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An assessment of food safety practices among public food vendors in urban and rural areas of Cross River State, Nigeria

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ABSTRACT

This study examined food safety practices among 593 registered food vendors in urban and rural areas of Cross River State, Nigeria. A descriptive survey design was adopted, and participants were selected using stratified random sampling. Data were gathered through the validated Food Safety Practices Questionnaire (FSPQ) and direct observation. The FSPQ had acceptable reliability indices (>0.70) across all subscales. One-sample t-test and two-way MANOVA were used to test the hypotheses at the 0.05 level of significance. Results indicated that food safety practices were significantly low in water supply (M=17.08), environmental cleanliness (M=17.07), and food handling (M=14.23), all below the population mean of 25.00 ($p<0.05$), whereas personal hygiene (M=29.47) exceeded the benchmark ($p<0.05$). Urban vendors demonstrated better hygiene (M=31.76) than rural vendors (M=23.83). A significant main effect of location was found, $F(4, 586)=114.56$, $p<0.001$, $\eta^2=0.439$, with urban vendors adhering more closely to standards. No significant differences were found between stationary and mobile vendors ($p=0.739$, $\eta^2=0.003$) or in their interaction with location ($p=0.517$, $\eta^2=0.006$). Enforcement of food safety regulations was significantly below the expected benchmark in urban (M=19.76, SD=8.85) and rural areas (M=20.84, SD=8.47), with the overall sample also recording low enforcement (M=20.07, SD=8.75). These findings expose deep-rooted challenges, particularly in rural areas lacking basic infrastructure. The absence of strong regulatory oversight further compounds the problem. Addressing these gaps will require urgent investments in potable water supply, targeted hygiene training, and a review of food safety laws.

Contribution/Originality: The study provides evidence from both urban and rural food vendors in Cross River State by integrating self-reported practices, direct observation, and regulatory enforcement. It also compares vendors by location and sales style, thereby extending evidence on food safety practices beyond single-setting assessments.

1. INTRODUCTION

Food safety is a cornerstone of public health, safeguarding populations from preventable diseases while ensuring equitable access to nutritious sustenance. In low- and middle-income countries, public food vendors play a pivotal role in urban and rural food systems, providing affordable, ready-to-eat meals to millions. However, the sector's informality and regulatory gaps raise critical concerns about hygiene practices, environmental conditions, and compliance with safety standards, contributing to widespread foodborne illnesses. Globally, contaminated food causes an estimated 600 million illnesses and 420,000 deaths annually, with Africa bearing the highest per capita burden [1]. In Nigeria, where street food sustains over 70% of urban dwellers, recurring outbreaks of cholera, typhoid, and

gastroenteritis underscore systemic vulnerabilities in food handling and oversight [2]. Cross River State, a hub of commercial and tourism activities, exemplifies these challenges because rapid urbanisation, limited sanitation infrastructure, and lax enforcement of food safety regulations amplify consumer risks.

Public food vendors (stationary stalls and mobile units) operate in environments prone to contamination, including areas near open drains, waste dumps, and crowded markets. Studies highlight recurrent malpractice, including the use of unsafe water sources, inadequate handwashing, improper storage, and reheating expired foods [3, 4]. Contaminated water, a key hazard, introduces pathogens such as E. coli and Salmonella, while unhygienic preparation areas attract disease vectors [5, 6]. Despite regulatory frameworks established by agencies such as NAFDAC and SON, enforcement remains inconsistent, particularly in rural areas where oversight is sparse. While prior research has documented risks in Nigerian street food [7, 8], few studies disaggregate practices by vendor type (mobile vs stationary) or evaluate compliance dynamics across urban–rural divides.

This study addresses these gaps by assessing food safety practices among public food vendors in Cross River State, Nigeria. The study specifically focused on (1) the level of adherence to food safety protocols in urban versus rural settings, (2) differences in food safety practices between mobile and stationary vendors in rural and urban areas, and (3) the extent of regulatory enforcement. It is important to address deficiencies in food safety practices among public food vendors in Cross River State to protect both public health and people's livelihoods. Breaking down the data by vendor type and location enables thorough exploration, analysis, and diagnosis of the problem. It also allows for tailored approaches that can help reduce the risk of contamination and the spread of foodborne illnesses. Without such decisive action, there might be a genuine risk of recurring disease outbreaks, significant economic repercussions from illness, and a decline in consumer confidence, all of which could undermine a sector that sustains millions of people.

2. LITERATURE REVIEW/HYPOTHESES FORMULATION

2.1. Food Safety Practices Among Vendors

Studies across diverse contexts reveal persistent inadequacies in vendor practices, particularly in low-resource settings. In Nigeria, for example, Emmanuel, et al. [9] reported that 81.5% of vendors had not received formal training, and three-quarters of these untrained individuals engaged in poor food-handling practices. Aluko, et al. [7] further observed concerningly low compliance with basic hygiene measures, noting that only 16.9% of vendors consistently washed their hands and a mere 3.8% used refrigeration to preserve food. Faremi, et al. [10] also found that 67.2% of Nigerian vendors possessed insufficient knowledge of foodborne pathogens, a factor closely linked to unsafe practices. These results are consistent with trends in West Africa; Dun-Dery and Addo [11] noted that, despite a high level of theoretical awareness, only 14% of Ghanaian vendors engaged in frequent handwashing, suggesting a substantial gap between what is known and what is practised.

On a global scale, research points to structural and environmental factors as key determinants of poor practices. In South Africa, Sepadi and Nkosi [12] linked unhygienic market conditions to heightened respiratory health risks, while Ahmed, et al. [13] identified institutional shortcomings, such as overlapping responsibilities and inconsistent enforcement, as obstacles to compliance in Ghana. Economic pressures also play a significant role; Ifeoma and Agwu [14] demonstrated that food-insecure households in Nigeria tend to prioritise affordability over safety, a tendency similarly reflected in Afghanistan's reliance on low-productivity agriculture amid ongoing conflict [15]. Even in sectors that are more strictly regulated, such as Chinese university canteens [16] and Kuwaiti restaurants [17], challenges remain in controlling cross-contamination and managing food temperatures, suggesting that the difficulties in converting guidelines into daily practice are both widespread and persistent.

Rapid urbanisation, limited sanitation infrastructure, and weak regulatory oversight create conditions similar to those described in the studies mentioned above. The lack of targeted training programmes and reliance on contaminated water sources and inadequate storage facilities, as reported by Aluko, et al. [7] and Emmanuel, et al.

[9] contribute to an environment in which foodborne pathogens can readily thrive. Moreover, the fragmentation of institutional responsibilities and a tendency among consumers and vendors to underestimate the risks involved [18] further reinforce this pattern of non-compliance. These observations support the hypothesis that *the level of food safety practices among food vendors in Cross River State is not significantly high* (Hypothesis 1).

2.2. Vending Type and Food Safety Practices Among Vendors

The relationship between vending type (mobile versus stationary) and adherence to food safety practices is important to public health discourse. Empirical studies suggest that differences in compliance are often influenced by structural and contextual factors rather than by inherent variations in vendor knowledge or intent. In fact, mobile vendors are often perceived to have poorer hygiene practices due to the transient nature of their operations and limited infrastructure [19, 20]. However, recent evidence suggests that these shortcomings may not be resolved, particularly when factors such as access to resources, targeted training programmes, and regional enforcement practices are taken into account.

Globally, mobile vendors face systemic challenges stemming from environmental and institutional constraints. Research from Can Tho City, Vietnam [21] and Kenya [22] reveals that mobile vendors tend to have lower compliance with food safety standards, primarily due to difficulties accessing clean water, proper waste disposal systems, and refrigeration. These challenges are further compounded by unstable working conditions and sporadic regulatory oversight [23], which increase the risk of contamination. In contrast, stationary vendors generally benefit from fixed infrastructure, such as piped water and storage facilities, and experience more regular health inspections, thereby promoting more consistent adherence to safety practices [8, 24]. This pattern resonates with the Social Ecological Model [25], which recognises that individual behaviour is influenced by broader community and institutional systems. Mobile vendors, lacking stable community support, are more exposed to environmental hazards such as pest infestations and airborne pollutants [26].

The Resource Dependence Theory [27] offers a critical perspective on these findings. It suggests that gaps in compliance are less a matter of vendor negligence and more a reflection of unequal resource distribution. For example, in Alexandria, mobile vendors had food safety knowledge comparable to that of their stationary counterparts. However, they struggled with practical implementation due to limited access to essential resources, such as refrigeration and clean water [28]. This example demonstrates that knowledge in isolation is not sufficient; structural barriers play a significant role in shaping actual practices. Interventions that address these disparities, including targeted training initiatives, have been shown to improve compliance among both mobile and stationary vendors in settings such as Vietnam and Kenya [21, 22].

Regional and contextual factors add further complexity to this issue. In rural areas, both mobile and stationary vendors often operate under similarly challenging conditions marked by weak infrastructure, limited regulatory presence, and socioeconomic constraints, which may result in comparable levels of compliance [29]. In urban environments, although resources tend to be more accessible, there is still considerable variation in enforcement and support. In cities with lax oversight, stationary vendors do not necessarily perform better than mobile vendors, as both groups can be affected by a general neglect of regulatory measures. Conversely, in regions where enforcement is more robust and resources are distributed more evenly, differences between vending types tend to diminish.

Taken together, these observations challenge the notion that there are inherent differences in food safety practices between mobile and stationary vendors. While structural factors may initially place mobile vendors at a disadvantage, the disparities are largely context-dependent and shaped by external factors such as training, resource availability, and consistent regulatory support. When these factors are duly considered, especially in regions where systemic constraints affect vendors uniformly, differences in compliance appear to be minimal. Thus, the empirical literature supports the hypothesis that *there is no significant difference in food safety practices between stationary and mobile food vendors in urban and rural locations* (Hypothesis 2).

2.3. Enforcement of Food Safety Rules

A careful literature review reveals systemic shortcomings that undermine regulatory frameworks and contribute to low compliance and ongoing public health concerns. Legislative and institutional fragmentation stands out as a significant impediment to effective enforcement. Many of Nigeria's food safety laws, formulated over a decade ago, have not kept pace with contemporary challenges [30]. A large proportion of existing legislation, around 87.5%, predates the modern complexities of food safety, and key terms within these laws are insufficiently defined, making their application difficult [31]. The continued delay in enacting the Food Safety and Quality Bill (2016) further illustrates persistent legislative inertia, maintaining a fragmented approach that disperses responsibilities among agencies such as NAFDAC, SON, and local governments [30].

Operational deficiencies further compound these challenges. Research from secondary cities such as Calabar and Minna indicates that government oversight is often superficial, characterised by minimal intervention that fails to address gaps in service delivery [32]. Interactions between regulators and street food vendors tend to focus more on revenue collection than on educating vendors about hygiene standards or enforcing compliance [33]. Weak surveillance systems have been linked to persistent food contamination along the production and consumption chain [31], a situation worsened by inadequate funding and limited training for enforcement agencies.

There is also a clear disparity between awareness of food safety regulations and actual compliance. Studies conducted in Osun and Oyo States report that although a high percentage of vendors are aware of the regulations, up to 89.5% in some cases, actual adherence to safety protocols is considerably lower [34, 35]. For instance, rural vendors in Oyo State showed significantly lower compliance than their urban counterparts ($t = 9.597$, $p = 0.003$), largely due to structural barriers such as unreliable electricity supply and limited institutional support. Furthermore, research by Nordhagen, et al. [36] indicates that many vendors do not prioritise food safety as a core element of business success, while consumers often value affordability over safety, reflecting a broader cultural trend that undermines regulatory efforts.

The differences between urban and rural areas add another layer of complexity. Rural regions are particularly affected by infrastructural and educational challenges, with vendors often relying on underage workers with limited literacy, thereby increasing the risk of food contamination [33]. There is also a disparity between awareness of food safety regulations and compliance. In Oyo State, Olajubutu, et al. [34] reported that 89.5% of vendors had a high level of awareness of food safety regulations, whereas only 53.5% had a high level of compliance, with rural vendors recording lower compliance than their urban counterparts. Resnick, et al. [32] observed that, while vendors in secondary cities experience less frequent regulatory harassment, this is more indicative of passive governance than of a proactive commitment to food safety. The literature has shown that socioeconomic disparities create an environment in which food safety enforcement in Nigeria is, at best, inconsistent in urban areas and markedly deficient in rural settings. The empirical evidence thus supports the third hypothesis of this study: *the enforcement of food safety regulations in both rural and urban areas is not significantly high* (Hypothesis 3).

3. METHODS

This study adopted a descriptive survey research design, commonly employed to document occurrences, activities, or phenomena unfolding within a defined population. According to Nassaji [37], this design relies on collecting qualitative data, which are subsequently analysed using quantitative methods while ensuring that the population sample is observed in its natural setting. Researchers employing this design do not manipulate variables or interfere with the observation process [38]. The rationale for selecting this design was to capture occurrences, activities, and patterns among food vendors in Cross River State, Nigeria.

3.1. Study Population

The target population comprised 1,185 registered food vendors in Cross River State, Nigeria. This group included proprietors of restaurants and fast-food establishments, mobile vendors operating from wheelbarrows or carts, and individuals selling snacks and roasted foods. The distribution of registered food vendors across the state's 18 Local Government Areas (LGAs) was as follows: Calabar Municipality (N = 146), Ikom (N = 104), Calabar South (N = 98), Ogoja (N = 87), Odukpani (N = 76), Biase (N = 72), Yakurr (N = 71), Akamkpa (N = 67), Obudu (N = 59), Boki (N = 58), Bekwara (N = 56), Obanliku (N = 51), Obubra (N = 47), Yala (N = 47), Akpabuyo (N = 43), Abi (N = 42), Etung (N = 39), and Bakassi (N = 22).

3.2. Sampling Procedure

Given Cross River State's geographical and administrative diversity, stratified random sampling was employed to enhance accuracy and ensure proportional representation. Stratification was preferred over simple random sampling to reduce sampling error and facilitate comparisons across subgroups, given the population's varied sociodemographic characteristics [39, 40]. LGA stratified the population to guarantee adequate representation of both urban and rural areas. Within each stratum, 50% of the vendors were selected, a proportion determined to achieve a 95% confidence level with a 5% margin of error while maintaining a balance between precision and feasibility [41]. Proportional allocation aligned the sample distribution with the population distribution, preventing urban areas from being overrepresented.

Participants were selected within each stratum using the hat-and-draw method. This approach was chosen for its simplicity, cultural appropriateness, and ability to foster participant trust. The selection process involved drawing papers marked "yes" (indicating inclusion in the sample) and "no" (indicating exclusion from the sample), ensuring an equal probability of selection for each stratum (1/k, where k is the stratum size). Sampling with replacement was employed to uphold fairness and ensure equal probability across successive draws, particularly in strata with smaller populations [42].

3.3. Sample/Participants

The final study sample comprised 593 food vendors, proportionally selected across the 18 LGAs in Cross River State. The distribution of participants was as follows: Calabar Municipality (n = 73, 12.3%), Ikom (n = 52, 8.8%), Calabar South (n = 49, 8.3%), Ogoja (n = 44, 7.4%), Odukpani (n = 38, 6.4%), Biase (n = 36, 6.1%), Yakurr (n = 36, 6.1%), Akamkpa (n = 34, 5.7%), Obudu (n = 30, 5.1%), Boki (n = 29, 4.9%), Bekwarra (n = 28, 4.7%), Obanliku (n = 26, 4.4%), Obubra (n = 24, 4.0%), Yala (n = 24, 4.0%), Akpabuyo (n = 22, 3.7%), Abi (n = 21, 3.5%), Etung (n = 20, 3.4%), and Bakassi (n = 11, 1.9%).

Demographic analysis indicated that a substantial proportion of vendors were middle-aged, with 32.0% (n = 190) aged 40–49 and 22.4% (n = 133) aged 30–39. Younger participants were underrepresented: 19.4% (n = 115) were 20–29 years old, 11.8% (n = 70) were under 20 years old, and 14.3% (n = 85) were 50 years or older. Most vendors were female (70.7%, n = 419), whereas males accounted for 29.3% (n = 174). The marital status distribution showed that 65.3% (n = 387) were married and 34.7% (n = 206) were single. Regarding educational background, 51.9% (n = 308) had completed secondary education, 18.0% (n = 107) held a primary school certificate, and 11.8% (n = 70) had received vocational training.

A smaller proportion had attained tertiary education (11.0%, n = 65), while 7.3% (n = 43) had no formal schooling. The study also found that urban vendors constituted 71.2% (n = 422) of the sample, whereas 28.8% (n = 171) operated in rural locations. Business operations were nearly evenly divided, with 48.1% (n = 285) operating stationary vending outlets and 51.9% (n = 308) operating mobile vending.

3.4. Instrument and Measures

The Food Safety Practices Questionnaire (FSPQ) evaluated food safety awareness, behaviours, and environmental factors among food vendors in Cross River State, Nigeria. This tool was developed in response to the lack of validated instruments suited to the informal food vending context in the region, as identified through a systematic review [43, 44]. The questionnaire comprises three sections. Section A gathers demographic and socioeconomic details, including age, gender, marital status, education level, vending location, and mode of operation. These variables were incorporated based on evidence linking socioeconomic factors to hygiene practices [45, 46]. To enhance clarity and consistency, only closed-ended response formats were employed.

Section B examines water sourcing and sanitation practices using 10 items on a 4-point Likert scale (Strongly Agree to Strongly Disagree). The decision to use a 4-point scale was made to eliminate neutral responses, prompting clearer participant positions [47]. The items focus on key aspects such as sources of water used, frequency of source testing, and availability of handwashing stations, aligning with the World Health Organization [48] water safety guidelines. Section C employs direct observation to assess compliance with food safety regulations across three domains: environmental sanitation, food handling, and personal hygiene. Each domain comprised 10 items rated on a 4-point frequency scale (Always to Never). Direct observation was selected to mitigate inaccuracies associated with self-reported data [49].

3.5. Validity and Reliability

The FSPQ underwent rigorous validation in accordance with APA standards [50]. A panel comprising five specialists from the University of Calabar, three experts in health education and two in measurement and evaluation, assessed the instrument's face and content validity. This aligns with the recommended range of 3–10 experts for instrument validation [51]. They evaluated item clarity, relevance, and comprehensiveness using a structured rubric. Initial concerns included ambiguous wording and inconsistent response formats, which were subsequently refined. Inter-rater agreement was initially 78%, calculated via percentage concordance. After addressing inconsistencies, refining six items, standardising response anchors, and expanding demographic categories, agreement increased to 92%, exceeding the 80% threshold for validity [52].

Post hoc content validity indices (CVIs) were computed, with item-level CVIs (I-CVIs) ranging from 0.80 to 1.00. Most items (90%) scored at least 0.80, indicating strong relevance. The overall scale-level CVI (S-CVI/Ave) was 0.89, surpassing the acceptable benchmark of 0.80 [51]. Due to the absence of a recognised regional benchmark, criterion validity was not assessed; instead, validation was supported through triangulation with observational data. A mix of positively and negatively worded items was included to minimise acquiescence bias. The interdisciplinary expert panel ensured that the instrument satisfied health education and psychometric requirements [53]. Given resource limitations, expert review provided a cost-effective alternative to large-scale pilot testing while maintaining methodological rigour [54].

For the reliability assessment, a pilot study was conducted with 50 purposively selected food vendors from the state, excluding those who participated in the main study to minimise bias. Data from a single administration of the FSPQ were analysed using Cronbach's alpha (α) to evaluate internal consistency, a widely accepted reliability measure for Likert-scale instruments [55]. Results indicated strong internal consistency across all subscales ($\alpha = .77–.83$), exceeding the .70 threshold for exploratory research [50]. Test–retest reliability was impractical due to vendor mobility; however, including a diverse sample mitigated potential geographic biases. Observational data in the main study further reduced reliance on self-reported responses.

3.6. Data Collection

Before data collection, ethical clearance was obtained from the University of Calabar's Institutional Review Board (IRB) under approval number UNICAL-IRB-2024-054. Informed consent was secured through a two-step process:

participants first received verbal explanations in either English or Pidgin, followed by written consent via a checkbox in Section A of the questionnaire. For vendors unable to read or write, consent was confirmed through thumbprints witnessed by community leaders. Participation was entirely voluntary, with no incentives or penalties, and respondents retained the right to withdraw at any time.

Five trained research assistants were engaged to administer the FSPQ and locate vendors in their natural work environments, including markets, roadside stalls, and mobile vending points, to ensure representative sampling without selection bias. To maintain consistency, the research assistants received thorough training before deployment. Data collection spanned three months to account for temporal variations in vendor practices. Daily debriefing sessions addressed logistical issues, such as vendor mobility and participant attrition. A response rate of 98% was achieved. Personal identifiers were removed after collection to safeguard confidentiality and replaced with anonymised codes during data entry. All data were securely stored on encrypted, password-protected computers.

3.7. Data Analysis

The collected data were systematically reviewed and categorised by variable type and response format. Demographic information was classified using nominal or ordinal scales, depending on the nature of the variables. Likert-scale responses were processed using a polytomous scoring method, assigning numeric values to each response category. For positively worded items in Section B, scores ranged from 4 (Strongly Agree) to 1 (Strongly Disagree), while negatively worded items were reverse-scored to ensure consistency and prevent misinterpretation. After scoring, a person-by-item matrix was created using Microsoft Excel, followed by data cleaning to identify and rectify missing responses, inconsistencies, and outliers that could affect analytical accuracy. Hypothesis testing was conducted using a one-sample t-test and a two-way multivariate analysis of variance (MANOVA). The analyses were performed using SPSS version 27, with statistical significance set at 0.05.

4. RESULTS

4.1. Hypothesis One

The level of food safety practices among food vendors in rural and urban areas of Cross River State is not significantly high. A one-sample t-test was conducted to assess whether food safety practices among food vendors in Cross River State were significantly higher than the population mean of 25.00, based on 10 items per dimension.

Table 1. Population t-test results showing the level of food safety practices among rural and urban vendors in Cross River State.

Location	Variables	μ	$\bar{X}$	SD	Md	t	df	p
Overall respondents	Sources of water supply	25.00	17.08	7.56	-7.92	25.54*	592	0.000
	Environmental cleanliness	25.00	17.07	6.35	-7.93	30.44*	592	0.000
	Food handling	25.00	14.23	5.24	-10.77	49.99*	592	0.000
	Personal hygiene	25.00	29.47	7.61	4.47	14.32*	592	0.000
Urban	Sources of water supply	25.00	18.44	8.21	-6.56	16.41*	421	0.000
	Environmental cleanliness	25.00	17.97	6.88	-7.03	21.01*	421	0.000
	Food handling	25.00	14.94	5.66	-10.06	36.55*	421	0.000
	Personal hygiene	25.00	31.76	6.26	6.76	22.18*	421	0.000
Rural	Sources of water supply	25.00	13.71	3.97	-11.29	37.15*	170	0.000
	Environmental cleanliness	25.00	14.84	4.03	-10.16	32.93*	170	0.000
	Food handling	25.00	12.50	3.51	-12.50	46.60*	170	0.000
	Personal hygiene	25.00	23.83	7.71	-1.17	1.99*	170	0.049

Note: *Significant mean difference between the population and sample means.

Results (Table 1) indicate that the mean scores for water supply sources (M = 17.08), environmental cleanliness (M = 17.07), and food handling (M = 14.23) were significantly lower than the population means, $t(592)$, $p < 0.05$.

Thus, food safety practices in these areas were significantly low. However, personal hygiene (M = 29.47) exceeded the population mean, showing a significant mean difference, $t(592) = 14.32$, $p < 0.05$.

An analysis of food safety practices among urban and rural food vendors in Cross River State revealed significant deviations from the population mean ($\mu = 25.00$) across multiple dimensions. For urban vendors, the water supply source exhibited a significantly lower mean ($M = 18.44$), $t(421) = 16.41$, $p < 0.05$, indicating a substantial divergence from the population norm. Similarly, environmental cleanliness ($M = 17.97$), $t(421) = 21.01$, $p < 0.05$, and food handling ($M = 14.94$), $t(421) = 36.55$, $p < 0.05$, demonstrated statistically significant deficits. Consequently, the null hypothesis, positing no significant elevation in practices relative to the population mean, was retained for these dimensions, underscoring suboptimal adherence to water safety, cleanliness, and food-handling protocols. In contrast, personal hygiene among urban vendors exceeded the population mean ($M = 31.76$), $t(421) = 22.18$, $p < 0.05$, thereby rejecting the null hypothesis and indicating significantly higher adherence to hygiene standards.

For rural vendors, all dimensions fell below the population mean. Water supply ($M = 13.71$), $t(170) = 37.15$, $p < 0.05$, environmental cleanliness ($M = 14.84$), $t(170) = 32.93$, $p < 0.05$, and food handling ($M = 12.50$), $t(170) = 46.60$, $p < 0.05$, showed pronounced deficits. Notably, personal hygiene ($M = 23.83$), $t(170) = 1.99$, $p = 0.049$, also lagged significantly below the benchmark. The null hypothesis was thus retained across all rural dimensions, indicating no statistically significant elevated adherence to any of the assessed food safety practices.

4.2. Hypothesis 2

The study examined whether food safety practices differed significantly by vending type (stationary or mobile) and location (urban or rural). Specifically, food safety practices were assessed across four key dimensions: water source, environmental cleanliness, food handling, and personal hygiene. A two-way MANOVA was the most suitable statistical approach for two categorical independent variables and multiple continuous dependent variables. This analysis evaluated the main effects of sales style and location, as well as their interaction, on food safety practices. Table 2.

Table 2. Two-way MANOVA results summary of the main and interaction effects of sales style and location on overall food safety practices among food vendors in Cross River State.

Effect	Tests	Value	F	Hyp. df	Error df	p	η_p^2
Intercept	Pillai's Trace	0.98	7058.81[b]	4	586	0.000	0.980
	Wilks' Lambda	0.02	7058.81[b]	4	586	0.000	0.980
	Hotelling's Trace	48.18	7058.81[b]	4	586	0.000	0.980
	Roy's Largest Root	48.18	7058.81[b]	4	586	0.000	0.980
Location	Pillai's Trace	0.44	114.56*[b]	4	586	0.000	0.439
	Wilks' Lambda	0.56	114.56*[b]	4	586	0.000	0.439
	Hotelling's Trace	0.78	114.56*[b]	4	586	0.000	0.439
	Roy's Largest Root	0.78	114.56*[b]	4	586	0.000	0.439
Sales style	Pillai's Trace	0.00	0.50[b]	4	586	0.739	0.003
	Wilks' Lambda	1.00	0.50[b]	4	586	0.739	0.003
	Hotelling's Trace	0.00	0.50[b]	4	586	0.739	0.003
	Roy's Largest Root	0.00	0.50[b]	4	586	0.739	0.003
Sales style * Location	Pillai's Trace	0.01	0.81[b]	4	586	0.517	0.006
	Wilks' Lambda	0.99	0.813[b]	4	586	0.517	0.006
	Hotelling's Trace	0.01	0.813[b]	4	586	0.517	0.006
	Roy's Largest Root	0.01	0.813[b]	4	586	0.517	0.006

Note: b Exact statistic.
*Significant at $p < 0.05$.

The results in Table 2 show that all multivariate tests indicated a statistically significant intercept effect (V = 0.98, $\Lambda = 0.02$, T = 48.18, $\theta = 48.18$), $F(4, 586) = 7058.81$, $p < 0.001$, $\eta_p^2 = 0.980$. This confirms that the overall model explained nearly all the variance in food safety practices. A significant main effect of location was observed across all multivariate tests ($V = 0.44$, $\Lambda = 0.56$, $T = 0.78$, $\theta = 0.78$), $F(4, 586) = 114.56$, $p < .001$, $\eta_p^2 = 0.439$. Urban and rural

vendors differed substantially in their food safety practices, with location accounting for approximately 44% of the variance. No significant main effect of sales style (stationary vs. mobile) was found ($V = 0.00$, $\Lambda = 1.00$, $T = 0.00$, $\theta = 0.00$), $F(4, 586) = 0.50$, $p = 0.739$, $\eta_p^2 = 0.003$. The negligible effect size suggests minimal differences between stationary and mobile vendors. The interaction effect was non-significant across all tests ($V = 0.01$, $\Lambda = 0.99$, $T = 0.01$, $\theta = 0.01$), $F(4, 586) = 0.81$, $p = 0.517$, $\eta_p^2 = 0.006$. This indicates that the influence of sales style on food safety practices did not vary between urban and rural settings. Thus, there was no statistically significant difference in overall food safety practices between stationary and mobile food vendors operating in urban or rural locations.

Similarly, the main and interactive effects of sales style and location on each dimension of food safety practices were further examined, and the results are presented in Table 3. Table 3 indicates that location significantly affects specific food safety practices, including the source of water supply ($F[1, 589] = 51.23$, $p < 0.05$, $\eta_p^2 = 0.080$), environmental cleanliness ($F[1, 589] = 30.55$, $p < 0.05$, $\eta_p^2 = 0.049$), food handling ($F[1, 589] = 26.43$, $p < 0.05$, $\eta_p^2 = 0.043$), and personal hygiene ($F[1, 589] = 165.20$, $p < 0.05$, $\eta_p^2 = 0.219$). This indicates that location explains 8.0%, 4.9%, 4.3%, and 21.9% of the variance in food safety practices across these dimensions, respectively. In contrast, sales style (stationary vs. mobile) demonstrated no significant main effects on any food safety practices ($p > 0.05$). Furthermore, Table 3 confirmed no significant interaction between sales style and location for water supply sourcing, environmental cleanliness, food handling, or personal hygiene ($p > 0.05$). This indicates that urban stationary vendors, urban mobile vendors, rural stationary vendors, and rural mobile vendors exhibited comparable adherence to these practices. Therefore, the null hypothesis, that no significant differences exist in food safety practices between stationary and mobile vendors across urban and rural locations, is retained. These findings suggest that interventions to improve food safety should prioritise location-specific challenges rather than vendor operational style.

Table 3. Main and interactive influence of sales style and location on specific food safety practices.

Source	Dependent Variable	Type III SS	df	MS	F	P	η_p^2
Corrected Model	Source of water supply	2773.66[a]	3	924.55	17.56	0.000	0.082
	Environmental cleanliness	1212.39[b]	3	404.13	10.51	0.000	0.051
	Food handling	755.89[c]	3	251.96	9.56	0.000	0.046
	Personal hygiene	7736.68[d]	3	2578.89	57.27	0.000	0.226
Intercept	Source of water supply	124673.44	1	124673.44	2367.52	0.000	0.801
	Environmental cleanliness	129901.52	1	129901.52	3378.90	0.000	0.852
	Food handling	90975.19	1	90975.19	3451.15	0.000	0.854
	Personal hygiene	373788.24	1	373788.24	8300.72	0.000	0.934
Location	Source of water supply	2697.93	1	2697.93	51.23*	0.000	0.080
	Environmental cleanliness	1174.39	1	1174.39	30.55*	0.000	0.049
	Food handling	696.73	1	696.73	26.43*	0.000	0.043
	Personal hygiene	7438.87	1	7438.87	165.20*	0.000	0.219
Sales style	Source of water supply	10.78	1	10.78	0.21	0.651	0.000
	Environmental cleanliness	10.56	1	10.56	0.28	0.600	0.000
	Food handling	0.00	1	0.00	0.00	0.998	0.000
	Personal hygiene	69.50	1	69.50	1.54	0.215	0.003
Sales style * Location	Source of water supply	14.91	1	14.91	0.28	0.595	0.000
	Environmental cleanliness	3.80	1	3.80	0.10	0.753	0.000
	Food handling	29.05	1	29.05	1.10	0.294	0.002
	Personal hygiene	48.73	1	48.73	1.08	0.299	0.002
Error	Source of water supply	31016.77	589	52.66			
	Environmental cleanliness	22644.04	589	38.45			
	Food handling	15526.53	589	26.36			
	Personal hygiene	26523.17	589	45.03			

Source	Dependent Variable	Type III SS	df	MS	F	P	η_p^2
Total	Source of water supply	206735.00	593				
	Environmental cleanliness	196562.00	593				
	Food handling	136435.00	593				
	Personal hygiene	549404.00	593				
Corrected Total	Source of water supply	33790.43	592				
	Environmental cleanliness	23856.44	592				
	Food handling	16282.42	592				
	Personal hygiene	34259.85	592				

Note: a R Squared = 0.082 (Adjusted R Squared = 0.077).
b R Squared = 0.051 (Adjusted R Squared = 0.046).
c R Squared = 0.046 (Adjusted R Squared = 0.042).
d R Squared = 0.226 (Adjusted R Squared = 0.222).
*Significant at $p < .05$

4.3. Hypothesis 3

The level of enforcement of food safety rules in rural and urban areas of Cross River State is not significantly high. A one-sample t-test was used to test the hypothesis for rural and urban locations, respectively, against a hypothesised mean ($\mu = 25.00$). In urban areas, enforcement levels ($M = 19.76$, $SD = 8.85$) were significantly lower than the benchmark, $t(421) = 40.07$, $p < 0.05$. Similarly, rural areas recorded suboptimal enforcement ($M = 20.84$, $SD = 8.47$), $t(170) = 28.32$, $p < 0.05$. In the overall sample, enforcement levels ($M = 20.07$, $SD = 8.75$) were also significantly lower than the benchmark, $t(592) = 48.92$, $p < 0.05$. Table 4 presents the one-sample t-test results for the extent of enforcement of food safety rules in urban and rural areas. The mean enforcement levels for the urban, rural, and overall samples were below the hypothesised mean of 25.00, with all three differences statistically significant ($p < 0.001$). Thus, the null hypothesis was rejected, indicating that enforcement levels were significantly below the hypothesised benchmark in both urban and rural areas and in the overall sample.

Table 4. One-sample t-test of the extent of the enforcement of food safety rules in urban and rural areas.

Location	N	μ	$\bar{X}$	SD	df	t	p
Urban	422	25	19.76	8.85	421	40.07	0.000
Rural	171	25	20.84	8.47	170	28.32	0.000
Overall	593	25	20.07	8.75	592	48.92	0.000

5. DISCUSSION

5.1. Level of Food Safety Among Vendors

This study reveals serious shortcomings in food safety practices among food vendors in Cross River State, Nigeria, with far-reaching public health implications. Weaknesses were evident in water sourcing, environmental sanitation, and food handling, whereas personal hygiene appeared to be relatively well maintained. These findings reinforce concerns documented in previous studies and point to structural challenges that require urgent attention. Many vendors rely on untreated water sources, including rainwater and unregulated boreholes, which puts food safety at risk. The lack of routine contaminant testing and contingency plans for water shortages further compounds the problem. Pepple and Akpan [56] observed similar patterns across Nigeria, where informal water sources are commonly used for food preparation. Addressing this issue requires investment in accessible potable water systems, alongside training programmes to strengthen vendors' capacity to manage water safely.

Urban markets showed noticeable lapses in sanitation, including poor waste disposal and stagnant water, both of which increased the risk of contamination. While some vendors maintained relatively clean workspaces and ensured adequate ventilation, inconsistencies remained in the cleaning of storage areas and non-food-contact surfaces. Sepadi and Nkosi [12] found comparable conditions, reporting that unsanitary environments were common in a large proportion of markets. Strengthening the enforcement of hygiene regulations and providing structured education for

vendors could improve compliance. Weaknesses in hand hygiene, unsafe food storage, and poor temperature control were widespread in both urban and rural settings. The risks appeared to be greater in rural areas, where some vendors reused unwashed cutting boards and handled raw meat without washing their hands. Aluko, et al. [7] reported similar findings among Nigerian street vendors, and Ma, et al. [57] identified the lack of handwashing facilities as a major barrier to safe food handling. Organised training programmes, especially in rural areas, are needed to reduce these risks and promote safer handling practices. Personal hygiene stood out as a relatively strong aspect of food safety among vendors. Many complied with basic standards, such as wearing clean clothing, avoiding direct hand contact with food, and using protective gear. Faremi, et al. [10] reported a high level of compliance (78.2%) among Nigerian vendors. However, Emmanuel, et al. [9] found lower adherence in another study, possibly due to differences in location or research methods. The commitment to personal hygiene among vendors presents an opportunity to reinforce other aspects of food safety, using existing awareness as a starting point for further improvements. Thus, reducing the risk of foodborne diseases requires a coordinated approach. First, expanding access to treated water and improving waste management infrastructure should be a priority. Second, targeted training programmes should be designed with rural vendors in mind, addressing specific challenges in food handling and sanitation. Third, regulatory agencies must strengthen their monitoring of hygiene standards to ensure compliance through appropriate oversight measures. Finally, public health campaigns should build on vendors' existing hygiene practices, using them as a platform to promote broader food safety improvements.

5.2. Vending Types and Food Safety Practices: Mobile vs Stationary Vendors

This study found no statistically significant differences in food safety practices (water sourcing, environmental cleanliness, food handling, and personal hygiene) between stationary and mobile vendors in Cross River State, Nigeria. Both cohorts exhibited comparable adherence to standards, challenging assumptions that mobility inherently compromises compliance. While this aligns with Prabakaran, et al. [58], who identified no link between operational tenure and safety knowledge, it diverges from studies associating mobility with heightened risks due to logistical constraints [21, 22] or superior practices among stationary vendors [8, 24]. Such discrepancies may reflect contextual factors, including equitable regulatory enforcement, access to infrastructure, and culturally embedded hygiene norms in Cross River State [59, 60]. Notably, urban and rural vendors faced analogous challenges irrespective of mobility. Rural vendors' infrastructural deficits (e.g., unreliable water supply) and urban vendors' market overcrowding [34] affected both operational types equally, suggesting systemic rather than mobility-specific barriers. This homogeneity in practices underscores the efficacy of institutional measures, such as structured training and community-driven initiatives, in mitigating structural vulnerabilities. The contrast with studies emphasising mobility-related risks Huynh-Van, et al. [21] may stem from methodological variations (e.g., compliance metrics and sampling frameworks) or stricter local oversight of mobile vendors compared with regions with lax monitoring [61]. To sustain progress, policymakers must prioritise infrastructure investments in rural areas while maintaining regulatory parity across vendor types. Future research should investigate how cultural norms and enforcement mechanisms mediate compliance, particularly in contexts where informal vending predominates.

5.3. The Level of Enforcement of Food Safety Rules in Rural and Urban Areas

This study identifies systemic deficiencies in the enforcement of food safety regulations across urban and rural areas of Cross River State, Nigeria, mirroring nationwide governance gaps [31]. Ineffective enforcement manifests as inconsistent inspections, inadequate oversight of unhygienic practices, and the proliferation of unregistered vendors operating beyond regulatory accountability. Regulatory agencies also lack accessible compliance-reporting mechanisms and fail to provide actionable feedback or tailored training, reflecting a prioritisation of revenue generation over proactive safety measures. Amfani-Joe [33] documented analogous enforcement inefficiencies, noting officials' failure to communicate compliance expectations to vendors. These challenges exemplify fragmented

governance structures. Resnick, et al. [32] characterise such lapses as "benign neglect," in which statutory frameworks exist without being implemented. Nigeria's outdated regulatory architecture exacerbates this: over 85% of food safety laws predate modern standards, and the stalled Food Safety and Quality Bill (2016) perpetuates stagnation [30]. This misalignment leads to inconsistencies in compliance and heightens public health risks. This suggests that institutionalising routine inspections, enhancing interagency coordination, and establishing transparent vendor reporting systems are critical first steps. Legislative modernisation, paired with standardised vendor training programmes, would strengthen compliance. Concurrently, fostering community engagement could cultivate a culture of accountability, ensuring equitable enforcement across geographies. Such measures collectively offer a pathway to bridging the enforcement-practice gap in Nigeria's food safety ecosystem.

6. CONCLUSION

This study assessed food safety practices among food vendors in urban and rural areas of Cross River State, Nigeria. It evaluated adherence to food safety protocols, compared mobile and stationary vendors, and examined the level of regulatory enforcement. The findings showed significant deficiencies in both settings regarding water sourcing, environmental sanitation, and food handling, while personal hygiene was relatively well maintained. There were no meaningful differences between mobile and stationary vendors. Regulatory enforcement was consistently weak, revealing broader gaps in governance. These findings have important implications for public health. Poor food safety practices increase the risk of foodborne illnesses, particularly in resource-limited settings. The results are particularly relevant to Nigerian policymakers, regulatory bodies, and public health practitioners. They provide evidence underscoring the need for infrastructure improvements, such as access to clean water and better waste management. Targeted training programmes and legislative reforms are also crucial. While the study focuses primarily on Cross River State, its findings have broader relevance. They provide a framework for addressing challenges in areas with similar informal food-vending systems. By focusing on immediate actions and long-term systemic reforms, the study remains relevant to food safety, global food security, and sustainable development efforts.

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Institutional Review Board Statement: The study was approved by the Ethics Committee of the University of Calabar [Approval No. UC/IRB/2024/089], dated [21 August 2021]. Informed verbal consent was obtained from all participants, and all data were anonymized to protect participant confidentiality.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
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