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Food Safety and Hygiene Practices among Food Vendors in a Tertiary Educational Institution in South Western Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors FAF, MIO and GCN designed the study and wrote the protocol. Authors MIO and GCN managed the analyses of the study and performed the statistical analysis. Authors FAF and GCN managed the literature searches. Author MIO wrote the first draft of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Food-borne illness is a public health problem causing morbidity and mortality in general population. Many people die of food poisoning annually in Nigeria from foodborne pathogens from contaminated food and water consumption in emergent nations. Hence this study assessed the knowledge of food safety and hygiene practice among food handlers in a Nigerian University.

A descriptive cross-sectional study was conducted among food vendors and food handlers in Obafemi University Ile-Ife, South Western Nigeria. The vendors that participated in the study were 238 and had been on the job for not less than one year. Data was collected using 3- sectioned structured questionnaire, this was analyzed using Statistical Package for Social Sciences (SPSS) version 20.

The result showed that more than half of the respondents were female (58%), while (48.7%) of the respondents had completed training in food safety, of which (49.6%) have completed university education or currently enrolled in the university. Knowledge of food safety among respondents showed that 76 (31.9%) of respondents had adequate knowledge on transmission of food borne diseases while 160 (67.2%) had inadequate knowledge. Also, 115 (78.2%) of respondents had satisfactory safety hygiene practices and 28 (19.0%) had unsafe hygiene practices.

In the face of adequate knowledge on food safety among participants, the majority had unsafe hygiene practice, as most vendors do not wear a hat or cover hair when serving or preparing food. Thus vendors need education on safety hygiene practices knowing that knowledge without practice is bitty and fruitless.

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1. INTRODUCTION

Food-borne illnesses are the causes a number of diseases worldwide. It is an increasing public health problem in emergent as well as developed nations, resulting into morbidity and mortality in the general population, particularly in susceptible groups, such as infants, young children, elderly and the immunocompromised [1]. In spite of the efforts made on food safety and environment, 2.1 million adults and three million children, including two million in emergent nations, die each year from water consumption or contaminated food [2]. According to World Health Organization an estimated 1.5 billion cases and over 125, 000 deaths occur in children every year as a result of water and food contaminations [3]. In developing countries, an estimated 70% of diarrheal episodes are linked with the ingestion of contaminated foods [4,5,6].

In 2017, World Health Organization estimated that approximately 600 million people fall ill after eating contaminated food resulting in 33 million healthy years; foodborne diseases account for 40% diseases burden among under 5 years. [4] Food contamination is common not only in developing countries but also in developed countries of the world. This is particularly high when food is prepared for a large number of people at the same time, especially in canteens and restaurants. Eating out of the home may lead to an increased risk of contracting a food-borne illness.

According to Arendt, Rajagopal, Strohbehn, Stokes, Meyer, and Mandernach, eating away from home, especially in restaurants, is associated with a significant number of food-borne disease outbreaks in the United States [7]. Jones and Angulo demonstrated that eating in restaurants was a risk factor for foodborne diseases hence this industry has a role to play in reducing food-borne disease outbreaks [8]. This can be achieved by addressing food handler-related risk factors in these food establishments. Eating away from home is common to students. Indeed this leads to a food endemic in Queens College, Yaba Lagos where 50 students where admitted to the school clinic after eating spaghetti and drinking water from the refectory. It was also recorded that specimen collected from 40 kitchen workers revealed that cysts of *Entamoeba histolytica* were isolated in the stool of 23 food handlers; *salmonella paragraph*, the causative agent of Typhoid Fever, was also isolated from 3 handlers [9].

Haileselassie, Taddele, Adhana, Kalayou suggested that inadequate food safety laws, weak regulatory systems, lack of financial resources to invest in safer equipment, inadequate knowledge of food borne diseases and their causes, improper handling of food and unhygienic environments among others have been identified as some of the causes of food borne diseases [10]. It has been observed that many of the vendors who sell both raw and cooked food items are not regulated. They operate haphazardly without any monitoring of what they prepare and how they prepare it [11].

The altering patterns of food consumption have had a great influence on the increasing incidence of food borne diseases. Traditionally, foods were produced and consumed locally [12]. Food vendors play important role in ensuring food safety throughout the chain of food production and storage [11]. Mishandling and pay no attention to hygienic measures on the part of the food vendors may enable pathogenic organisms to gain entry and in some cases survive and multiply insufficient numbers to cause illness in the consumer [13]. Akintaro submitted that large quantity of food produced and distributed gets to the consumers in an unwholesome condition due to poor handling methods, inefficient processing equipment and storage practices, high ambient tropical temperature and humidity conditions [14]. Food contamination can occur at any point during its preparation, bringing to bear the importance of food safety and hygiene in the prevention of food borne diseases [15,16].

Good hygiene practices have been documented to prevent several food-borne diseases when practised. It is broadly acclaimed that deliberate or accidental contamination of food due to inappropriate handling of food might endanger the lives of consumers [5]. Several hygiene practices such as poor personal and environmental hygiene, inadequate storage of food and drinks, improper preparation and cooking are known to cooperate the safety of food [17].

Food is said to be hygienic when it is free of a hazardous substance that could be harmful to human or animal health [18]. Though this is the case, microbiological hazards in ready to eat food and chemical hazards, mostly pesticides

from agricultural products including fresh vegetables and fruits have been highlighted [19]. Recent reports also highlighted the danger of high levels of heavy metals including lead, cadmium, arsenic, mercury and copper from utensils, raw materials or transport methods used [19]. Ensuring food hygiene and safety practice among vendors is one challenge that has existed for decades, and therefore the need for vendors to adhere to high standard food safety regulations and hygiene practices cannot be overemphasized [20]. However, a preventive strategy based on thorough analysis of prevailing conditions to ensure the achievement of quality assurance programme objectives is also recommended [21]. According to WHO, it is estimated that more than 200,000 people die of food poisoning annually in Nigeria from foodborne pathogens (especially *E. coli* and *Salmonella*) [4]. The deaths were caused by contaminated foods through improper processing, preservation and service [3]. Practices acknowledged as contributing to foodborne outbreaks include improper refrigeration, prolonged handling and inadequate reheating of cooked food and contamination of food by commercial or household food handlers who worked while ill or had poor personal hygiene [22,23].

The knowledge of food handlers about the food borne infections and their safety practices is an important issue in the outbreaks of food borne infection [12]. In Ghana, Elvis, and Henry, found out that food vendors' in their study are aware of food and personal hygiene among vendors and a greater percentage of the vendors adhered to basic hygiene practices (87%) [24]. Considering that a percentage of vendors are yet to adopt basic hygiene practices, it will be prudent to ensure continuous education and enforcement of policy regulations within the food industry. Earlier, Smith, Agomo, Bamidele, Opera, Aboaba found out that in Nigeria, 27.7% of food handlers do not wash their hands before preparing food and 28.1% use only water to wash hands after using the toilet [25]. They also found out that 90% of food handlers have heard about typhoid fever but only 15.6% of them know how it is contracted.

In an attempt to assess knowledge of food borne infection and food safety practices among local food handlers in Ijebu-Ode Local Government Area of Ogun State, Oladoyinbo, Akinbule, and Awosika found out that 41.6% food handlers in their study had poor knowledge FBI [26]. Only 7.6% respondents had adequate knowledge, 31.5% respondents had poor food safety practices. Educational qualification of participants was found to be significant related to their knowledge of food borne illness (P=0.001) and it also significantly affected their food safety practices (P=0.0011). Knowledge of food borne illness and food safety practices of food handlers have a poor correlation coefficient ($r<0.24$). Similarly, Tolulope, Zuwaira, Danjuma, Zaman, in a related study carried out among food vendors in primary schools in Jos, Plateau State, North Central Nigeria, found out that 60.9% of a participant in their study had good knowledge with a mean knowledge score of 18.59 ± 5.90. Age of the vendors was found to be related to their food safety and hygiene practices [27].

In Owerri, 92% of participants in a study to assess food safety needs of restaurants reported that they cleaned and sanitized food equipment and contact surfaces while 37% engaged in cross-contamination practices. Forty-nine percent reported that they would allow a sick person to handle food. Only 70% reported that they always washed their hands while 6% said that they continued cooking after cracking raw eggs. All respondents said that they washed their hands after handling raw meat, chicken or fish. About 35% lacked knowledge of ideal refrigeration temperature while 6% could not adjust refrigerator temperature. A linear relationship was found to exist between education and knowledge of pathogens (r = 0.999), cooking school attendance and food safety knowledge (r = 0.992), and class of restaurant and food safety knowledge (r = 0.878). The lack of current knowledge of food safety among restaurant staff highlights increased the risk associated with fast foods and restaurants [28].

This study was carried out to assess the knowledge and practice of food safety and sanitation among food handlers located in Obafemi Awolowo University community.

2. METHODS

This descriptive cross-sectional study was carried out among food vendors and food handlers in a government owed university in south western Nigeria. The university is made up of six major areas; an Academic area where faculties, departments and lecture theatres are located; Halls of residence area where students reside, male and female; Bank area; Staff quarters; Teaching and research farm;

Commercial farm and Market/Bukateria where the majority of the cafeteria is located. The institution also has a health centre which is located near the various student halls of residence.

In all, there are 257 food vendors/handlers in the university from 59 restaurants and canteen, all the food vendors/handlers were intended to be part of the study because of considerable small but only 238 eventually consented and participated in the study. However, only those that had been on the job for not less than one year were recruited to participate in the study. Informed consent was sought and gained from all food vendors/handlers that eventually participated in the study.

A structured questionnaire whose validity had been previously ascertained with face and content validity criteria was used as the instrument for data collection. The questionnaire yielded and Cronbach alpha result of 0.83 on reliability check. The type of questions used in the questionnaire to obtain information was; simple alternate questions, multiple choice question, and specific information questions. The questionnaire was divided into three sections. Section A determined the socio-demographic characteristics of the respondent. Section B assessed the level of knowledge of food handlers on food safety, hygiene and critical food safety factors, while section C assessed the food hygiene and food safety practices among food handlers. Data collected through structured questionnaire was sorted out, coded and entered into the Statistical Package for Social Sciences (SPSS) version 20 for analysis using descriptive statistical technique and percentages. Chi-square statistical test was used to determine the relationship between characteristics of food handlers and practice of food safety. A 95% confidence level was used and $p \leq 0.05$ was considered statistically significant.

The knowledge of respondents on food safety was assessed using four critical food safety factors; knowledge on transmission of food borne diseases, knowledge on personal hygiene, knowledge on contamination and cross-contamination, and knowledge on temperature control. There were 35 stem questions on knowledge of food safety and hygiene with 105 responses. Only 35 of these responses were correct. One mark was awarded for each correct response and no mark was awarded for a wrong response or I don't know response and a total of 35 maximum attainable scores were used for knowledge of food safety and hygiene. A score of 0–23 marks out of 35 marks was graded to be inadequate knowledge and a score of 24–35 marks out of 35 marks was graded as adequate knowledge (that is 70% as adequate knowledge). There were 17 questions on the practice of food safety and hygiene. A three-point rating scale was used for the responses (2 points for always, 1 points for sometimes, 0 points for never. A total of 34 maximum attainable points was used for the practice of food safety. A score of 0–23.7 marks out of 34 marks was graded as unsatisfactory practice while a score of 23.8–34 marks out of 34 marks was graded as satisfactory practice.

3. RESULTS

3.1 Socio-demographic

In all, two hundred and thirty-eight (238) food handlers participated in this study. More than half of the respondents are female (58%), about two-third of the respondent fell within the age range of 19-30 (63.9%). Barely half (48.7%) of the respondents had completed training in food safety, also, about half of the respondent (49.6%) have completed university education or currently enrolled in the university. Results also showed that 2.9% had a primary level of education while 39.1% have a secondary level of education (Table 1).

3.2 Knowledge of Food Safety

Knowledge of food safety as shown in Table 2 revealed that sixty-three percent (63.9%) of the respondent agree that fresh meat always has microbes on the surface with just about nineteen percent (19.3%) agreeing that HIV can be spread through food. Also, a good percentage of the respondents (69.7%) agree that healthy people can cause illness by carrying germs to food. A good percentage of respondents (81.9%) disagreed with the practice that hands should be washed with water alone. 89.5% also believe that hands should be dried with a kitchen towel after hand washing. 93.3% and 95.0% of respondent respectively agree that hand should be washed with soap and water after using the toilet and washed properly after sneezing. Eight-six percent (86.6%) of the respondents agree that foods can be contaminated with microbes by coming in contact with unsafe foods. 61.8% also agree that soap and water can kill all harmful microbes.

Table 1. Social-demographic characteristics of food vendors

	Characteristics (n= 238)	Frequency n(%)
Sex	Male	93 (39.1)
	Female	138 (58.0)
Age	< 18 years	22 (9.2)
	19-30 years	152 (63.9)
	Above 30 years	57 (23.9)
Level of Education	Primary/elementary	7 (2.9)
	High/secondary	93 (39.1)
	College/University	118 (49.6)
	Skills/Vocational	8 (3.4)
	Others	5 (2.1)
Job experience in food service	< than 1 year	42 (17.6)
	1 - 2 years	44 (18.5)
	3 - 5 years	47 (19.7)
	≥6 years	46 (19.3)
Position at work	Food worker	75 (31.5)
	Supervisor	13 (5.5)
	Manager/administration	61 (25.6)
	Others	36 (15.1)
Training in food service	Yes	116 (48.7)
	No	109 (45.4)

Table 2. Knowledge on food safety

Variable (N=238)	Agree n(%)	Disagree n(%)	I Don't Know n(%)
Transmission of food-borne diseases			
Fresh eggs can have salmonella (*a bacteria*)	112 (47.1)	68 (28.6)	58 (24.4)
Fresh meat always has microbes on the surface	152 (63.9)	47 (19.7)	39 (16.4)
Canned foods may have harmful microbes	154 (64.7)	50 (21.0)	34 (14.3)
Healthy people can cause illness by carrying germs to food	166 (69.7)	49 (20.6)	23 (9.7)
It is normal for fresh chicken to have salmonella	67 (28.2)	93 (39.1)	76 (31.9)
Lettuce and other raw vegetables might have harmful microbes	174 (73.1)	24 (10.1)	40 (16.8)
Foods served cold (salads) do not have to be Disinfected	99 (41.6)	110 (46.2)	29 (12.2)
Cooked foods do not have microbes	120 (50.4)	102 (42.9)	16 (6.7)
The HIV virus can be spread through food	46 (19.3)	174 (73.1)	18 (7.6)
Cholera can be spread through food	189 (79.4)	40 (16.8)	9 (3.8)
Personal health hygiene			
Hands should be washed with water alone after handling raw meat	43 (18.1)	195 (81.9)	0.0
You can prepare food with a wound on the hand if the wound is covered with a bandage	74 (31.1)	159 (66.8)	5 (2.1)
After washing, hands may be dried with a kitchen towel	213 (89.5)	19 (8.0)	6 (2.5)
It is not necessary to wash hands to handle food that is already cooked	20 (8.4)	213 (89.5)	5 (2.1)
After using the toilet, we should always wash hands with soap and water	222 (93.3)	11 (4.6)	5 (2.1)
When wearing gloves, you can handle cooked foods after handling raw meat	63 (26.5)	152 (63.9)	23 (9.7)
Hands should be properly washed after sneezing or blowing your nose	226 (95.0)	6 (2.5)	6 (2.5)

Variable (N=238)	Agree n(%)	Disagree n(%)	I Don't Know n(%)
After using the bathroom, hands can be washed in the kitchen sink	112 (47.1)	120 (50.4)	6 (2.5)
Wearing gloves while handling food protects the food service staff from infection	171 (71.8)	41 (17.2)	26 (10.9)

Variable (N=238)	Agree (%)	Disagree (%)	I Don't know (%)
Cross contamination			
Food-borne disease can result from storing raw meat and cooked foods in the same refrigerator	124 (52.1)	63 (26.5)	50 (21.1)
Foods can be contaminated with microbes by coming in contact with unsafe foods	206 (86.6)	3 (1.3)	29 (12.2)
Food preparation surfaces can contaminate foods	178 (73.9)	21 (8.8)	41 (17.2)
Ready to eat foods (eg. Vegetables) can be prepared on the same cutting board that was used to prepare meat	35 (14.7)	190 (79.8)	13 (5.5)
Soap and water can be used to kill all harmful microbes on cutting boards after preparation of raw meat	147 (61.8)	75 (31.5)	16 (6.7)
Prepared or ready-to-eat foods are stored on the top shelf in a refrigerator that also stores raw food	51 (21.4)	150 (63.0)	37 (15.5)
Cutting boards, meat slicers and knives should be sanitized after each use	211 (88.7)	12 (5.0)	14 (5.9)
Temperature control			
Foods that need to be kept hot should be at 60°c or above	167 (70.2)	17 (7.1)	53 (22.3)
Leftovers should be reheated to a minimum temperature of 75°C	143 (60.1)	32 (13.4)	62 (26.2)
Microbes may grow because prepared food was left at room temperature for a long period	185 (77.7)	23 (9.7)	30 (12.6)
Cooked foods might be safely stored in the refrigerator at 5°C	178 (74.8)	14 (5.9)	46 (19.3)
Refrigeration kills all the bacteria that might cause food-borne illnesses	99 (41.6)	108 (45.4)	31 (13.0)
Microbes responsible for food-borne illnesses grow well at room temperature	180 (75.6)	14 (5.9)	44 (18.5)
Frozen foods should be thawed (melted) on the counter or in the sink	135 (56.7)	50 (21.0)	53 (22.3)
After thawing (melting) frozen meat, it should be held for 5 hours at room temperature	66 (27.7)	87 (36.6)	80 (33.6)
Foods stored at 40°C is being held in the temperature danger zone	71 (29.8)	48 (20.2)	119 (50)

A great percentage of them (88.7) also agree that cutting boards, meat slicers and knives should be sanitized after each use. Seventy percent (70.2%) of the food handlers agreed that foods should be stored at 60°c or above to keep it hot while just 7.1% disagreed. The majority (77.7%) of the food handlers also agree that microbes may grow if food is kept at room temperature for long. 75.6% similarly agree that microbes thrive at room temperature. In general, 76 (31.9%) of respondents had adequate knowledge on transmission of food borne diseases while 160 (67.2%) had inadequate knowledge on the subject. 107 (45.0%) had adequate knowledge of personal hygiene while 131 (55.0%) had inadequate knowledge (Table 3a). One Hundred and forty-one respondents 141 (59.2%) had adequate knowledge of contamination and cross-contamination while 95 (39.9%) inadequate knowledge on the subject. 72 (30.3%) had adequate knowledge on temperature control while 160 (67.2%) had inadequate knowledge.

The mean knowledge score of the participants on each of four critical factor of food safety examine

as shown in Table 3b was found to be 5.44±2.10 (out of 10) for transmission of food-borne diseases; 6.20±1.25 (out of 9) for personal hygiene; 4.76±1.53 (out of 7) for cross-contamination while for temperature control was found to be 5.25±1.81 (out of 9). On the overall, the mean knowledge score of the participant was found to be 21.71±4.49 out of 35 on the food safety knowledge scale.

3.3 Food Safety Practices

The majority (79.8%) of a respondent check for expiry dates of all products. Fifty-four percent (54%) of them has never used a thermometer to check the temperature of food. Only 33.2% of respondents always wear a hat or cover hair when serving or preparing food. Also, only 12.2% of them come to work when ill. One hundred and fifteen 115 (78.2%) of respondent practising satisfactory as it pertains to food safety and hygiene while 28 (19.0%) of the respondents practice unsatisfactorily.

Educational level of the food vendors was found to be significantly related to food safety and hygiene practices of the food vendors (X^2 = 21.81; P = 0.001). Also, previous training in food service was found to be significantly related to food safety and hygiene practices among the participants (X^2 = 27.91; p = 0.001). However, no significant relationship was found to exist between knowledge of food safety and food safety practices among the participants (X^2 = 0.67; p = 0.17) (Table 5).

4. DISCUSSION

Two hundred and thirty-eight food vendors participated in this study. More than half (63.9%) of the respondents were within the age group of 19-30. This was slightly similar to findings of studies conducted among food vendors in Nigeria, Slovenia and Malaysia in 2011. Females were more among the food handlers that participated in the study. About half of the participants in the study had a university education. This is higher than what had been reported about food vendors in Nigeria in separate studies by Oladoyinbo, Akinbule, and Awosika, among local food handlers in Ijebu-Ode and Fasoro, Faeji, Oni, Oluwadare among food handlers in a Rural Community in Southwest Nigeria. This might not be unconnected with the university environment that this study was carried out [26,29].

Table 3a. Summary of knowledge of food vendors on critical food safety factors

Critical food safety factors (N=238)	Knowledge assessment		
	Adequate knowledge n(%)	Inadequate knowledge n(%)	Total n(%)
Transmission of food-borne diseases	76 (31.9%)	160 (67.2)	236 (99.2%)
Personal health hygiene	107 (45.0%)	131 (55.0%)	238 (100%)
Contamination and cross contamination	141 (59.2%)	95 (39.9%)	238 (100%)
Temperature control	72 (30.3%)	160 (67.2%)	232 (97.3%)
Total knowledge on food safety	78 (32.8%)	150 (63.0%)	228 (95.8%)

Table 3b. Mean Knowledge of food vendors in critical food safety factors

Critical food safety factor	Maximum score	70% of max score	Mean score	Standard deviation
Transmission of Food-borne diseases	10.00	7	5.44	2.10
Personal Health Hygiene	9.00	6.3	6.20	1.25
Cross- contamination	7.00	4.9	4.76	1.53
Temperature control	9.00	6.3	5.25	1.81
General knowledge	35.00	21.7	21.71	4.49

Table 4. Food handlers' hygienic practices

Variable (N=238)	Always (%)	Sometimes (%)	Never (%)
Do you wash your hands before touching unwrapped raw food?	110 (46.2)	128 (53.8)	0.0
Do you wash your hands after touching unwrapped raw foods?	166 (69.7)	67 (28.2)	5 (2.1)
Do you wash your hands before touching cooked foods?	175 (73.5)	58 (24.4)	5 (2.1)
Do you wash your hands after touching cooked foods?	170 (71.4)	68 (28.6)	0.0
Do you use separate utensils when preparing raw and cooked foods?	133 (47.5)	93 (39.1)	32 (13.4)
Do you thaw (melt) frozen foods at room temperature?	70 (29.4)	119 (50.0)	48 (20.2)
Do you check the expiry dates of all products?	190 (79.8)	33 (13.9)	15 (6.3)
Do you use a thermometer to check temperature?	37 (15.5)	62 (26.1)	139 (58.4)
Do you use gloves when serving unwrapped foods?	43 (18.1)	121 (50.8)	71 (29.8)
Do you wash your hands before using gloves?	64 (26.9)	102 (42.9)	70 (29.4)
Do you wash your hands after using gloves?	92 (38.7)	103 (43.3)	41 (17.4)
Do you wear an apron or uniform when serving food?	55 (23.1)	134 (56.3)	49 (20.6)
Do come to work when ill a fever, upset stomach or diarrhea?	29 (12.2)	127 (53.4)	82 (34.5)
Do you use a handkerchief or rag when suffering from a cold?	138 (58.0)	71 (29.8)	29 (12.2)
Do you wear a hat or head covering when serving food?	79 (33.2)	89 (37.4)	70 (29.4)
Do you disinfect cutting boards after each use?	129 (54.2)	72 (30.3)	37 (15.5)
Do you use kitchen towels to dry utensils?	136 (57.1)	69 (29.0)	28 (11.8)

Table 5. Relationship between respondents' socio-demographics and practice of food safety

Variables	Practice of food safety			Chi Square Value
	Satisfactory Practice	Unsatisfactory practice	Total	
Training in food service				
Yes	89	27	116	Df = 1, p= 0.0,
No	46	63	109	x^2 = 27.906
Educational Status				
Primary	5	15	20	Df=4,
Secondary	61	32	93	p=0.001
University/ college	75	43	118	X^2 =21.810
Knowledge of food safety and hygiene				
Adequate	49	29	78	Df= 1,
Inadequate	90	60	150	p= 0.172, x^2= 0.679

The knowledge of food vendors about the food borne infections and their safety practices is an important concern in the outbreaks of food borne infection [12]. Mizanur et al. established that training in food safety significantly increased food safety practice among food handlers in Kuching city in Malaysia [30]. However, despite this importance of training on food safety practice only about half of the food handlers in this study had received formal or informal training on food safety. This is lower than the proportion of food handlers that had training on food safety practices in separate studies conducted in Malaysia, Thailand and Ethiopia [31,32,33].

In our study, only one-third of the food vendors had adequate knowledge of food safety and hygiene. This is lower than 63.0% reported by

Tolulope, Zuwaira, Danjuma, Zaman, in a study conducted among food vendors in primary schools in Jos, Plateau State, North Central Nigeria. [27]. This is also true of submissions of Nee & Sani among food handlers at residential colleges and canteen [34]. However, findings of the separate studies conducted in Malaysia and Iran by Zain, & Naing; and Pirsaheb Almasi, & Rezaee respectively corroborate findings of this study Also in a Thailand study only 13.0% of food vendors had good knowledge of food safety [31,32,35].

Also, about one-third of the participants had adequate knowledge on the transmission of food-borne diseases with about half of them agreeing that fresh eggs can have salmonella, 63.9% and 69.7% also agreeing that fresh meat always have microbes on the surface and healthy people can cause illness by carrying germs to food. Majority of the food vendors in this study believed that cholera can be spread through food. This is consistent with submissions of Tolulope, and colleagues [27]. Some of the food vendors in this study agreed that HIV can be spread through food. Despite huge campaign about HIV and how it can be transmitted it is surprising that some of the participants in this study can still believe that it can be transmitted through food. This might be explaining the fact that not all the food vendors that participated in this study had previous training on food safety.

More than half of the participants in this study had adequate knowledge on contamination and cross-contamination with 52.1% of respondents agreeing that food borne disease can result from storing raw meat and cooked food in the same refrigerator and 86.6% also agree that food can be contaminated with microbes by coming in contact with unsafe foods. However, our results revealed that only 30.3% of the food vendors had accurate knowledge of ideal refrigerator temperature. This is similar to findings of a study conducted in Imo State, Nigeria where only 38% of respondents had adequate knowledge about ideal refrigerator temperature [36]. Food preservation which refrigerating is an important method is an essential component of maintaining food safety. If only one in every three food handlers examined in this study knows the correct temperature for refrigeration it implies that only a few of the handlers can effectively store food by refrigeration. This might suggest that there might be a high rate of food contamination during storage among the study population.

Tolulope and other, in their study, found out that a little above half of their participants had a good practice of food safety and hygiene [27]. This is similar to what is found out in this study, although, the proportion of the food vendors in this study was found to be a little higher than that of Tolulope and colleagues study. Marcia in a similar study reported that majority of food vendors washed hands before touching cooked foods but only 65.4% wash hands before touching unwrapped raw foods [37]. They also reported that majority of food vendors in their study always or sometimes sanitized utensils after washing them. This study corroborates our study as the majority of the food vendors in the study always practised hand washing with soap and water before touching or preparing food. Similar to findings of our study are the submission of Sylvester & Craig; and Fasoro, Faeji, Oni, Oluwadare, in their separate studies among Restaurants workers in Owerri and residents of Are-Ekiti community respectively [36,29]. This is, however, in contrast with Tolulope, Zuwaira, Danjuma, Zaman, a submission that only few food vendors always practice hand washing with soap and water before and after preparing food [27]. This is also true for Smith, Agomo, Bamidele, Opera, Aboaba study [25]. However, the few that don not washes hands appropriate is of great concern especially in this era of the frequent outbreak of a number of viral infection like Lassa that can be transmitted by poor food handling.

Concerning cleaning and sanitizing cutting surfaces before and after use, more than half of the food vendors practised cleaning and sanitizing of cutting surfaces as expected. This was way lower in the study by Tolulope, et al. where only 15.5% practice cleaning and sanitization of cutting surfaces [27]. Furthermore, one-third of the food vendors cover their heads or wears a hat when serving food. The fact remains that the hair is a good culture for microorganism, hence it should be a normal practice that food handlers always cover their hair. The reason for this poor practice might be out of negligence or pure ignorance on the part of the food handlers. However, more than the percentage of the food vendor that cover their head when preparing food admitted that they sometimes cover their when serving food. This shows that a number of the food vendors that cover their head do so not because of the hygiene and safety issues involved but to please their customer.

Educational level of the food vendors was found to be significantly related to food safety and hygiene practices of the food vendors (P = 0.001). This is consistent with the submission of the previous researcher among food vendors in Nigeria [26,27,29,36]. Also, Tolulope, Zuwaira, Danjuma, Zaman submitted that training in food service had a significant relationship with food vendors safety and hygiene practice [27]. This is also found to be true among participants in this study (p = 0.001). Our study, however, found out that there is no significant relationship between knowledge of food hygiene and safety practice among the food vendors that participated in the study (p = 0.172). This was inconsistent with findings of Tolulope, Zuwaira, Danjuma, Zaman and another study by Cuprasittrut, Srisorrachatr, Malai in Thailand [27,32].

This implies that among the participants, level of education and previous training food safety affects their food hygiene and safety practices. Therefore, food handlers will benefit from regular training and retraining to ensure that their food safety practices will improve.

5. CONCLUSION

Food contamination as a result of food handling the food vendors and handlers is capable of resulting in severe morbidity and mortality among the different population, especially in developing nations like Nigeria where there are weak regulations. The study assessed knowledge of food safety and hygiene practice among food handlers in a Nigerian University. Knowledge of food safety among respondents showed that less than half of the participants' adequate knowledge on transmission of food borne diseases. However, the majority of the respondents had satisfactory safety hygiene practices while some still have a number of unsafe hygiene practices. Thus vendors need education on safety hygiene practices knowing that knowledge without practice is bitty and fruitless.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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