

Research Article

Attitudes Toward Food Safety Among Street Food Vendors in Demerara-Mahaica, Guyana

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Abstract

Street food vending provides an important source of income and affordable meals in Guyana; however, its largely informal nature raises persistent concerns regarding food safety and public health. Vendors' attitudes toward food safety are critical, as attitudes influence food-handling behaviors and can ultimately affect the risk of foodborne illness. Despite this relevance, no empirical study in Guyana has previously examined food safety attitudes among street food vendors, creating a notable gap in the food safety literature. This study aimed to assess food safety attitudes among night street food vendors in the Demerara-Mahaica region and to examine the extent to which demographic characteristics are associated with these attitudes. Demographic and attitude data were derived from a larger street food safety survey, in which a questionnaire was administered to 104 vendors between April and June 2024. Descriptive statistics were used to summarize overall attitude patterns. At the same time, hypothesis tests using the chi-square test, t-tests, ANOVA, and binary logistic regression assessed associations between attitudes and demographic characteristics. The results show that most vendors demonstrated a positive attitude toward general food safety principles; however, notable misconceptions emerged in areas requiring a technical understanding. These include proper thawing, refreezing, cross-contamination, and the cold storage hierarchy. Statistically significant associations were identified between a few high-risk attitude items and overall attitude scores. The logistic regression model comprises education level and place of schooling, and, based on the Nagelkerke R^2 statistic, it explains 10% of the variation in attitude scores. These findings indicate that although vendors value food safety, targeted, context-appropriate education is necessary to address persistent misconceptions that may compromise safe practices. Efforts to strengthen vendor training, enhance risk communication, and support regulatory oversight could meaningfully improve food safety outcomes within Guyana's informal street food sector.

Keywords

Food Safety Attitudes, Street Food Vendors, Public Health, Guyana, Foodborne Illness Prevention

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1. Introduction and Background

Street food vending is a prevalent and growing feature of urban economies in many developing nations, offering affordable meals while supporting livelihoods within the informal sector. In Guyana, particularly in the Demerara-Mahaica region, the country's most densely populated administrative and commercial center, street vending plays a vital socio-economic role. Daily vending activities supply meals to residents, commuters, students, and workers, while simultaneously sustaining micro-entrepreneurship. However, the sector operates within an environment where public health oversight, sanitation infrastructure, and food safety surveillance remain unevenly developed [1]. National evaluations of Guyana's food control system have documented persistent weaknesses in foodborne disease reporting, limited laboratory capacity, and regulatory fragmentation, all of which contribute to delays in outbreak detection and uncertainty surrounding the true burden of foodborne illness [1-3]. Government communications have similarly highlighted the need for a strengthened surveillance system and more coordinated interventions to address foodborne disease risks [4]. These findings collectively emphasize the importance of understanding the local determinants of food safety, particularly the attitudes and practices of those directly involved in food preparation and distribution.

International research consistently indicates that street food vendors' attitudes toward food safety are critically linked to their handling practices and willingness to comply with hygiene standards. Studies in Jordan and Bangladesh demonstrate that negative attitudes or insufficient knowledge are closely associated with unsafe behaviors. In contrast, improved knowledge through training often fosters more favorable attitudes and, in some cases, better compliance [5, 6]. Nevertheless, research also shows that even positive attitudes or adequate knowledge do not always translate into safer practices. Evidence from Lesotho reveals that although vendors possessed good attitudes and knowledge following training, structural constraints, such as lack of facilities, poor water access, and weak enforcement, limited their ability to maintain safe food-handling practices [7]. This disconnect, between intention and implementation, underscores the complex interplay between individual attitudes and broader environmental factors.

Comparative studies between developed and developing countries further highlight variations in how attitudes influence behavior. In Malaysia, for example, vendors displayed greater awareness of food safety standards but continued to operate under unsatisfactory hygiene conditions [8]. Conversely, in Ethiopia and Ghana, poor knowledge was strongly associated with negative attitudes and low sanitation standards among vendors [9, 10]. Research from the Philippines also indicates that vendors may demonstrate a strong personal commitment to food safety yet still face practical limitations arising from inadequate resources or fragmented regulatory

support [11]. By contrast, studies conducted in higher-income settings point to the benefits of well-developed monitoring systems, licensing requirements, and predictable enforcement, all of which promote more positive attitudes toward compliance [12].

Regulatory systems and enforcement play an important role in shaping these attitudes across diverse contexts. A systematic review found that vendors operating in environments with strong regulatory oversight generally exhibited more favorable attitudes toward safe food handling, viewing compliance as essential to protecting their livelihoods and maintaining consumer trust [13]. Scholars also found that the introduction of structured traceability and tracking systems reinforces food handlers' sense of accountability and strengthens consumer confidence in the safety of food products, illustrating how regulatory and monitoring frameworks can shape attitudes toward compliance [14]. Where regulatory systems are weak or inconsistently applied, vendors frequently adopt negative or indifferent attitudes toward food safety regulations, even when they possess adequate knowledge. This trend has been documented in South Africa and other African settings, where informal or inconsistent regulatory structures contributed to lapses in compliance [15, 16]. Education and continuous training also influence attitudes, as seen in Myanmar and Sri Lanka, though their long-term effectiveness depends on the presence of monitoring mechanisms and enabling infrastructure [17, 18].

Against this international backdrop, the Demerara-Mahaica region presents a unique context in which food safety attitudes among street vendors remain understudied despite the region's high concentration of vending activity and documented gaps in public health surveillance. Existing research in Guyana highlights systemic weaknesses, including underreporting of gastroenteritis, limited laboratory diagnostic capacity, and fragmented food control systems, which may influence how vendors perceive and prioritize food safety [1-3]. Moreover, national agencies have acknowledged the need for enhanced regulatory coordination and surveillance mechanisms to address foodborne disease risks [4]. Despite these concerns, no empirical study has examined how street food vendors in Demerara-Mahaica view food safety, how their attitudes shape their practices, or how these attitudes interact with local regulatory and infrastructural realities.

This study addresses this gap by investigating street food vendors' attitudes toward food safety in Demerara-Mahaica. By integrating insights from global research with Guyana's specific public health and regulatory context, this work aims to generate evidence that can inform policy, guide targeted interventions, and support efforts to strengthen food safety practices in one of the country's most important urban regions.

2. Materials and Methods

Study Design

This study employed a cross-sectional descriptive design to assess street food vendors' attitudes toward food safety in the Demerara-Mahaica region of Guyana. This design was appropriate for this type of study that measures constructs of characteristics at a single point in time [12, 15]. In this case, the construct of interest is vendors' food-safety attitudes.

Study Area

The study was conducted in Demerara-Mahaica (Region 4), the most populous and economically active region in Guyana. The area contains the highest concentration of street food activities, including fixed stalls, semi-mobile carts, and mobile vendors located near markets, schools, transportation hubs, commercial districts, and other high-traffic public spaces.

Study Population and Sampling

This study draws data from a larger street food safety survey conducted in the Demerara-Mahaica region between April and June 2024 [19]. The study population consisted of active night street food vendors who prepared and/or sold ready-to-eat foods. Street food vending in Guyana is informal, highly mobile, and unregulated, with no official vendor registry, making probability-based sampling infeasible. Accordingly, the study employed convenience sampling, consistent with established approaches to researching informal food sectors [6, 7, 9, 19].

At the time of data collection in 2024, the inclusion criteria required vendors to be: 18 years or older, directly involved in food handling and/or preparation, operating from a stall, tabletop, cart, or other mobile unit, and consenting participants. The excluded vendors were those selling only packaged, sealed, or bottled products and temporary substitutes. Vendors were approached while actively operating along major vending routes, including transportation hubs, market zones, roadside clusters, commercial districts, and recognized nighttime vending sites. Ethical approval for the survey was obtained from the relevant institutional review board, and Figure 4 (see Appendix II) presents the consent procedures that were followed before each interview. The final sample of 104 vendors represents all individuals who met the criteria and completed the questionnaire.

Instruments and Data Collection

Data was collected using a structured questionnaire (see Appendix III) adapted from an established food safety assessment tool used in global food safety studies [6, 20]. It was modified to reflect Guyana's local vending environment. Whereas the instrument captures vendors' data on demographics, knowledge, attitudes, and practices, the present study uses the Demographic Characteristics and Food Safety Attitude sections. This is consistent with the study's objective of assessing attitudes toward food safety among street food vendors in the Demerara-Mahaica region.

The demographic section captured key vendor attributes

needed to contextualize variations in food safety attitudes. Variables included: gender, age group, ethnicity, educational attainment, whether the vendor obtained their education in Guyana, years of experience as a food handler, history of food safety training, and the vendor's general vending location. These demographic variables allowed for meaningful subgroup comparisons and the examination of possible associations between vendor characteristics and attitudes toward food safety.

The core of the study consisted of 16 attitude items, each designed to assess vendors' beliefs and perceptions regarding key aspects of food safety. Vendors responded with "Yes," "No," or "Don't Know." Attitude items covered several thematic areas: Personal hygiene, food handling and storage, cross-contamination prevention, environmental and equipment, and health screening. Each Yes/No/Don't Know response provided quantifiable data that were later coded for analysis.

Data Analysis

The responses to attitude items mostly followed the coding structure: 1 = Yes, 0 = No, and 999 = Don't Know. However, for items A12, A13, A14, A16 (see Table 1), the 'no' response was desirable, and so these items were reverse-coded. Subsequently, all variables followed a standardized meaning structure: 1 = Positive/Correct attitude, 0 = Negative attitude, and 999 = Don't Know.

We relied on Microsoft Excel and IBM SPSS version 29 software packages for data management and analysis. The analytical procedures were designed to provide both a descriptive overview of vendors' food safety attitudes and inferential tests that explored potential links between attitudes and demographic characteristics. A 5% level of significance was applied to all hypothesis testing and, results were interpreted using the rule that p-values < 0.05 indicate statistical significance, while p-values greater than or equal to 0.05 were treated as non-significant.

Descriptive Analysis

Descriptive statistics were used to summarize both the demographic characteristics of vendors and their responses to the 16 food safety attitude items. Frequencies, percentages, and charts were generated to show the distribution of vendors. Furthermore, a total attitude score for each vendor was calculated as the count of favorable attitude responses. The percentage of favorable responses was also evaluated and grouped into three categories based on thresholds commonly applied in food safety KAP studies: high ($\geq 75\%$), moderate (50–74%), and low (<50%) [6, 10, 21]. Summary statistics of measures of location, spread, and shape were reported to characterize the overall attitude levels in the sample.

Inferential Analysis

Inferential statistics were used to examine whether food safety attitudes differed across demographic characteristics. The strength of associations between the attitude categories and categorical demographic variables (gender, age group, education level, training status, years of experience, and ed-

ucation obtained in Guyana) was tested using the Chi-square test of independence. Our analyses honored critical assumptions of this test [22, 23] that reside in the sample size: the expected value for each cell in the cross-tabulation must be at least 1 and there should be no more than 20% of cells with expected values less than five. A violation of these assumptions are likely to result in reduced reliability of the chi-square estimates, limiting the validity of the conclusions that can be drawn. Furthermore, the likelihood ratio test and Fisher's exact test [24] were used to provide deeper insights in all cases whether significant or not. Differences in mean attitude percentage scores across demographic groups were assessed using independent-samples t-tests and one-way ANOVA. To identify independent predictors of positive food safety attitudes, a binary logistic regression model was constructed with attitude classification. To accomplish this, while satisfying the large-sample and other model assumptions, the total attitude variable was recoded into High and Low-Moderate categories and treated as the dependent variable. Predictor variables were the demographic characteristics.

3. Results

A total of 104 night street food vendors participated in the

study. The demographic characteristics of the sample displayed substantial diversity relevant to understanding patterns in food safety attitudes. Most vendors were female (61.5%, $n = 64$), with males representing 38.5% ($n = 40$) of the sample. Vendors ranged widely in age, although the majority were concentrated in the economically active age groups: 26–35 years (34.6%) and 36–45 years (31.7%). Smaller proportions were aged 18–25 (12.5%), 46–55 (16.3%), 56–60 (2.9%), and > 60 years (1.9%). Ethnically, the sample included African Guyanese (49.0%), Mixed ethnicity (26.0%), Spanish-speaking vendors (12.5%), East Indians (10.6%), with Chinese (1.0%) and Amerindian (1.0%) vendors represented in smaller numbers. Regarding education, most vendors had attained secondary-level schooling (70.2%), followed by university education (16.3%), primary (9.6%), nursery/kindergarten (1.0%), and postgraduate education (2.0%). The vast majority received their education in Guyana (80.8%, $n = 84$). Experience in food handling varied: 21.2% had less than 1 year, 34.6% had 1–5 years, 21.2% had 5–10 years, and 23.1% had more than 10 years. Less than half of the vendors (41.3%) had received any formal food safety training, while 58.7% had never undergone training. These demographic characteristics provide essential context for understanding differences in food safety attitudes across vendors.

Table 1. Observed Attitude of Vendors.

Questionnaire Items	Response n (%)		
	Yes	No	Don't Know
A1 Proper hand hygiene can prevent food-borne diseases	102 (98.1%)	2 (1.9%)	
A2 Raw and cooked foods should be stored separately to reduce the risk of food contamination	99 (95.2%)	3 (2.9%)	2 (1.9%)
A3 It is necessary to check the temperature of refrigerators/freezers periodically to reduce the risk of food contamination	95 (91.3%)	4 (3.8%)	5 (4.8%)
A4 The health status of workers should be evaluated before employment	91 (87.5%)	9 (8.7%)	4 (3.8%)
A5 The best way to thaw a chicken is in a bowl of cold water	42 (40.4%)	50 (48.1%)	12 (11.5%)
A6 Wearing masks is an important behavior to reduce the risk of food contamination	88 (84.6%)	13 (12.5%)	3 (2.9%)
A7 Wearing gloves is an important behavior to reduce the risk of food contamination	99 (95.2%)	3 (2.9%)	2 (1.9%)
A8 Wearing caps is an important behavior to reduce the risk of food contamination	101 (97.1%)	2 (1.9%)	1 (1.0%)
A9 Dish towels can be a source of food contamination	85 (81.7%)	12 (11.5%)	7 (6.7%)
A10 Knives and cutting boards should be properly sanitized to prevent cross-contamination	99 (95.2%)	4 (3.8%)	1 (1.0%)
A11 Food handlers who have abrasions or cuts on their hands should not touch foods without gloves	83 (79.8%)	18 (17.3%)	3 (2.9%)
A12 Well-cooked foods are free of contamination	83 (79.8%)	9 (8.7%)	12 (11.5%)
A13 Can a closed can/jar of cleaning product be stored together with closed cans and jars of food products?	13 (12.5%)	83 (79.8%)	8 (7.7%)
A14 Defrosted foods can be refrozen	35 (33.7%)	55 (52.9%)	14 (13.5%)

Questionnaire Items	Response n (%)		
	Yes	No	Don't Know
A15 The ideal place to store raw meat in the refrigerator is on the bottom shelf	36 (34.6%)	62 (59.6%)	6 (5.8%)
A16 Eggs must be washed after purchase as soon as possible	68 (65.4%)	27 (26.0%)	9 (8.7%)

Table 1 presents the summary results of the street food vendors' responses to the attitude variables. Vendors consistently demonstrated strong attitudes toward personal hygiene and the use of protective equipment, with most agreeing that proper handwashing prevents foodborne illness (98.1%) and that masks, gloves, and caps help reduce contamination (84.6%–97.1%). Similarly, positive attitudes were observed regarding the prevention of cross-contamination, including the belief that raw and cooked foods should be stored separately (95.2%), dish towels can transmit contamination (81.7%), and that cutting boards and knives should be sanitized (95.2%). Awareness of temperature control and worker health was also high, as the majority recognized the importance of monitoring refrigerator and freezer temperatures

(91.3%) and evaluating employees' health before they handle food (87.5%). In contrast, attitudes toward thawing and re-freezing practices were mixed: 40.4% correctly identified cold-water thawing as safe, and 55.5% correctly held that refreezing defrosted foods is unsafe. The most significant misconceptions appeared in technical food safety concepts, where very few vendors recognized that well-cooked foods can still be re-contaminated (8.7%), only one-third understood that raw meat should be placed on the bottom shelf of the refrigerator (34.6%), and just 26.0% correctly disagreed with washing eggs. These thematic patterns suggest that while foundational hygiene-related attitudes are strong, substantial gaps persist in more advanced or scientific aspects of food safety, highlighting priority areas for targeted training.

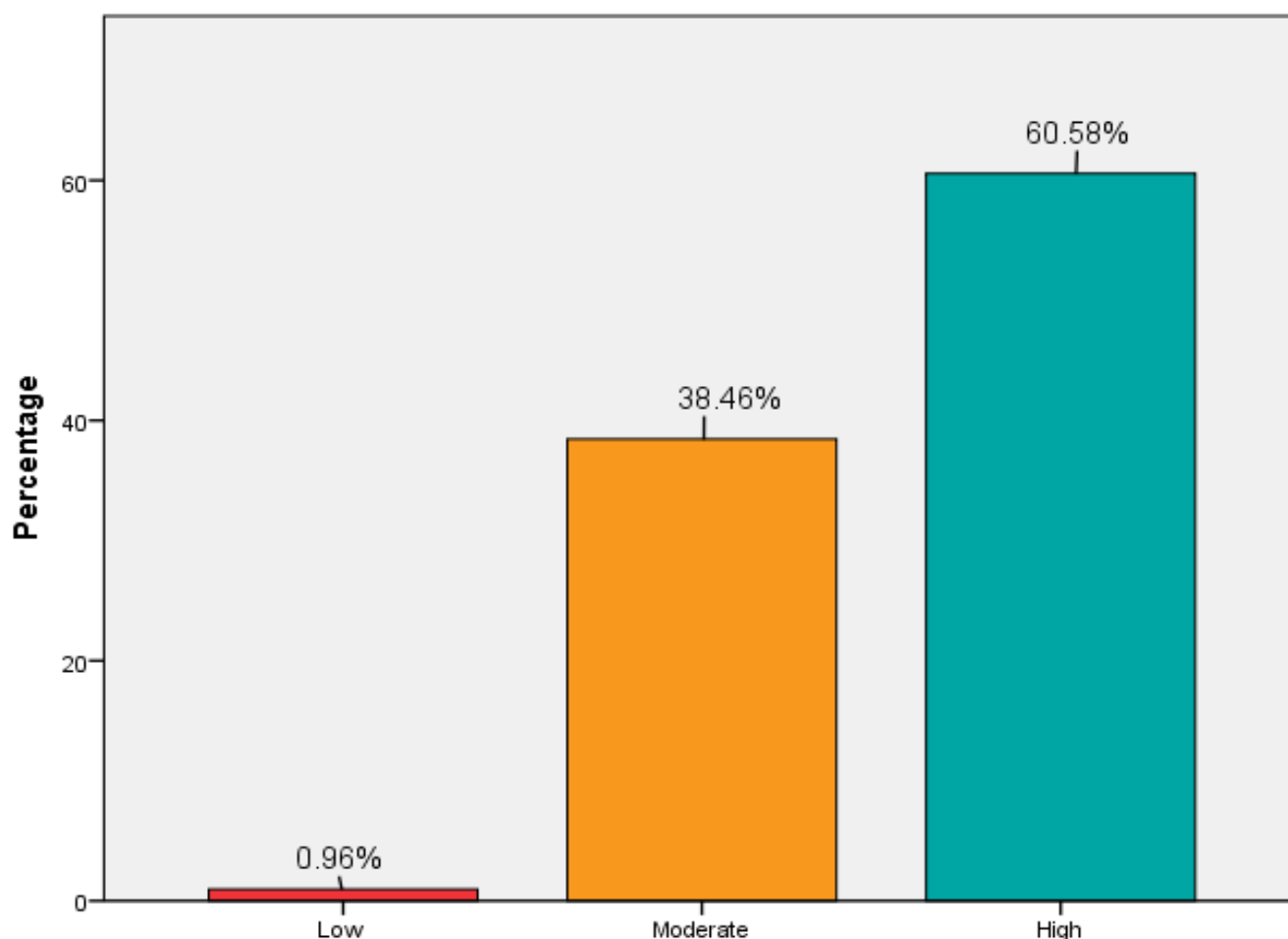


Figure 1. Attitude percentage of vendors toward food safety.

Overall food safety attitude scores, calculated as the percentage of correct responses across all valid attitude items, showed substantial variation among vendors. Attitude percentages ranged from 37.5% to 93.8%, with a mean score of 75.8% (Standard deviation = 9.1), indicating a generally high percentage of positive attitude responses. The bar graph in [Figure 1](#) summarizes the distribution of attitude percentage scores. We find that 63 vendors (60.6%) achieved scores of 75% or higher. However, a considerable proportion, 38.5% (n=40) fell within the moderate category (50 – 74%), and one vendor fell outside of the high or moderate categories. This distribution suggests that, while overall attitudes are encouraging, many vendors still have room for improvement. This emphasizes the need for ongoing education and reinforcement to

strengthen their understanding of core and technical food safety principles.

Chi-square analyses were conducted to determine whether vendors with higher overall percentages of favorable responses were more likely to select correct responses on specific attitude items. Several statistically significant associations emerged. [Figure 2](#) presents the distributions of correct and incorrect responses for the four attitude items, which showed statistically significant dependency relations with the categories of correct responses to all food safety attitude questions. Vendors who selected the favorable responses to these items were more likely to attain high percentages of correct responses.

Table 2. Cross Tabulation of the Vendors ' Attitude Responses and the categorized Attitude percentage.

Cross Tabulation with the Attitude percentage variable		Pearson Chi-Square (P-value)	OR value	Exp. Val. Assumption Satisfied
A1	Proper hand hygiene can prevent food-borne diseases	0.196	3.885	No
A2	Raw and cooked foods should be stored separately to reduce the risk of food contamination	0.029	2.524	No
A3	It is necessary to check the temperature of refrigerators/freezers periodically to reduce the risk of food contamination	0.658	0.192	No
A4	The health status of workers should be evaluated before employment	0.063	3.336	No
A5	The best way to thaw a chicken is in a bowl of cold water	0.002	10.044	Yes
A6	Wearing masks is an important behavior to reduce the risk of food contamination	0.000	15.547	No
A7	Wearing gloves is an important behavior to reduce the risk of food contamination	0.000	11.398	No
A8	Wearing caps is an important behavior to reduce the risk of food contamination	0.932	0.156	No
A9	Dish towels can be a source of food contamination	0.000	14.580	No
A10	Knives and cutting boards should be properly sanitized to prevent cross-contamination	0.000	12.519	No
A11	Food handlers who have abrasions or cuts on their hands should not touch foods without gloves	0.007	7.104	Yes
A12	Well-cooked foods are free of contamination	0.731	0.117	No
A13	Can a closed can/jar of cleaning product be stored together with closed cans and jars of food products?	0.019	5.425	Yes
A14	Defrosted foods can be refrozen	0.006	7.448	Yes
A15	The ideal place to store raw meat in the refrigerator is on the bottom shelf	0.034	7.331	No
A16	Eggs must be washed after purchase as soon as possible	0.125	4.230	No

[Table 2](#) presents the chi-square test results comparing vendors' individual attitude responses with their categorized attitude percentage (low, moderate, or high). Twelve items did not satisfy the expected values assumptions and so no definitive conclusions are drawn for establishing dependency

relationships. However, the odds ratios are high for nine of these indicators suggesting that vendors who give favorable responses to each of these items are more likely to have more positive attitude scores than other vendors. Notable among these are the high odds ratios for attitudes towards wearing

mask, wearing gloves, dish towels, and knives and cutting boards. The other four items (In bold) satisfy the expected value assumptions, show statistically significant associations, and also boast high odds ratios. These statistics provide evidence that the total attitude scores are significantly dependent

on vendors' responses to each of these four indicators. More specifically, vendors who provided the correct responses to each of these four variables were between 5 and 10 times more likely to have high food safety attitudes as compared to other vendors.

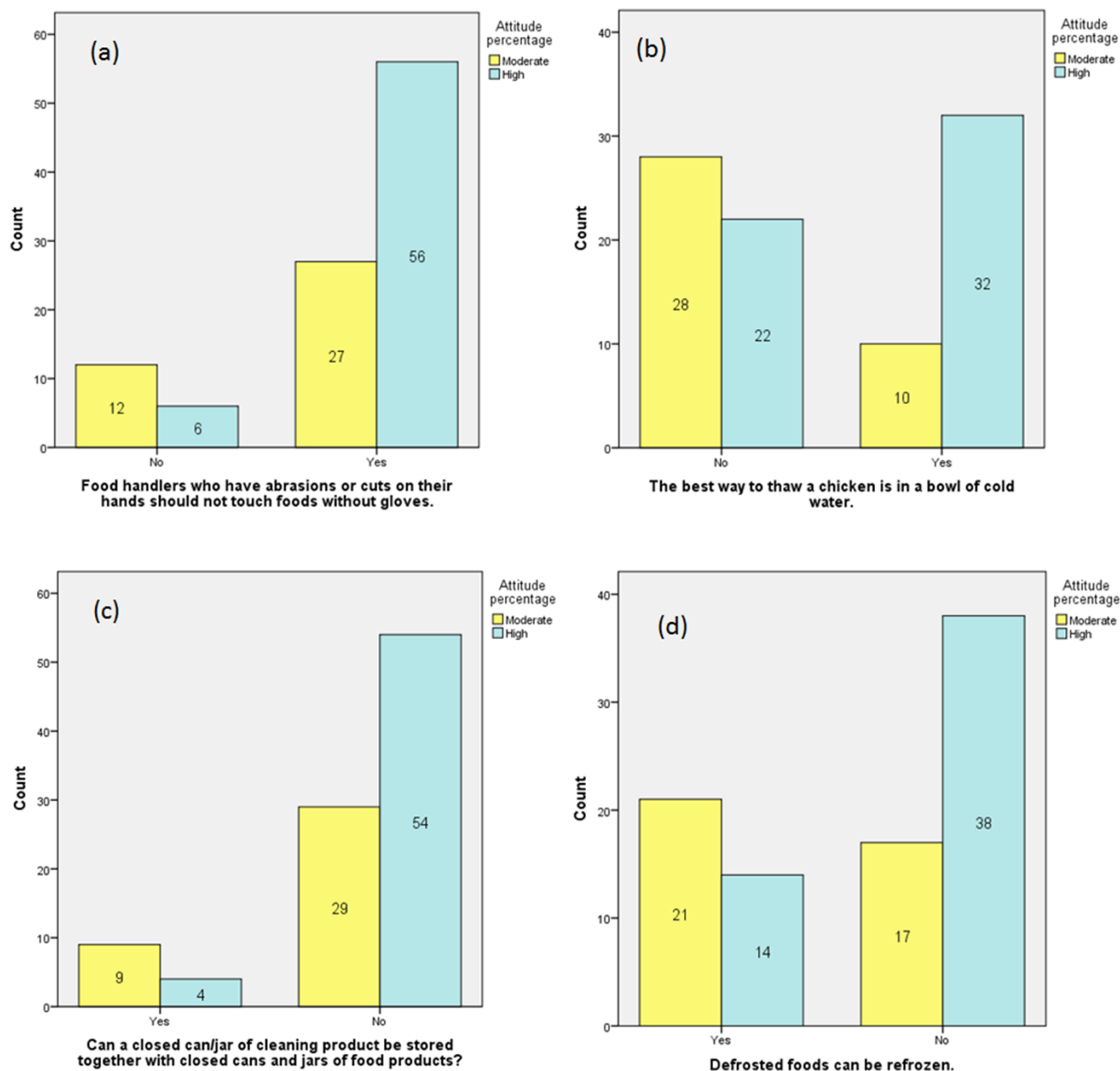


Figure 2. Clustered Bar Charts Showing Significant Dependency Relations Between Attitude Score Categories and Attitude Towards (a) Abrasions and Cuts, (b) Thawing Chicken, (c) Foods Near to Cleaning Products, and (d) Refreezing Foods.

Vendors who provided favorable responses to one or more of these items were significantly more likely to have high attitude percentages. That is, those vendors who (a) agreed that food handlers with cuts or abrasions should not handle food without gloves [$\chi^2(1, N = 101) = 7.27, p = .007$], (b) believed that cold-water thawing as the correct method for

defrosting chicken [$\chi^2(1, N = 92) = 9.76, p = .002$], (c) correctly rejected the unsafe practice of storing sealed cleaning products together with sealed food containers [$\chi^2(1, N = 96) = 5.53, p = .019$], and (d) indicated that defrosted foods should not be refrozen [$\chi^2(1, N = 90) = 7.42, p = .006$]. For all significant items, the Likelihood Ratio tests (all $p < .05$) and

Fisher's Exact Tests (all $p < .05$) supported the chi-square findings, confirming the stability of the associations. All other chi-square tests assessing the relationship between overall

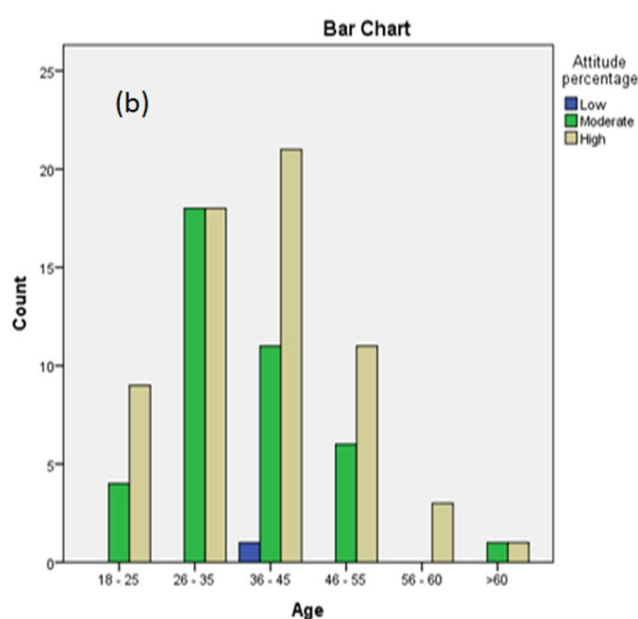
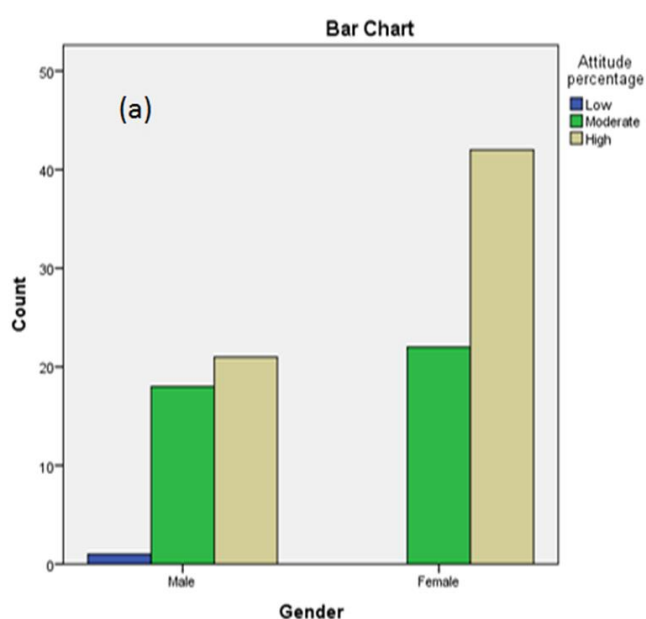
attitude percentage and item-level responses were not statistically significant, indicating that no additional meaningful associations were detected.

Table 3. Cross tabulation of the vendors' demographic responses and the categorized attitude percentage.

Demographics Cross Tabulation with the Attitude percentage variable		Pearson Chi-Square (P-value)	Exp. Val. Assumption Satisfied
D1	Gender	0.221	No
D2	Age	0.742	No
D3	Ethnicity	0.612	No
D4	Education	0.102	No
D5	Education in Guyana	0.159	No
D6	Experience	0.223	No
D7	Food Safety Training	0.695	No

Table 3 presents the chi-square tests assessing whether vendors' demographic characteristics were associated with their categorized attitude levels (low, moderate, or high). None of the demographic variables showed statistically significant associations, as all p-values were above 0.05. Additionally, the chi-square assumptions were not satisfied: at least one expected cell count fell below 1, and more than 20% of the expected counts were below 5 for every variable. These violations indicate that the test results are unstable and these findings should be interpreted cautiously, future studies may require larger samples or alternative statistical approaches to

more accurately assess demographic influences on attitude levels. Figure 3 shows the cluster bar chart with the demographic values and the categorized attitude percentages. The visual patterns indicate that the distribution of low, moderate, and high attitude levels remains broadly similar across most demographic groups, with no clear shifts that would suggest strong demographic influences on attitude. Overall, the chart reinforces the conclusion that vendors' demographic characteristics do not substantially affect their attitude classifications.



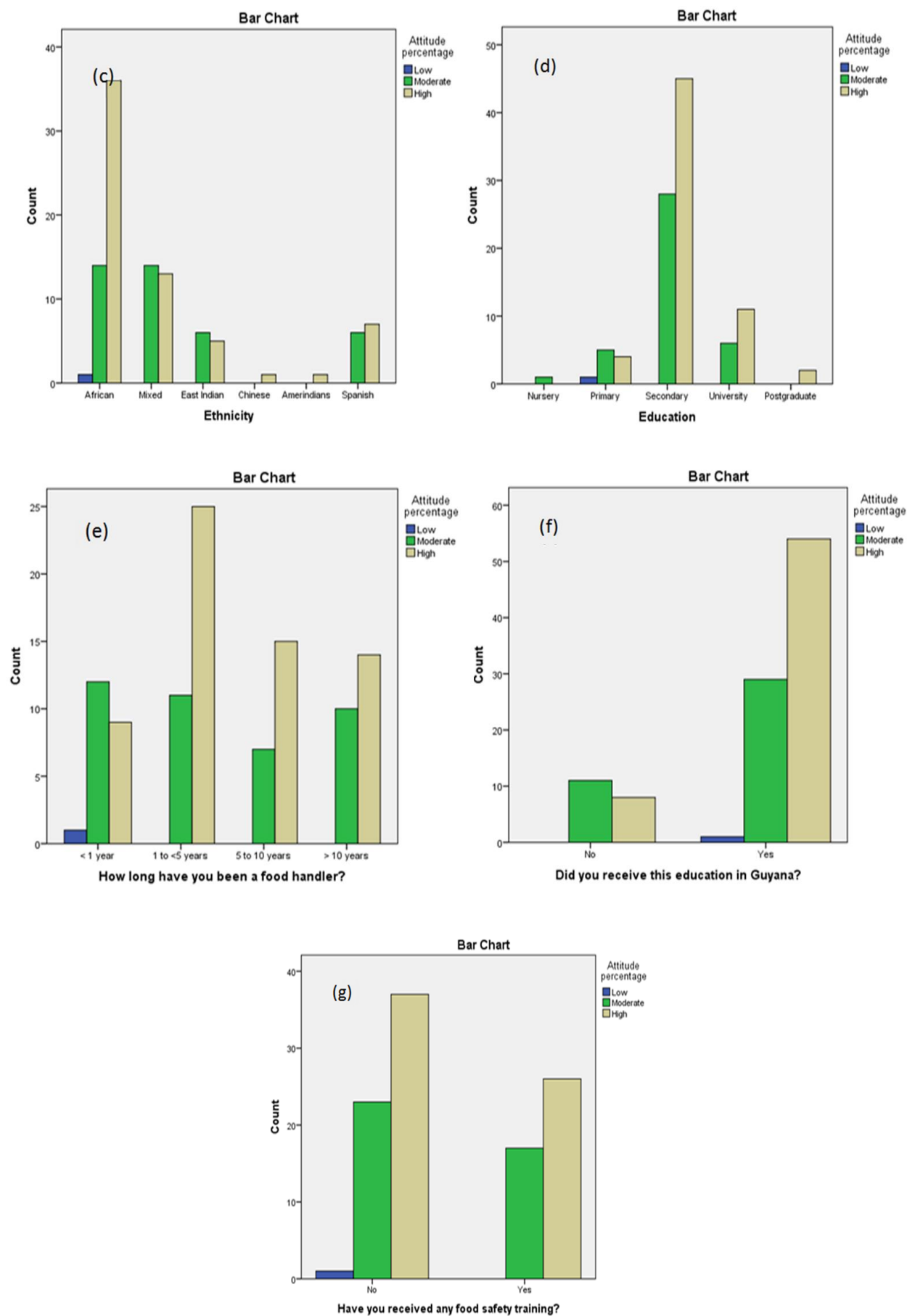


Figure 3. Clustered Bar Charts Showing Demographic Relations Between Attitude Score Categories.

Furthermore, one-way ANOVA tests were conducted to examine whether overall mean food safety attitude percentages differed significantly across demographics. The results indicated no statistically significant differences in the means across the various categories of each demographic variable. The association between gender and percentage attitude scores was not statistically significant ($p = 0.0501$). Although this value is close to the 0.05 threshold, it does not meet the criterion for significance based on the rule $p < 0.05$. [Table 4](#) presents the demographic variables, the relevant assumptions, and the respective p -values for the tests. These findings indicate that food safety attitudes among vendors in the Demerara-Mahaica region do not vary by vendor demographic characteristics.

Table 4. Percentage Attitude Scores by Demographics Using the One-way ANOVA.

Variable		Equal Variance Assumed	P-value
D1	Gender	Yes	0.0501
D2	Age	Yes	0.998
D3	Ethnicity	Yes	0.848
D4	Education	Yes	0.107
D5	Education in Guyana	Yes	0.274
D6	Experience	Yes	0.265
D7	Food Safety Training	No	0.888

Additionally, binary logistic regression was conducted to identify demographic factors associated with the likelihood of having a positive food safety attitude. The dependent variable was the recoded percentage attitude variable, with vendors scoring $\geq 75\%$ coded as high (1) and those scoring $< 75\%$ coded as low-moderate (0). The results are presented in [Table 5](#) (see Appendix I), which shows that all demographic variables were entered into the model. The backward likelihood-ratio selection method was employed to converge the process to the best model.

Aside from D4_Education, no other variable has a significance level (Sig.) lower than 0.05 for the first five steps. The education level and education in Guyana variables were significant in the sixth step and therefore constitute the final model. The values in the final column in the table (see Appendix 1), Exp (B), indicate the odds ratio (OR), where, at the final stage, that of education level is $OR = 2.23$ with $p = .042$, and that of education in Guyana is $OR = 3.14$ with $p = 0.04$. Based on these statistics, we find that vendors with higher levels of formal education were more than twice as likely to exhibit positive food safety attitudes as those with lower levels of education. Additionally, vendors who received their

education outside of Guyana were over three times more likely to demonstrate positive attitudes than those who received their education in Guyana. This finding suggests possible differences in curricular exposure to food safety topics or broader differences in educational training across systems.

The final model was statistically significant ($\chi^2 = 7.94$, $df = 2$, $p = .019$), indicating that the two retained predictors meaningfully improved classification accuracy compared with the null model comprising all demographic variables. This final model correctly classified 67% of cases, with a Nagelkerke R^2 of 0.10, suggesting that approximately 10% of the variation in positive attitudes was explained by the two predictors.

The final logistic regression model from Step 6 is expressed as:

$$\text{"logit"(p)} = -2.974 + 0.801 (\text{"Education Level"}) + 1.146 (\text{"Educated Outside Guyana"}),$$

where p is the probability of having a positive food safety attitude. The coefficients indicate that increases in education and receiving education outside Guyana raise the log-odds of exhibiting a positive attitude. The pseudo- R^2 values clearly highlight this limitation: Nagelkerke R^2 decreased from 0.120 to 0.100, indicating that the final model accounts for only 10.0% of the variation in food safety attitudes. Despite the low proportion of explained variance, the results consistently show that vendors with higher education levels and those trained outside of Guyana are more likely to recognize and adhere to key food safety principles, such as contamination prevention, proper thawing/refreezing, and chemical storage.

Taken together, the findings suggest that while education is a meaningful predictor, much of the variation in vendors' attitudes likely depends on additional unmeasured factors. Strengthening local food safety education programs and designing targeted interventions for vendors with lower educational attainment may therefore play a crucial role in improving food safety practices across the Demerara-Mahaica region.

4. Discussion

This study examined the attitudes of street food vendors in the Demerara-Mahaica region toward food safety, an area where the literature lacks prior empirical work in Guyana. Overall, the findings indicate that while most vendors exhibit positive attitudes toward food safety, significant gaps remain, particularly in areas related to perceived risk, responsibility, and adherence to essential safety principles. These patterns align closely with studies from multiple low- and middle-income countries where street vending is informal, regulatory oversight is limited, and vendors often rely on experiential knowledge rather than formal training.

The high proportion of vendors reporting favorable attitudes toward safe food handling mirrors results observed in

Jordan and Bangladesh, where improved knowledge and awareness were also associated with more positive attitudes [5, 6]. However, the Guyanese findings also show that attitudes are not uniformly strong across all domains. Vendors were less likely to agree with statements that challenged common misconceptions or required a more profound understanding of contamination pathways, consistent with evidence that positive attitudes alone may not guarantee safe behavior [7]. This discrepancy between general optimism and specific technical gaps is widely documented in the literature on informal food environments.

Important comparative insights emerge when these findings are positioned within the broader international context. Vendors in Malaysia and the Philippines, for example, also reported high levels of commitment to food safety yet continued to experience challenges in practice, mainly due to resource limitations, infrastructural constraints, and inconsistent enforcement [8, 11]. In contrast, studies in Ethiopia and Ghana have consistently shown that limited knowledge and weak regulatory environments are associated with negative or ambivalent attitudes toward food safety [9, 10]. The present study's findings fall between these extremes: Guyanese vendors demonstrate positive overall attitudes but also show lingering uncertainty regarding specific risk-based behaviors, like patterns reported in Ghana, where vendors possessed moderate awareness but inconsistent attitudes toward key risk factors [25].

Additionally, the results from Namibia further support this interpretation. In their context, vendors generally expressed positive attitudes but struggled to translate these attitudes into safe handling behaviors, partly due to structural constraints and weak enforcement mechanisms [26]. The evidence from both Ghana and Namibia reinforces the argument that attitudes among informal vendors are strongly shaped by the regulatory environment, infrastructural challenges, and access to training, factors that are also relevant in Guyana, given documented weaknesses in surveillance, inspection, and food control coordination [1, 2, 4].

The significant associations found between food safety attitudes and key demographics, including training and education, further underscore the role of capacity building in shaping vendor perspectives. Vendors with prior training demonstrated more positive attitudes, consistent with findings across Low and Middle-Income Countries where structured training has been shown to enhance both attitudes and compliance [5, 6]. Similarly, the significant link between education and attitude suggests that foundational literacy, comprehension skills, and exposure to health concepts contribute to more favorable views of food safety. Comparable relationships were observed in the Sarawak study, where vendors with higher levels of education displayed better attitudes and greater alignment with recommended practices [27].

Although a few attitude variables are significantly associated with the total number and percentage of favorable responses, the findings also show that vendors' demographic

characteristics do not influence these attitude scores. An attempt at modelling attitude scores with demographic characteristics yielded only two significant variables. Furthermore, the model explained only a small percentage of the variation in attitudes. Nevertheless, this poor level of explanatory power is typical in attitude research involving informal-sector food handlers [13, 28]. This modest R^2 value (Nagelkerke $R^2 = 0.10$), also suggests that additional unmeasured factors may play an important role in shaping vendors' attitudes, including economic pressures, customer expectations, time constraints during peak sales periods, and local infrastructure limitations such as inconsistent access to potable water or waste disposal facilities. Psychosocial influences, such as perceived risk, cultural norms, or prior training experiences, affect vendors' attitudes but show inconsistent associations with observed hygiene practices. Various studies indicate that formal training or education sometimes enhances knowledge and attitudes without resulting in substantial improvements in practices [12, 29, 30]. Another contributing factor may be social-desirability bias, whereby vendors provide responses they perceive to be socially acceptable, especially regarding hygiene or food-handling practices, rather than reporting their true attitudes. Such bias can inflate positive responses, dampen observable variation, and reduce the model's ability to detect meaningful predictors [31, 32]. Consequently, future research should incorporate contextual and behavioral variables, such as workplace or refresher training and socio-cultural assessments, while combining observation with implicit or indirect measures to better explain variances and target interventions effectively [12, 30, 31].

Despite these encouraging findings, the persistence of uncertainty and disagreement on several key attitude items indicates areas where targeted interventions may be necessary. Misconceptions about safe food temperatures, cross-contamination, and environmental hygiene can undermine prevention efforts, particularly in regions where past evaluations have identified systemic challenges in laboratory capacity, surveillance, and coordinated oversight [1, 2]. The present findings, therefore, highlight an opportunity to design training that not only increases awareness but also directly addresses context-specific misconceptions that appear to persist even among experienced vendors.

Taken together, the findings contribute new empirical evidence to Guyana's limited body of research on street-food safety. The positive overall attitude profile is encouraging, but the mixed responses to technical risk-related items reveal critical knowledge-attitude gaps that could influence actual behavior, especially in informal and resource-limited settings. These results align with global evidence from comparable regions and underscore the need to strengthen structured training programs, improve monitoring mechanisms, and enhance public health communication tailored to the realities of nighttime street food vending in Guyana. In particular, the enlightenment of food vendors through continuous and context-specific education is essential. Strengthening access to

practical food-safety training, reinforcing correct handling techniques, and integrating routine awareness activities into local licensing or supervisory processes would help address the gaps identified. Such targeted capacity-building efforts have the potential to improve vendors' everyday practices and contribute to safer street-food environments.

While the present study offers valuable insights into the food-safety attitudes of street food vendors in the Demerara–Mahaica region, several limitations warrant consideration. The reliance on convenience sampling restricted the external validity of the findings and may limit their generalizability beyond the specific vending sites surveyed. The use of self-reported data introduced the potential for social-desirability bias, whereby vendors may overstate positive attitudes or underreport unfavorable ones.

Future research should address these limitations by employing larger, probabilistic, or mixed-method samples and triangulating survey results with direct observations of vendor behavior. Longitudinal designs could further clarify how attitudes evolve following targeted training programs or regulatory reforms. Given that participants in this study were primarily night-time vendors, the role of environmental illumination also warrants investigation. Adequate lighting is essential for tasks such as monitoring food surfaces, identifying contamination risks, and maintaining overall hygiene. Because lighting conditions were not measured in the present study, future research should include targeted questions assessing whether vendors have access to sufficient lighting during food preparation and service. Such insights would help clarify how environmental constraints intersect with food-safety attitudes and operational practices. Additionally, examining how infrastructural constraints, such as access to potable water, sanitation, and refrigeration, interact with individual-level attitudes would provide a more comprehensive understanding of food-safety compliance within Guyana's informal food sector.

5. Conclusion

While street food vending is an essential economic and social activity, food contamination, foodborne diseases, and deaths have raised global concerns about street food vendors' knowledge, attitudes, and practices. In Guyana, this is compounded by the scarcity of academic research and data on street food vendors. This paper presents an empirical study of street food vendors' attitudes towards food safety in the Demerara-Mahaica region of Guyana. Vendors generally demonstrated a positive attitude toward food safety; however, significant gaps were observed in technical areas, including contamination risks and temperature control. Furthermore, the findings reveal that vendors with an acute understanding of key food safety practices, particularly those involving thawing, refreezing, contamination control, and chemical storage, tend to respond more favorably to a greater number of food safety attitude questions. Moreover, the demographic varia-

bles do not influence vendors' attitudes. These findings suggest that food safety attitudes are homogeneous across the region and that, while vendors value food safety, misconceptions persist that may hinder safe practices. This highlights the importance of strengthening accessible training for all stakeholders and underscores the need for deliberate, concerted improvement in Guyana's food safety surveillance and regulatory oversight. The study included only night street food vendors who sold cooked foods. Therefore, the findings may not perfectly match the attitudes of vendors who operate during the day or those who provide prepackaged, processed foods and beverages. Considering the associated public health issues and concerns, there is a need for data and broader empirical studies of the knowledge, attitudes, and practices of all street food vendors and consumers in Guyana. In the meantime, this study establishes a baseline for understanding food safety attitudes within Guyana's informal street food vending sector. It underscores the need for coordinated efforts to improve monitoring and adherence to food safety principles.

Abbreviations

ANOVA	Analysis of Variance
OR	Odds Ratio

Author Contributions

Linda Francois: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Software, Visualization, Writing – original draft, Writing – review & editing

Dwayne Shorlon Renville: Data curation, Formal Analysis, Investigation, Methodology, Resources, Software, Validation, Writing – review & editing

Tandeka Barton: Investigation, Methodology, Resources, Validation

Bunnel Bernard: Investigation, Resources, Writing – review & editing

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Data Availability Statement

The raw data supporting the conclusions of this article will be made available by the authors on request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Appendix

Appendix I: Table 5

Table 5. Binary Logistic Regression Predicting Positive Food Safety Attitudes.

Variables in the Equation		B	S.E.	Wald	df	Sig.	Exp (B)
Step 1 ^a	D1_Gender	.390	.471	.686	1	.407	1.477
	D2_Age	.050	.221	.052	1	.820	1.051
	D4_Education	.856	.402	4.549	1	.033	2.355
	D6_Experience	.127	.227	.312	1	.577	1.135
	D7_FoodSafetyTraining	-.278	.457	.370	1	.543	.757
	D5_EduInGuy	.676	.726	.866	1	.352	1.965
	D3_Ethnicity	-.084	.157	.288	1	.592	.919
	Constant	-3.539	1.684	4.417	1	.036	.029
Step 2 ^a	D1_Gender	.386	.470	.673	1	.412	1.471
	D4_Education	.847	.398	4.518	1	.034	2.332
	D6_Experience	.147	.207	.505	1	.477	1.159
	D7_FoodSafetyTraining	-.283	.456	.385	1	.535	.754
	D5_EduInGuy	.707	.711	.988	1	.320	2.028
	D3_Ethnicity	-.083	.157	.281	1	.596	.920
Step 3 ^a	Constant	-3.444	1.627	4.482	1	.034	.032
	D1_Gender	.338	.461	.536	1	.464	1.402
	D4_Education	.845	.398	4.512	1	.034	2.329
	D6_Experience	.146	.207	.499	1	.480	1.158
	D7_FoodSafetyTraining	-.246	.450	.298	1	.585	.782
	D5_EduInGuy	.907	.609	2.213	1	.137	2.476
Step 4 ^a	Constant	-3.717	1.548	5.763	1	.016	.024
	D1_Gender	.370	.457	.656	1	.418	1.447
	D4_Education	.791	.385	4.213	1	.040	2.206
	D6_Experience	.128	.204	.394	1	.530	1.137
	D5_EduInGuy	.895	.608	2.162	1	.141	2.446
Step 5 ^a	Constant	-3.651	1.547	5.574	1	.018	.026
	D1_Gender	.367	.455	.649	1	.420	1.443
	D4_Education	.789	.388	4.128	1	.042	2.202
	D5_EduInGuy	.990	.590	2.814	1	.093	2.690
Step 6 ^a	Constant	-3.404	1.503	5.132	1	.023	.033
	D4_Education	.801	.390	4.232	1	.040	2.229

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp (B)
D5_EduInGuy	1.146	.558	4.218	1	.040	3.144
Constant	-2.974	1.396	4.539	1	.033	.051

a. Variable (s) entered on step 1: D1_Gender, D2_Age, D4_Education, D6_Experience, D7_FoodSafetyTraining, D5_EduInGuy, D3_Ethnicity.

Appendix II: IRB Approval Letter

Institutional Review Board FWA00030719
Ministry of Health
 Brickdam, Georgetown, GUYANA
 Telephone: 592-226-1224
 E-mail: guyanamohirb@gmail.com

Memo

To: Tandeka Barton
From: Chair, Institutional Review Board
Date: May 16, 2024
Subject: IRB Approval – New Protocol # 045/2024

The Ministry of Health's Institutional Review Board (IRB) has reviewed the request for approval of protocol # 045/2024 entitled "*Understanding the Interplay of Food Safety Knowledge, Attitudes, and Behaviours among Street Food Vendors and Consumers in Georgetown, Guyana: An Integrated Approach with Microbiological Analyses*" and has approved the protocol for the maximum allowable period of one year. This IRB approval expires on **May 15, 2025**.

As a reminder, the IRB must review and approve all human subjects' research protocols at intervals appropriate to the degree of risk, but not less than once per year. There is no grace period beyond one year from the last IRB approval date. It is ultimately your responsibility to submit your research protocol for continuation review and approval by the IRB. Please keep this approval in your protocol files as proof of IRB approval and as a reminder of the expiration date. To avoid lapses in approval of your research and the possible suspension of subject enrolment and/or termination of the protocol please submit your continuance request at least six weeks before the protocol expiration date.

Upon completion of your research an **electronic Report MUST** be submitted to the Board.

Any problems of a serious nature should be brought to the immediate attention of the IRB and any proposed changes to the protocol should be submitted as an amendment to the protocol for IRB approval before they are implemented.

Should you have any questions please contact the **IRB Administrator** or the **IRB Chair** via email or telephone at the email address or telephone number listed above.


 Dr. Reeta Gobin
 Chair

Figure 4. Institutional Review Board (IRB) approval letter granting ethical clearance for the study.

Appendix III: Questionnaire

Coded ID # _____

Knowledge, Attitudes, and Behavior Questionnaire - Vendor

Introduction

I, (*name of researcher/assistant supplied*), am conducting a research on food safety. I would like you to participate in this survey by answering some questions relating to food safety. This questionnaire should take approximately twenty-five minutes of your time, and any information you provide will be strictly confidential. Are you willing to participate in this survey and if so is now a convenient time? Before answering, I do sincerely hope that you will partake in this survey as the information you provide would be used to better food safety in Guyana. Please remember that participation is voluntary and this survey has a follow up phase where I am required to take samples of your cooked product for the purpose of testing.

To the interviewer (*circle the correct response where applicable*)

Vendor Demographics

1. Gender: Male Female
2. Age: 18-25 26-35 36-45 46-55 56-60 >60
3. Ethnicity African; Mixed; East Indian; Chinese; Amerindian; Spanish
4. Education: Nursery Primary Secondary University Postgraduate
5. Did you receive this education in Guyana? Yes No
6. How long have you been a food handler? < 1 year; 1-5 years; 5 – 10 years; >10 years
7. Have you received any Food Safety Training? Yes No
8. Location of vendor: _____ NA

Food Safety Knowledge (*circle the provided response*)

1. Abortion in pregnant women can be induced by food-borne disease.
 - a. Yes
 - b. No
 - c. Don't Know
2. Bloody diarrhea can be transmitted by food.
 - a. Yes
 - b. No
 - c. Don't Know
3. Swollen cans can contain microorganisms.
 - a. Yes
 - b. No
 - c. Don't Know
4. During infectious disease of the skin, it is necessary to take leave from work.
 - a. Yes
 - b. No
 - c. Don't Know
5. Eating and drinking in the work place increase the risk of food contamination.
 - a. Yes
 - b. No
 - c. Don't Know
6. Hepatitis A virus is a foodborne pathogen.
 - a. Yes
 - b. No
 - c. Don't Know
7. Microbes are in the skin, nose and mouth of healthy food handlers.
 - a. Yes
 - b. No
 - c. Don't Know
8. Salmonella is among the food-borne pathogens.
 - a. Yes
 - b. No
 - c. Don't Know
9. Staphylococcus is among the food-borne pathogens.

- a. Yes
 - b. No
 - c. Don't Know
10. Influenza can be transmitted by aerosols rather than food.
- a. Yes
 - b. No
 - c. Don't Know
11. Using gloves while handling food reduces the risk of food contamination.
- a. Yes
 - b. No
 - c. Don't Know
12. Washing hands before work reduces the risk of food contamination.
- a. Yes
 - b. No
 - c. Don't Know
13. AIDS can be transmitted by food.
- a. Yes
 - b. No
 - c. Don't Know
14. Children, healthy adults, pregnant women and older individuals are at equal risk for food poisoning.
- a. Yes
 - b. No
 - c. Don't Know
15. Food prepared in advance reduces the risk of food contamination.
- a. Yes
 - b. No
 - c. Don't Know
16. Proper cleaning and sanitization of utensils decrease the risk of food contamination.
- a. Yes
 - b. No
 - c. Don't Know
17. Reheating cooked foods can contribute to food contamination.
- a. Yes
 - b. No
 - c. Don't Know
18. Washing utensils with detergent leaves them of contamination.
- a. Yes
 - b. No
 - c. Don't Know
- Food Safety Attitude (circle the provided response)
1. Proper hand hygiene can prevent food-borne diseases.
- a. Yes
 - b. No
 - c. Don't Know
2. Raw and cooked foods should be stored separately to reduce the risk of food contamination.
- a. Yes
 - b. No
 - c. Don't Know
3. It is necessary to check the temperature of refrigerators/freezers periodically to reduce the risk of food contamination.
- a. Yes
 - b. No
 - c. Don't Know
4. The health status of workers should be evaluated before employment.
- a. Yes
 - b. No

- c. Don't Know
5. The best way to thaw a chicken is in a bowl of cold water.
- a. Yes
- b. No
- c. Don't Know
6. Wearing masks is an important behavior to reduce the risk of food contamination.
- a. Yes
- b. No
- c. Don't Know
7. Wearing gloves is an important behavior to reduce the risk of food contamination.
- a. Yes
- b. No
- c. Don't Know
8. Wearing caps is an important behavior to reduce the risk of food contamination.
- a. Yes
- b. No
- c. Don't Know
9. Dish towels can be a source of food contamination.
- a. Yes
- b. No
- c. Don't Know
10. Knives and cutting boards should be properly sanitized to prevent cross contamination.
- a. Yes
- b. No
- c. Don't Know
11. Food handlers who have abrasions or cuts on their hands should not touch foods without gloves.
- a. Yes
- b. No
- c. Don't Know
12. Well-cooked foods are free of contamination.
- a. Yes
- b. No
- c. Don't Know
13. Can a closed can/jar of cleaning product be stored together with closed cans and jars of food products?
- a. Yes
- b. No
- c. Don't Know
14. Defrosted foods can be refrozen.
- a. Yes
- b. No
- c. Don't Know
15. The ideal place to store raw meat in the refrigerator is on the bottom shelf.
- a. Yes
- b. No
- c. Don't Know
16. Eggs must be washed after purchase as soon as possible.
- a. Yes
- b. No
- c. Don't Know

Observed Food Handling Behavior (circle or provide the correct observation)

Facilities

1. Stall location: Near school Near supermarket Street corner Seawall Near residence community Mobile vendor Other (please state)

2. What material is the structure made of where the food is sold:

Stainless steel Zinc/iron Plastic /Wooden table Other

3. What structure is the facility where the food was prepared?

Covered Canopy Semi-closed container Uncovered Other (please state)

4. Where was the food prepared? On site At home Both

Environment around the stall (based on observation)

5. Environment around the stall is clean

a. Yes

b. No

6. Access to potable water at the site or close to the site

a. Yes

b. No

7. Adequate hand washing facilities available

a. Yes

b. No

8. Adequate waste water or food disposal facilities available

a. Yes

b. No

9. Stall is far from rubbish

a. Yes

b. No

10. Stall is far from waste water

a. Yes

b. No

11. Stall is far from toilet facilities and open drains

a. Yes

b. No

12. Stall is far from animals

a. Yes

b. No

13. No flies on the stall

a. Yes

b. No

Personal hygiene (interviewer observances)

14. Operator washed their hands in clean water each time before handling, preparing, or serving food

a. Yes

b. No

15. Operator washed their hands each time after visiting the toilet

a. Yes

b. No

c. Not Observed

16. Operators clothes were clean and presentable

a. Yes

b. No

17. Operator used an apron when handling, preparing, or serving food

a. Yes

b. No

18. Operator handled food with bare hands

a. Yes

b. No

19. Operator nails were clean and short

a. Yes

b. No

20. Operator hair was covered when handling, preparing or serving food

a. Yes

b. No

21. Operator wore a mask when handling, preparing, or serving food

- a. Yes
- b. No

22. Operator handled money while serving food

- a. Yes
- b. No

If answer to Q22 is yes: Did operator wash their hands after handling money before handling food again?

- a. Yes
- b. No

23. Dirt or dust was removed using: an apron bare (uncovered) hands dirty cloth clean cloth Activity not observed

24. Operator wore jewelry while handling food

- a. Yes
- b. No

If answer to Q24 is yes: Was the jewelry adequately covered?

- a. Yes
- b. No

25. Operator smoked while handling food

- a. Yes
- b. No

26. Operator used the same utensils to prepare raw and cooked food

- a. Yes
- b. No

Food Storage

27. Food was stored/displayed in sealed containers

- a. Yes
- b. No

28. Raw, partially cooked, and cooked food products were kept separate

- a. Yes
- b. No

29. Previously cooked foods were kept cool e.g. in an ice box or refrigerator

- a. Yes
- b. No

Utensils

30. Utensils were covered

- a. Yes
- b. No

31. Utensils were adequately cleaned every time after use

- a. Yes
- b. No

32. Utensils were cleaned with soapy water

- a. Yes
- b. No

License

33. Operator had a license

- a. Yes
- b. No

34. Operator had a food handlers card

- a. Yes
- b. No

35. Operator had a health certificate

- a. Yes
- b. No

Indicate any additional pertinent information here

Sample collection (# and types of samples collected): _____

End of Survey/Questionnaire

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