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Assessment of Food Safety Knowledge and Compliance to Hygienic Practices among Street Food Vendors in Zanzibar Urban District

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Authors' contributions

This work was carried out in collaboration between both authors. Author JKH was the principal investigator (study design, data collection, data analysis, interpretation, write up and critical review). Author LWTF was involved in the study design, interpretation, write up and critical review of the manuscript. Both authors approved the final version submitted for publication.

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ABSTRACT

This cross-sectional descriptive study assessed the hygienic and safety measures among street food vendors in the Urban district of Zanzibar. A total of 265 food vendors with immobile food vending units were involved. Data were gathered using a structured researcher-administered questionnaire and complemented with observation. Compliance ranks to food safety and hygiene were established based on computed compliance scores. Descriptive statistics and chi-squared tests (α = 0.05) were employed in data analyses. The results indicated that only a moderate fraction of the vendors have had formal training in food safety and hygiene, however the majority of whom demonstrated great awareness about food safety and hygiene. Among the surveyed vending sites 36% appeared clean, 50.2% and 42.6% vending sites had waste bin and / or refuse sites respectively, wash basin (44.9%) and soap availability (47.2%). Safe food handling practices

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included food covering (57.4%), adequate protection of food from flies and dust (40.8%), cold preservation of food (28.3%), saving food hot or reheated before sale (35.1%), dishing out food with appropriate gadgets (53%). Observed good food hygiene conducts included washing hands with soap before preparing food (always 63%, sometimes 34%), washing hands with soap after toilet visit (always 33.2%, sometimes 46.8%), clean finger nail (98.5%), hair protection (33.6%) and use of apron (29%). The results likewise indicate an overall compliance of 0.50 on environmental hygiene of vending site, 0.45 on food handling practices, and 0.66 on vendors' hygiene and sanitary practices. This implies an average overall compliance with the hygiene of the vending site and food handling practices and good overall compliance with the vendors' hygiene and sanitary practices. Chi-square analysis revealed that gender, education attainments, formal training on food safety and vending duration are influencing factors for food safety and hygiene measures.

Keywords: Food safety and hygiene; sanitary condition; vending sites; hygiene and sanitary practices; street food vendors.

1. INTRODUCTION

The term "street food" refers to a variety of ready-to-eat foods and beverages sold and sometimes prepared, in public places. Street food may be consumed where it is purchased or can be taken away and eaten elsewhere [1]. Street food vending is a prevailing and distinctive part of a large informal sector. It is commonly seen in public places, particularly in the cities and is distinctive in the sense that it provides a basic need to the urban inhabitants [2]. This sector is thriving hastily due to rising and altering food demands by the urban residents needing cheaper food in the face of a tough economy [3]. In most developing countries, Tanzania inclusive, town adults consume food from street vendors on a regular basis since it is readily available, cheap and usually fresh [4]. There are diverse types of food vending sites comprising of mobile stalls, a variety of push-carts, roadside stands, and hawkers depending upon the creativity of the individual, resources available, type of food sold and the accessibility of other facilities [3]. However, issues of food safety due to food borne illnesses have led to an increase in global concern [3]. Estimates of the global burden of foodborne diseases [1] indicated that each year worldwide, contaminated food causes 600 million cases of foodborne diseases and 420,000 deaths. Africa and Southeast Asia are believed to have the highest incidence and death rates associated to foodborne disease [1]. In developing countries, up to an estimated 70% of cases of diarrheal disease are associated with consumption of unwholesome food [5,6]. According to [4] food safety concerns in Africa are characteristically centered on diseases that are related to poor hygiene. It also further indicated that in sub-Saharan Africa foodborne disease and foodborne disease eruptions are routinely attributed to poor personal hygiene of street food vendors and food handlers in food settings [7]. Street-vended foods may cause significant community health problems owing to lack of basic infrastructure and services, such as potable water supplies, their short-term nature, and inadequate knowledge of basic food safety precautions [4].

A study by [8] indicated that when school children were queried to show whether the foods vended by street vendors were safe to eat, majority responded that they were not. The most significant reason given was that the food were prepared under unhygienic situations and were presented uncovered [8]. Earlier researcher [9] established that contamination of street food in Dar es Salaam was due to numerous factors, mainly poor contaminated water, food handling, and unhygienic environment. According to [10] the yearly food poisoning cases in Zanzibar documented in 2012, 2013 and 2014 were 590, 479 and 333 correspondingly. The most current study [11] associated the prevalence of Shigellosis among children under 5 years of age in Unguja Island, Zanzibar, to the consumption of street food. Previously [9] indicated that, often than not, the street food vending industry has been linked with food poisoning eruptions, which prompts for a need to enhance an understanding of hygienic handling practices and safety aspects of food among street food vendors. Although the street food vending industry in Zanzibar employs many people and contributes to her GDP, however the sanitary conditions of food vending sites and hygienic practices of street food vendors has received little attention. In lots of incidences [12] investigators have established that street vendors do not observe acceptable

food handling practices leading to pathogenic cross contamination and hence unsafe food products for consumption. However evidence on the level of compliance with food hygienic practices and food safety measures among food vendors in Zanzibar is lacking, which is crucial for proper organization and execution of intended interventions. The present study, thus aimed at assessing food safety knowledge and compliance to hygienic practices among street food vendors in Zanzibar Urban District.

2. MATERIALS AND METHODS

2.1 Study Design

The study design used in this study was a cross-sectional study design which employed structured questionnaire.

2.2 Description of the Study Area

The study was conducted in the Urban district of Zanzibar. The district is located in the West urban region, and contains 55 shehia (villages) and 852 street food vendors [13]. The Urban district was selected for this study because it is the most highly populated administrative area with a lot of commercial activities and the majority food vendors.

2.3 Study Population and Sample Size

The study population was comprised of food vendors operating in the food vending industry in respective Shehia within the Urban district of Zanzibar. The sample size of street vendors was determined by using published tables for determining sample size as described earlier [14]. Based on the study population size of 852 of street food vendors in the Urban district of Zanzibar, the sample size (s) was established to be 265 at 95% confidence level.

2.4 Inclusion and Exclusion Criteria

The inclusion and exclusion criteria of the vendors was done as described by earlier researchers [7,10]. The study involved only food vendors with stationary food vending sites used for preparation / sales of street food and have operated for at least six months. All mobile food vending units such as push carts and their vendors were excluded together with vendors who have been in this business for less than six months.

2.5 Sampling of Shehia and Vendor Vending Sites

The Urban district has 55 Shehia (villages) from which five Shehia were randomly selected which included Darajani, Mikunguni, Forodhani, Malindi, and Muembeladu. From each of the five Shehia, 53 street food vendors were randomly selected. The venders were selected as described by [15] in which case a walk-through survey of randomly selecting food vendors / vending sites was done. A total of 265 vending units was selected.

2.6 Data Collection

A pre-tested structured researcher-administered questionnaire was used in data collection. The structured questionnaire and observational checklist were first prepared in English and then translated into Kiswahili which is the national language and medium of communication. The data collection tool was pretested among selected street food vendors operating in the Urban District of Zanzibar from the randomly selected Shehia which did not participate in the main study. The pretesting involved 20 food vendors to test for suitability, relevance and ambiguities of the questions in the questionnaire. On the basis of the pre-test result, some slight revisions were made for the questionnaire. During data collection, the researcher was assisted by two pre-trained health officers who are diploma holders.

2.7 Compliance Scores and Compliance Levels

Compliance scores (C-scores) and overall compliance score (OC-scores) were computed as described by Monney et al. [20].

2.7.1 Compliance score

C-scores were calculated from this equation:

$$Compliance\ Score\ (C-Score) = \frac{Nc}{T}$$; Where

Nc = Number of food vendors complying with a particular food hygiene and safety principle and T = Total number of food vendors.

2.7.2 Overall compliance score

Overall C-scores (OC- scores) were computed separately for each study item (environmental hygiene of food vending sites, vendors' food

Table 1. Compliance scores and corresponding compliance levels

Compliance score	Compliance level	Description
0.0 – 0.20	Very Poor	0% - 20% of food vendors comply with a particular food hygiene and safety principle
0.20 – 0.04	Poor	20% - 40% of food vendors comply with a particular food hygiene and safety principle
0.40 – 0.60	Average	40% - 60% of food vendors comply with a particular food hygiene and safety principle
0.60 – 0.80	Good	60% - 80% of food vendors comply with a particular food hygiene and safety principle
0.80 – 1.00	Very good	80% - 100% of food vendors comply with a particular food hygiene and safety principle

handling practices and vendors hygiene and sanitary practices) based on the C-scores for the food hygiene and safety practices. This denotes the overall mean compliance to each food safety and hygiene parameter evaluated in the current study.

$$Overal\ Compliance\ Score\ (OC-Score) = \frac{\sum_i^n C-score_i}{n}$$

2.7.3 Interpretation of the compliance scores

The compliance scores were interpreted as described in Table 1.

2.8 Data Analysis

Data analysis was done using IBM SPSS Software version 20.0 Descriptive analysis was used to summarize the results and Chi-square test was used to establish the statistical association.

3. RESULTS

3.1 Demographic Characteristics of Food Vendors

The results on demographic characteristics of food vendors are presented on Table 2. The results indicate that approximately two-thirds (67.5%) of the respondents were female and the remaining were male, which implies street food vending activity attracts female more than men. On the other hand, the dominant age groups are those between 18-35 years which constitute more than two-thirds of the labour force. In terms of education achievement the majority were primary and secondary school leavers each of which constituting about 42%. The involvement of university and vocational college graduates in street vending activity was below 3%. The majority of food vendors (59.2%) had been in this business for less than 5 years and about 15% have been engaged for between 11-15 and over 15 years.

3.2 Food Vendors' Knowledge on Food Safety and Hygiene

The results (Table 3.) show that 58.1% of the respondents were aware of the food hygiene and safety laws. Moreover, the majority (85.3%) had knowledge on food preparation acquired through informal education / self-taught and the rest got it through formal education / vocational institutions. Vendors with formal training on food hygiene and safety were about half (49.8%), others (42.6%) had acquired it through informal education. On the other hand, only 21% indicated that food hygiene and safety is the responsibility of each and every one (all) but the majority (59.2%) singled out food vendors' themselves. It was also realized that, the majority (70.6%) knew about the importance of food hygiene and safety, which is, safeguarding the consumers whereas 29.1% linked it with cleanliness. The majority (71.3%) specified health checkup as an important element of food safety and hygiene but the rest either disagreed or did not know. Moreover, 95.1% knew that food poisoning is caused by pathogenic microorganisms. A significant fraction of them (98.5% and 99.2%, 96.2% respectively) associated consumption of raw or undercooked meat, raw or unwashed vegetable and food kept at room temperature for 12 to 24 h after cooking with high risk of food poisoning. All respondent knew that persons who come in contact with food without observing hygienic practices may be the source of microbiological contamination of food. The majority vendors (97%) also knew that well cooked food is free from pathogenic organisms. On the other hand, 93.2% vendors knew that food refrigeration slows down the microbial growth, thereby decreases the possibility of food

poisoning. The majority (97.4%) also implicated drinking raw (unheated) or untreated water with a high risk of poisoning.

3.3 Environmental Hygiene of Food Vending Sites

The results on environmental hygiene of food vending sites (Table 4) show that only 36% of the vending sites had clean environment and just half of the vending sites had waste bins in place and only 42.6% had refuse sites. Wash basins and soap were available at 44.9% and 47% vending sites respectively. Of all the sites, 76.7% were free from rats and/ or cockroaches. The compliance score for environmental hygiene of food vending sites varied from 0.36 to 0.77, with an overall compliance score of 0.50.

Table 2. Demographic characteristics of food vendors

Study parameters	Variable	Frequency (n=265)	Percentage (%)
Gender	Male	86	32.5
	Female	176	67.5
Age (Years)	18 - 25	90	34
	26 - 35	94	35.5
	36 - 45	51	19.2
	46 - 55	30	11.3
Educational attainments	None	34	12.8
	Primary	113	42.6
	Secondary	112	42.3
	Vocational college	4	1.5
	University	2	0.8
Period of selling food (Years)	Less than 5	157	59.2
	5 – 10	69	26
	11 - 15	20	7.5
	Over 15	19	7.2

Table 3. Vendors' knowledge on food safety and hygiene

Food safety knowledge aspect	Variable	Frequency (n=265)	(%)
Are you aware of laws on food hygiene & safety?	Aware	154	58.1
	Not aware	111	41.9
How did you acquire the knowledge on food preparation and vending?	Acquired through Informal education/self-taught	226	85.3
	Acquired through Formal education/vocational institution	39	14.7
Do you have formal training on food hygiene and safety?	Trained	133	50.1
	Not trained	132	49.8
Do you have informal education on food hygiene and safety gained from colleagues or school authorities?	Yes	113	42.6
	No	152	57.4
	Don't know	0	0
Who is responsible for food hygiene & safety?	Food vendor	157	59.2
	Consumer	45	17
	Government	5	1.9
	All	58	21.9
What is the importance of food hygiene and safety?	Safeguard consumers	187	70.6
	Cleanliness	77	29.1

Food safety knowledge aspect	Variable	Frequency (n=265)	(%)
Is health checkup an important element of food safety and hygiene?	I don't know	1	0.3
	Yes	189	71.3
	No	74	27.9
Food poisoning is caused by pathogenic microorganism's pathogens?	I don't know	2	0.8
	Yes	252	95.1
	No	8	3.0
Consuming raw or undercooked meat poses a high risk of food poisoning?	I don't know	5	1.9
	Yes	261	98.5
	No	1	0.4
Consuming raw, unwashed vegetables poses a high risk of food poisoning?	I don't know	3	1.1
	Yes	263	99.2
	No	2	0.8
Persons who come in contact with food without observing hygienic practices, may be the source of microbiological contamination of food?	I don't know	0	0
	Yes	265	100
	No	0	0
Well-cooked food is free from pathogenic microorganisms cooked food?	I don't know	0	0
	Yes	257	97
	No	7	2.6
Food consumption, which was kept at room temperature for 12 to 24 h after cooking, poses a high risk of food poisoning?	I don't know	1	0.4
	Yes	255	96.2
	No	7	2.6
Storage of food at refrigerator will slow down the growth of microorganisms, thereby decreases the possibility of food poisoning?	I don't know	3	1.1
	Yes	247	93.2
	No	13	4.9
Drinking raw (unheated) water from open air reservoirs, river or lakes, without additional treatment, such as heating or adding chlorine, poses a high risk of poisoning?	I don't know	5	1.9
	Yes	258	97.4
	No	7	2.6
	I don't know	0	0

3.4 Vendors' Food Handling Practices

The food handling practices among food vendors (Table 5) show that over half (57.4%) of the vendors kept food in covered containers whereas 44% kept food in uncovered containers. Of all the vendors, only 40.8% provided adequate protection of food from flies and dust. About one-third saved food hot / reheated it before saving but the majority (64.9%) neither saved hot food nor reheated it. The dishing out of food was done using spoon / ladle by 53.2% of the vendors, whereas others dished it out by bare hands (46.4%). The most common method for storing

food was that of using plastic containers (37.7%) and only 28.3% refrigerated the food. Other food storage practices included storage in open place (18.1%) and also plastic containers and cup boards, each of which was practiced by 7.9% of the respondents. The compliance score of vendors' food handling practices varied from 0.28 to 0.57 with an overall compliance of 0.45.

3.5 Vendors' Hygiene and Sanitary Practices

The results on vendors' hygiene and sanitary practices are presented in Table 6. The results show that 63% of the vendors always washed hands with soap before preparing food, (34%) did so occasionally and the remaining did not at all. After toilet visit only 33% always washed hands with soap, 46.8% did occasionally and 20% did not at all. The majority (59%) food vendors had food debris on their hands, the rest had none. Vendors with long finger nails were only 2.6% and 97.4% had short finger nails. Finger nail cleanliness was maintained by 98.5%. Regarding hair protection and use of apron, only one-third had hair covering and 29% had apron. Cuts on hands were recorded in 3% of the vendors. The most common methods of washing utensils was that of using clean water with soap (41.8%), warm soapy water (22.6%) and cold soapy water (22.2%). However, washing without using soap was also observed in a substantial number of vendors (13.2%). The vendors compliance with hygiene and sanitary practices varied from 0.29 to 0.99 with an overall compliance 0f 0.66.

3.6 Association between Selected Independent Parameters and Hygienic Measures

The results in Table 7 show the association between genders, education attainments, formal training on food safety, vending experiences and food safety measures. Genders and education attainments each had significant association (Table 7) with 4 food safety and hygiene parameters, whereas formal training on food hygiene and safety had significant association with 10 safety measures and vending experience had significant association with 7 safety measures.

4. DISCUSSION

4.1 Demographic Characteristics of Food Vendors

Street vending has a major economic impact in many countries and is a major source of employment [16]. The dominance of women in this study is in agreement with the findings of other earlier studies conducted in other countries such as South Africa [17] 90.5% female, Ghana [18] 70% female, Vietnam [19] 96.9% female and Ghana [20] 95% female. However the contrary was true for studies conducted in Brazil [21] 42% female and Ethiopia [22] 20.9% female. The higher proportion of female vendors could be explained by their traditional cooking and child care responsibilities in most developing countries. Moreover, limited progression of women in formal education which narrows their employability in formal sectors could

Table 4. Environmental hygiene of food vending sites

Vending site hygiene aspect	Variable	Frequency (n=265)	Percentage (%)	Compliance score
Clean environmental	Yes	96	36.3	0.36
	No	169	63.7	
Waste bin present	Yes	133	50.2	0.50
	No	132	49.8	
Refuse site present	Yes	113	42.6	0.43
	No	152	57.4	
Wash basin present	Yes	119	44.9	0.45
	No	146	55.9	
Soap present	Yes	125	47.2	0.47
	No	140	52.8	
Presence of rats or cockroaches	Yes	62	23.4	
	No.	203	76.6	0.77
Overall Compliance Score				**0.50**

Table 5. Vendors' food handling practices

Question item/parameter	Response options	Frequency (n=265)	Percentage (%)	Compliance score
Food in covered container?	Yes	152	57.4	0.57
	No	113	42.6	
Food in uncovered container?	yes	117	44.2	
	No	148	55.8	0.56
Adequate protection of food from flies and dust?	Yes	108	40.8	0.41
	No	157	59.2	
Food saved hot / reheated before sale?	Yes	93	35.1	0.35
	No	172	64.9	
Method for dishing out food	Spoon/ladle	141	53.2	0.53
	Bare hand	125	46.4	
Method used to store and contain left over foods	Refrigerator	75	28.3	0.28
	Cupboard	21	7.9	
	Plastic containers	100	37.7	
	Polyethylene bags	21	7.9	
	Open place	48	18.1	
Overall Compliance Score				**0.45**

also be another contributing factor. According to [23] street food vending is considered as a prevalent means for creating an income mostly among illiterate people, particularly women. The dominant labour force of individuals aged 18-35 years, suggest the greater involvement of active age groups probably due to the job's high energy demands. This is further implicated by the declining number of vendors with increasing age (Table 1). This age group (18-35 years) in the present study (67.5%) overlaps well with the age ranges reported by other researchers; [24], 25-45 years (91.7%), [20], 18-45 years (80.5%), [18], 26 – 35 years (47.9%), [22] 18 -40 years (46.7%), [19] over 40 years (70.8%) and [21] 40 – 59 years (42%). Vendors' educational attainments predominant in the present study indicated a similar pattern as that reported by earlier researchers [15,21,22] but with a slight difference from that reported by [24]. Their study indicated that junior and senior secondary school leavers were the dominant groups but minimal involvement was experienced among primary and vocational schools leavers. According to the study done in Brazil [21] only 4.7% of the food vendors had university education which is slightly higher than reported in the present study (1.5%). Their less involvement (university graduates) could be associated with their greater engagement in formal employment. The work experience recorded for the majority vendors (59.2%) in the present study (of < 5 years) compares well with that reported by other researchers [24], that is, 51.2%. This could be explained by either the recent proliferation of the food vending business (triggering internal migration of the vendors) or poor retention due to great attraction of other business sectors.

4.2 Food Vendors' Knowledge on Food Safety and Hygiene

It was observed that only a small segment of the vendors have had formal training in food preparation and about half of them had formal training on food safety and hygiene. Though food safety and hygiene knowledge is vital to be aware of the safety measures, however, the low level documented in this study is comparable with previous studies [15].They recorded only 28.7% of food vendors to have food safety training and 32.2% to have awareness about food safety law. According to [3] training help because it improve overall food vendors' practice of food safety. An indication that only less than a quarter of the vendors knew that food hygiene and safety is the responsibility of all stakeholders in the food chain, implies their ignorance of the food production chain and the risk of contamination at any step along the chain. Awareness about the importance of food hygiene and safety is an appropriate sign to observing food hygiene and safety practices. Many vendors in the present study demonstrated sufficient knowledge about food safety and hygiene such as identifying the causes of food poisoning (pathogenic microorganism, consumption of raw or undercooked meat, raw or unwashed

vegetable, food kept at room temperature for 12 to 24 h after cooking, food handlers and drinking untreated water) and also the precautionary measures to be taken such as implementing health check-up and refrigeration storage to avoid food poisoning. This could be attributed to food safety training, vending experience / duration, education attainments and gender inclination. Chi –square outputs have indicated the influence each of those variables on some of the food safety and hygiene practices (Table 7).

4.3 Environmental Hygiene of Food Vending Sites

Maintenance of clean environment observed in the present study (36%) is far below the 90.5% documented by [15]. Previously [18] also reported poor ability of street food vendors to maintain a clean food preparation area. Only 50.2% and 42.6% of the vending sites had waste bins and refuse sites respectively in place. The possession of waste bin by half of the vendors though slightly higher than that reported by [15], that is, 43.4% but is still inadequate to ensure proper handling of wastes. This could explain the poor cleanliness of most vending sites (63.7%) as reflected in Table 2. Lack of waste bin and or refuse sites suggests poor handling of food wastes which could attract flies. Other researchers [17] indicated that only 17.5% of the vendors had a waste disposal facility, while others depended on the nearby waste disposal facility or municipal bins or left it behind,

Table 6. Vendors' hygiene and sanitary practices

Question item / parameter	Response options	Frequency (n=265)	%	Compliance score
Wash hands with soap before prepare food	Always	167	63	0.63
	Sometimes	90	34	
	Not at all	8	3	
Wash hands with soap after toilet visit	Always	88	33.2	0.33
	Sometimes	124	46.8	
	Not at all	53	20	
Presence of food debris on vendors' hands	Yes	157	59	
	No	108	41	0.41
Vendor had long nails	Yes	7	2.6	
	No	258	97.4	0.97
Finger nails	clean	261	98.5	0.99
	Unclean	4	1.5	
Vendor had hair covering / protection	Yes	89	33.6	0.34
	No	176	66.4	
Vendor had cut on the hand	Yes	8	3	
	No	257	97	0.97
Vendor wore apron	Yes	77	29	0.29
	No	188	70.9	
Methods of washing utensils used by street food vendors	Washed in warm soapy water	60	22.6	0.87
	Washed in cold soapy water	59	22.2	
	Washed in cold water	20	7.5	
	Clean water used with soap	111	41.8	
	Clean water without soap	15	5.7	
	Water with dirty appearance	0	0	
Water supply at vending sites	Tap	210	79.2	0.79
	Borehole	8	3	
	Water vendor	47	17.7	
	Protected well	0	0	
	Unprotected well	0	0	
Overall Compliance Score				**0.66**

Table 7. Association between selected variables versus hygienic measures

Independent variables → Dependent variables ↓	Gender	Education attainment	Formal training on food hygiene and safety	Period of selling
Long nails	0.57	0.98	0.47	0.49
Hair covering	0.00*	0.17	0.00*	0.22
Wash hands with soap after toilet visit	0.35	0.00*	0.00*	0.02*
Water supply at vending site	0.23	0.64	0.27	0.20
Adequate protection of food from flies	0.02*	0.00*	0.00*	0.00*
Method of dishing out food	0.30	0.31	0.00*	0.13
Vendor wearing apron	0.14	0.18	0.00*	0.01*
Method used to store and contain leftovers	0.00*	0.00*	0.03*	0.01*
Food saved hot /reheated before sale	0.02*	0.26	0.00*	0.00*
Presence of cockroaches and rats	0.52	0.27	0.00*	0.01*
Awareness of laws on food hygiene	0.35	0.25	0.00*	0.00*
Food poisoning is caused by pathogenic microorganisms	0.09	0.00*	0.01*	0.11

*Chi-square test at α = 0.05, P values with * denotes significant differences)*

wrapped. According to [15] flies are mechanical vectors which can scatter infective agents to food and water for human consumption, causing potential food borne diseases such as cholera, dysentery, and typhoid. This is further reflected by the fact that some vending sites (23.4%) were infested with rats and/ or cockroaches. It is reported [15] that unsanitary environment and other nuisance offers opening for breeding of insect/vectors, including vermin that can affect food product quality. The presence of hand wash basin and availability of soap to only 44.9% and 47% vending sites respectively suggest irregular and improper hand washing practices. The compliance results on environmental hygiene of food vending sites varied from poor to good with an overall average compliance. This suggest the need for improvement in almost all areas.

4.4 Vendors Food Handling Practices

Food handling practices has a critical role to the safety of food products since insanitary and improper handling can predispose the food to contamination. The results (Table 5) imply that a significant fraction of vendors did not consider food covering as a necessity and an important aspect for ensuring safety; only 57.4% of the vendors kept food in covered containers. It is also further indicated that less than a half (40.8%) of the vendors provided adequate protection of food from flies and dust. Lack of covering and improper protections of foods increases the risk of contamination. Dust carries many microbes that may be pathogenic if left to settle onto prepared foods. Worse and more or less similar observations were reported by earlier researchers [25,26] respectively. It is recommend that [27] foods should be prepared in places located far away from refuse damp areas and protected from any source of contamination. Vending stalls are desired to be designed and constructed in such a way to enable easy cleaning and maintenance. A small number of vendors (28.3%) who kept food under refrigeration condition suggests that food was mostly stored in the temperature danger zone which increases the risk of microbial contamination. Earlier studies [23] indicate that prepared foods should be kept at a temperature of at least 60°C if kept for more than 4-5h. Street food vendors spend more than 8 h in vending business. When food [18] is held at temperatures below 5°C or above 60°C, the microbial growth is significantly slowed or stopped. Moreover, the majority vendors (64.9%) indicated that food was neither saved hot nor was it reheated and was dished out with bare hands by about half of the vendors (46.4%) which is a substantial fraction. These handling practices indicate poor food safety measures. Previously [24] also observed vendors (65%) had food remnants on their hands, signifying possible hand contact with food during dishing out food. Food handlers are potential sources of contamination (hands and nails hands can pick up germs very easily), their poor food handling practices are likely to predispose food to contamination. The compliance results on food handling practices ranges from poor to average with an overall marginal average compliance which implies the need for improvement in the entire food handling approach.

4.5 Vendors' Hygienic and Sanitary Practices

Personal hygiene and sanitary practices is another important aspect in ensuring food quality and safety. The present study investigated the vendors' hygienic and sanitary practices to ascertain their compliances to food safety practices. Though regular hand washing with soap was adhered to by the majority vendors (almost two-thirds and similar practice observed by one-third but an occasional adherence and none adherence at all by a significant fraction reflects the dangers consumers are exposed to e.g. contracting foodborne illnesses. Hands are prone to contamination as such both none and improper hand washing may lead to spread of communicable diseases particularly foodborne illness. The other study [21] also documented that33% of the vendors did not wash their hands at all, whereas 24% only used water to wash their hands. The presence of food debris on the hands of some vendors observed and dishing out food with bare hands in the present study may further signify poor and unsafe food handling practice. According to [15] some dislikable food handling practices are intensely entrenched in traditions and customs and thus demanding messages tailored to addressing such beliefs. This could possibly explain the hygienic and unhygienic practices experienced among food vendors in Zanzibar which cannot be detached from their traditions and customs as is the case elsewhere. However the positive observation among food vendors in the current study is the highest rate of maintaining short finger nails (97.4%) and keeping nails clean (98.5%). Such high level of finger nails cleanliness could be attributed to their short sized finger nails. The present documented result on long finger nails (2.6%) is however, much better compared to 6.6% reported by [15]. Long finger nails are undesirable because can act as a good catch of dirty and pathogens and hence predispose food to contamination. It was also observed that money handling (personal observation) between foods serving service without washing hands is a common practice, which could lead to cross-contamination. A similar situation is reported by [21] who documented that95% of the vendors did not wash hands between food and money transactions and restroom breaks. This could be well addressed by having a dedicated individual accountable for all financial transactions, however it has a cost implication. It was also interesting noting that, only one-third of the vendors had hair covering, since Muslims constitute the largest population fraction and hair covering among women is a norm. Nonetheless, chi-square analysis at $\alpha = 0.05$ indicate significant variations ($P=0.00$) in hair covering between genders (Table 7). Comparing with other studies, however, the hair covering situation in the present study is better than reported elsewhere [21] where, 91% did not have hair coverings. The present findings suggest the possibility of food contamination due to inadequate hair protection which can be a source of both physical and biological contamination. Hair is recognized to harbour *S. aureus*, it is thus vital to preclude loose hair and dandruff from dropping onto the food or food preparation areas [23] Cuts on hands recorded in a small fraction of vendors (3%) cannot also be ignored if care is not taken. Blood from hand injuries or cuts can be a source of contamination so extra care in particular cut protection is required to avoid the associated risks. None use of soap during washing observed among vendors (13.2%) may imply inadequate removal of food soils which could in turn facilitate microbial growth. Proper washing of food contact equipment's reduces the risks of them containing harmful contaminants and hence the dangers of contamination. The compliance data on hygiene and sanitary practices varied from poor to very good with an overall good compliance. This implies a high compliance in most of the hygienic and sanitary practices except hand washing after toilet visit, hair covering and presence of food debris on vendors' hands.

4.6 Association between Selected Independent Parameters and Hygienic Measures

The association results between independent variables (gender, education attainments, formal training on food safety and vending duration) and food safety and hygiene parameters imply that gender, education attainments, formal training on food safety and vending durations all have significant association with some food safety and hygiene practices, however, formal training on food hygiene and safety plays a great role in ensuring compliance to food safety and hygiene principles. Early researchers [3] demonstrated that food safety training and knowledge of food safety are influencing factors for ordinary food safety practice [3]. Similarly they indicated that age, food safety training, knowledge, attitude and duration of food vending are influencing factors for good food safety practice. However, contrary to the present result [15] indicated that short

duration of food vending maintained better food safety practice. They further argued that receiving food safety training may not always lead to maintaining good environmental hygiene on the part of the vendors. They suggested that a positive attitude is crucial in interpreting the knowledge acquired into practice [15]. This could possibly explain the variations in results between the two studies.

5. CONCLUSIONS

The results indicate that only half of the vendors had formal training in food safety and hygiene but the majority of whom demonstrated sufficient knowledge about food safety and hygiene such as identifying the causes of food poisoning and measures needed to avoid food poisoning. The compliance results indicate an overall compliance of 0.50 on environmental hygiene of vending site, 0.45 on food handling practices, and 0.66 on vendors' hygiene and sanitary practices. This implies an average overall compliance with both the hygiene of the vending site and food handling practices and good overall compliance with the vendors' hygiene and sanitary practices. Chi-square analysis revealed that gender, education attainments, formal training on food safety and vending duration are influencing factors for food safety and hygiene measures. However, training on food safety and hygiene was the most influential parameter. It is thus recommended that basic training on food safety and hygienic practices should be a pre-requisite to entering food vending business and regular monitoring be done to ensure the translation of the acquired basic food safety and hygiene knowledge and skills into appropriate and safe food codes of practices.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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