulatory push for vendors to adopt better waste management practices in the Philippines and Dipolog City. These insights highlight the need for targeted interventions to supply waste facilities, such as trash bins, and improve waste management awareness among vendors to ensure environmental sanitation and food hygiene.

In addition to proper waste disposal management, proper storage facilities for SFVs are equally important to ensure and maintain food safety and hygiene. The findings of this review indicate that street vendors had no storage facilities and resorted to placing their products or food under their stalls. These findings are similar to those of previous studies conducted in South Africa [57] and the

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Philippines [58,59]. The similarity of these results across various studies may be due to limited access to resources, urban infrastructure constraints, or regulatory challenges. Without proper storage, food can be exposed to contaminants and spoilage, leading to health risks, such as foodborne diseases and bacterial infections [47,60]. These findings signal the need for policy interventions, infrastructure support, and possibly regulations to improve storage conditions for street vendors.

Although cleanliness and effectiveness of street vending depend on storage conditions, the locations of stalls influence vendors' capacity to uphold environmental sanitation and hygiene standards. The findings of this review indicate that fixed vending stalls have essential amenities compared to mobile stalls. Likewise, previous studies have shown that fixed vending stalls typically have access to waste disposal, clean water, and storage facilities more than mobile stalls, thus promoting safer hygienic standards [47,61]. The disparity between fixed and mobile stalls may be attributed to infrastructure access; fixed locations often integrate into existing sanitation frameworks, whereas mobile vendors may struggle with inconsistent access to essential amenities. These findings reinforce the idea that fixed vending stalls provide a more stable and regulated environment for food handling than mobile stalls.

Furthermore, another finding was that street food stalls were located near waste and open drains, compromising the health of vendors and consumers. Studies conducted on the hygienic surroundings of vending stalls in China and Vietnam have found contradictory results in this regard. Strict urban planning rules and regulatory enforcement may explain why designated vending areas with appropriate cleanliness standards exist in places such as China [50] and Vietnam [62]. For example, while Vietnam's Ministry of Health enforces food safety laws that affect vendor placement and cleanliness standards [63], China's "Chengguan" urban management officials regulate street vending to lower environmental and sanitary concerns [64]. By keeping vending stalls away from open drains or garbage sites, these systems reduce public health hazards.

The review indicates that SFVs possess substantial knowledge of food hygiene, foodborne illnesses, and cleanliness, which drives them to adopt strategies aimed at minimising cross-contamination. These findings align with previous studies that noted that vendors had substantial knowledge and understanding regarding food safety [47,50] and the transmission of foodborne disease [65]. Furthermore, the findings in this review support those that noted that vendors who understood food safety principles were more likely to implement good hygiene practices [65]. However, previous studies noted that although vendors had knowledge, their actual food safety practices were inadequate [47,50]. Therefore, these findings highlight a gap between food hygiene knowledge and practice.

Bridging the gap between knowledge and implementation is essential for ensuring safer food handling practices. Understanding customer-centric preferences, which influence vendor behaviour and drive improvements in food safety and sanitation standards, is equally important. This review revealed that consumers prioritise cleanliness when choosing vendors and are more likely to buy from those who uphold stricter hygienic standards. These findings support those conducted in China [50], Ghana [66] and the Philippines [67], which similarly demonstrated that customers were influenced by cleanliness when selecting vendors. These findings indicate that customers conduct food assessments through comparisons. Moreover, consumers link the consumption of unsafe foods to various health issues, reporting symptoms such as stomach discomfort, including diarrhoea and vomiting, as well as chronic pain [68]. The reason for these similarities might be that clean environments signal better food handling practices to customers, thereby enhancing trust in a vendor's offerings.

While environmental sanitation enhances consumer trust, the direct hygiene behaviours of vendors, such as proper handwashing and the use of personal protective equipment, play a fundamental role in minimising contamination risk and ensuring safer food handling. The review highlighted inconsistencies in hygiene practices among vendors, with some neglecting proper handwashing while others attempted to maintain regular hand hygiene. Similarly, a previous study identified significant gaps in handwashing practices among vendors, reporting a failure in proper

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hand hygiene before meal preparation [69]. Additionally, vendors who wore gloves often overlooked handwashing, while among those who did wash their hands, only about one in three did so consistently when required [70]. The reason for this negligence of handwashing might be that some vendors have limited awareness of proper hygiene protocols or prioritise convenience over compliance. Addressing these gaps through targeted handwashing education and regulatory reinforcement may be essential to improving overall food safety standards.

Expanding on the inconsistencies observed in vendor hygiene practices, another critical aspect of food safety is adherence to protective attire, including aprons, head coverings, and facial masks. The review revealed that some vendors demonstrated higher compliance with protective attire, thereby enhancing food safety, while others did not comply with protective clothing, potentially compromising food safety standards. These findings are consistent with those of previous study that observed that most vendors adhered to protective clothing requirements [57]. However, other studies, including those of previous studies that highlighted ongoing gaps in compliance, with many street vendors neglecting essential protective gear such as aprons, hairnets, and facial masks [71,72]. This inconsistency heightens the risk of food contamination, underscoring the need for stricter enforcement and targeted training programs.

The findings of the current review indicate that vendors contaminate food through handling food with bare hands, cross-manage money and food without washing hands, and working while sick. Regarding direct food handling, these results align with a study in India, which found that vendors often used their hands instead of tongs when serving food [47]. Similarly, improper hygiene practices related to handling money and food without washing hands mirror prior observations, where vendors frequently neglected handwashing after handling currency, touching bodily areas, using unclean utensils, disposing of waste [57], and before meal service. Additionally, evidence supports that vendors continue working while sick, with reports of individuals handling food despite open wounds [73,74]. These gaps in hygiene increase the risk of cross-contamination, underscoring the importance of targeted interventions and structured training programs to enhance compliance.

Although individual hygiene practices are vital, the cleanliness and maintenance of food preparation equipment play a significant role in ensuring overall sanitation standards. The findings in this review identified improper cleaning practices for reusable equipment, including the use of standing water and towels to wash utensils, as well as the cross-utilization of utensils between raw meat and vegetables without proper washing. These practices increase the risk of cross-contamination and compromise food safety. These findings reflect previous observations indicating that vendors often employ improper techniques when cleaning utensils [50,73] and frequently reuse them across different food items without adequate washing [47]. Such practices significantly heighten the risk of cross-contamination, emphasising the need for stricter hygiene protocols and targeted interventions to enhance food safety standards.

In this review, while licencing plays a crucial role in regulating SFVs by ensuring compliance with food safety, notable differences in enforcement were observed across countries. The findings indicated that vendors in China with a high compliance rate regarding possession of licences and permits to operate as SFVs compared with in those South Africa. Similarly, prior studies have highlighted variations in licencing practices across different countries. For instance, in a study conducted in the Philippines, only 14 out of 37 street vendors held permits [75], whereas in other regions, such as Los Angeles, licencing rates were significantly higher, revealing that an estimated one-half of vendors were licenced [76]. These differences underscore the influence of local regulations and enforcement mechanisms on vendor compliance. In some cases, the strict enforcement of food sanitation regulations, licencing requirements, vendor training, and monitoring is inadequately implemented or insufficiently overseen by local or national authorities [77]. Properly structured food safety regulations and licencing initiatives might play a crucial role in mitigating potential food safety risks [78]. Strengthening oversight mechanisms could enhance compliance and improve public health outcomes.

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In addition to the discrepancies noted in licencing enforcement, another crucial regulatory mechanism affecting food safety compliance is the inspection of vending stalls. The findings revealed that inspections of vendor stalls foster compliance with food safety and hygiene as well as environmental sanitation. Similarly, in Clark County and Henderson, vendors undergo regular inspections to ensure compliance, with penalties imposed for infractions [79]. Moreover, the Orange County Health Care Agency conducts routine inspections of approximately 15,000 retail food facilities to enforce adherence to the California Retail Food Code [80]. The question is whether inspections lead to measurable improvements, such as reduced violations, better food safety practices, or enhanced fire safety adherence. The gap is whether inspections lead to measurable improvements such as reduced violations, better food safety practices, or enhanced fire safety adherence.

Finally, similar to regular inspections, which plays a vital role in ensuring vendor compliance with food safety and hygiene standards, the training of SFVs is equally important. The findings of this review revealed that street vendors who received formal training demonstrated high rates of food hygiene practices compared to those without training. Previous research has consistently shown that training programs play a crucial role in improving food safety practices and behaviours among street vendors [81–84]. The rationale for this similarity could be that when vendors are well-informed about hygiene protocols, contamination risks, and proper food handling techniques, it leads to improved food safety and hygiene compliance. These studies highlight the positive impact of educational interventions in fostering better hygiene standards and compliance with food safety regulations.

5. Limitations

Searching only four databases might restrict comprehensiveness, potentially leading to the omission of relevant studies published elsewhere. In addition, selecting only English-language articles improves accessibility but excludes studies published in other languages, which might contain relevant data, particularly from regions in which SFMs are a significant part of the economy.

Furthermore, limiting studies to those published from 2014 onwards ensures relevance but may exclude foundational research or historical trends that could provide important context. Some older studies may still offer valuable insights into long-term sanitation challenges. Finally, the three-tiered screening process (title, abstract, and full text) helps refine article selection but may not fully capture nuanced studies that provide relevant insights despite a non-explicit title or abstract.

6. Conclusions

This review comprehensively synthesised the key factors influencing environmental sanitation and hygiene practices in SFMs, categorising them into socioeconomic, infrastructural, behavioural, food handling, and regulatory themes. The review highlighted disparities in hygiene adherence based on gender and education, infrastructural gaps affecting compliance, and the roles of vendor knowledge and customer expectations in shaping hygiene practices. Additionally, the findings revealed the risks associated with food handling and the uneven implementation of licencing, inspections, and training programmes. This review allowed for a deeper understanding of the systemic challenges faced by vendors and provided a foundation for targeted recommendations. The recommendations included research, education, practice, and policy, emphasising gender-specific training, infrastructural improvements, and more consistent regulatory enforcement. Further research using observations and qualitative and quantitative methods is recommended to further explore this subject in different contexts and to develop evidence-based solutions and practical strategies to strengthen food safety standards in SFMs.

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Abbreviations

The following abbreviations are used in this manuscript:

PCC	Participants, concept, and context
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
SFVs	Street food vendors
SMFs	Street food markets
UJ	University of Johannesburg

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