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Title: An assessment of the Food Safety knowledge on employees at food establishments located on the University of the West Indies, St Augustine Campus

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AN ASSESSEMENT OF THE FOOD SAFETY KNOWLEDGE OF EMPLOYEES AT FOOD
ESTABLISHMENTS LOCATED ON THE UNIVERSITY OF THE WEST INDIES,
ST. AUGUSTINE CAMPUS

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ABSTRACT

Food borne illness is a very serious issue from which no one is immune. It has the potential to cause large-scale deaths in a short period of time and is particularly threatening to children, the elderly, expectant mothers, and persons with compromised immunity. This highlights the need for proper food safety practices, since food borne contaminants are introduced to foods when food handling practices are substandard. This study sought to assess the food safety knowledge of employees at food establishments located at the St. Augustine Campus of the UWI. The study was conducted by administering a questionnaire which examined the major areas of food safety personal hygiene, contamination, cleaning and sanitation, time and temperature control, and receiving and storage practices. The relationship between employee education level and food safety knowledge was tested and the result prove that it was weak but direct. Another test for relationship between length of employment and food safety knowledge yielded a different result since it was proven to be indirect but stronger than education level. A third test to compare the mean knowledge scores between groups of trained and untrained persons in food safety, prove that there was no difference, implying that food safety training had no statistically significant effect on knowledge. Employees' knowledge was generally poor since more than 60% scored below 50% on the questions presented. Recommendations for increasing food safety knowledge involved the restructuring of the food safety training systems to introduce practical and theoretical components, the introduction of regular or seasonal training sessions in food handling, and managers introducing food safety management systems, services and resources.

CHAPTER I

INTRODUCTION

Background

Food safety is a growing public health concern supported by the fact that in many countries the rates of food borne illnesses are increasing significantly. Worldwide, every year, millions of people fall ill and die as a result of consuming unsafe food (World Health Organization 2009). Although many countries have legislation in place to protect citizens from food related illnesses, several farmers, food manufacturers, distributors, retailers, employees of food entities, and vendors, are engaged in unsanitary practices.

According to the World Health Organization (2007), most food borne diseases are sporadic and often not reported or food borne disease outbreaks may take on massive proportions. In the United States, the Centers for Disease Control and Prevention(CDC), estimates that each year 1 out of 6 Americans (48 million) become ill due to food borne diseases with 128,000 persons being admitted at hospitals and 3,000 deaths. Estimates for 2011 also indicate that of the five most infectious pathogens, noroviruses account for 58% of illnesses, while non-typhoidal *Salmonella* infection is the major cause of hospitalization (35%) and death (28%) (CDC 2011).

Data from the Caribbean Epidemiological Center (CAREC) Annual Report for 2008 revealed that “food and water borne diseases continue to be a major cause of human illness in the Caribbean, as reflected by the number of reported cases of gastroenteritis and specific pathogens identified that are commonly transmitted by food and water.” These identified pathogens were: “non-typhoidal *Salmonella*, *Shigella*, *Campylobacter*, pathogenic *Escherichia coli*, norovirus and *Salmonella typhi* “. The Report also indicated the need for more stringent approaches to food safety and sanitation practices since a total of 126,405 cases were reported in 2008; 32, 553 more than the previous year.

In the Republic of Trinidad and Tobago, the Ministry of Health (MoH) Annual Statistical Report for 2004–2005 presented information which revealed that diarrhea and gastroenteritis of presumed infectious origin was the main contributor of certain infectious and parasitic diseases in both sexes – 30.1% in 2004 and 35.8% in 2005. There was an increase of 253 reported cases between 2004 and 2005 with most patients being in the 1–4 year age group. The second highest affected age group was 25–44 years.

The Public Health Inspectorate is the local authority charged with the responsibility of educating all interested foodservice employees on the principles of food safety and sanitation as stipulated by the law. Upon completion of a medical assessment and attendance to a lecture session, persons are issued food badges which are required to be displayed at all times while on duty at the food establishment. Health inspectors are vested with the power to randomly visit and inspect foodservice facilities (Ministry of Health 2011), and may approve or suspend operations on the basis of compliance with food safety standards and regulations.

Foodborne illness more commonly referred to as food poisoning, is a consequence of compromising food safety and sanitation practices, and affects an individual by way of infection (ingestion followed by replication in the intestine), or intoxication (ingestion of toxins/poisons) (ServSafe Essentials, 2002). Marriott (1997) stated that the sources of food borne pathogens are the “soil, feces, air and water.” He also used the chain of infection model to depict the path via which an agent (bacteria, virus, prion or parasite), is transmitted from its source to host (Marriott 1999, 54). The survival of these agents is heavily dependent on the optimal quantity of nutrients, pH (acid), temperature (41°F to 135°F), time, oxidation-reduction potential, and moisture (water activity values of ≥ 0.85) (ServSafe Essentials, 2002).

Given the above statistics and information, it is clear that the issue of food contamination is one which should never be lightly esteemed. In the past couple of years, several food manufacturers recalled food products from the market due to an outbreak of food borne illness where consumers became ill or died after consuming contaminated products/produce.

Some recent cases in point are the recall of bulk and consumer packaged in-shell hazelnuts and mixed nut products containing in-shell hazelnuts in March 2011, due to an outbreak of *Escherichia coli O157: H7*. The nuts were distributed between the dates of November 2, 2010 and December 22, 2010, and are reported to have already affected customers in Wisconsin, Michigan and Minnesota (US FDA 2011).

In August 2010, a recall of more than 300 million shell eggs produced by Wright County Egg of Galt, Iowa was necessary to control the spread of *Salmonella* Enteritidis which infected persons in seventeen states throughout the US (US FDA 2010). Another instance of food borne illness occurred in China in 2008 when more than a quarter million children were affected, 50,000 were hospitalized and six died as a result of melamine contamination in child formula (Ingelfinger 2008, 2745).

Persons have also contracted food borne illnesses after consuming foods from popular foodservice establishments and vendors. An incident of food borne illness occurred in Singapore at a Rojak Geylang Serai food stall located in the Geylang Serai Temporary Market during April, 2009. The food, rojak, was cross-contaminated with the bacterium *Vibrio parahaemolyticus* which was found in raw seafood ingredients. According to the Ministry of Health in Singapore, as of April 12, 2009, a total of 154 cases were reported, 48 persons were hospitalized, and 1 person died.

In November 2007, one hundred and three students and teachers of the Cap De Ville Government Primary School in south Trinidad were admitted to hospital after experiencing nausea, vomiting and abdominal pain. Investigations revealed that food contamination was the cause of the outbreak, and it was linked to the discovery of worms in macaroni pie that accompanied other items in the lunch boxes provided by a caterer attached to the National Schools Dietary Services Limited (NSDSL) (Newsday Reporters 2007).

Fortunately, there were no fatalities as a result of the situation though it was not the only one of its kind. In January 2011, 16 students of the Cocoyea Government Primary School complained of feeling ill after consuming tuna fish sandwich for breakfast. The meal was provided by another caterer who is also employed by the National Schools Dietary Services Limited (NSDSL) (Trinidad Newsday 2011).

Purpose of the Study

Food establishments at the campus, offer a wide variety of meals which can be purchased from as early as 8am till 10pm at affordable prices. Foods are prepared based on static menus and cater to the needs of vegans, non-vegans, and persons of various religious and ethical persuasions. Although food types are widely varied, large quantities are prepared on site by trained and untrained employees under questionable environmental conditions.

In light of the fact that food safety is a matter of high importance, the purpose of this study was to examine the level of food safety knowledge of employees at food establishments situated on the St. Augustine Campus of the University of the West Indies (UWI).

Objectives of the Study

The specific objectives of this study were:

1. To determine if food safety training has a greater impact on food safety knowledge.
2. To examine and the relationship that exists between education level and food safety knowledge.
3. To examine the association between length of employment in the foodservice industry and food safety knowledge.
4. To evaluate the overall food safety knowledge of foodservice employees working at food establishments stationed on the St. Augustine campus of the UWI.

Hypotheses

It was hypothesized that:

1. There is a direct correlation between experience in the foodservice industry and food safety knowledge.
2. A positive association exists between higher education levels and food safety knowledge.
3. The mean food safety knowledge score of trained employees is greater than the mean score of untrained employees.

Significance of the Study

The UWI St. Augustine Campus currently has a full-time and part-time enrollment of over 13,000 students (Sankat 2011). Of this number, 168 male students reside on Canada Hall, 142 females live at Trinity Hall, and a combination of 168 male and female students are accommodated at Milner Hall (UWI 2011). Many students also occupy homes and apartments located within walking distance of the campus.

This significantly large number of students is at a greater risk for contracting food borne illnesses because they are more dependent on consuming foods provided on the campus. Most students are pressed for time during the semester, and lack the skill to prepare meals. As a result, they purchase ready-to-eat foods quite often while they are on the University's compound.

This study was necessary to provide a reasonable explanation for the food safety practices observed by many students and staff members. Suspicion of compromised food safety practices was heightened in cases where customers reported having bouts of food borne illness after ingesting poorly handled and most likely contaminated food that was prepared and served on campus.

In order to justify if these mishaps occurred due to a lack of food safety knowledge, an evaluation was carried out to include employees of every food establishment who prepare foods for sale within the boundaries of the campus. The results of this research may serve to emphasize the need to restructure the mode of delivery of food safety education, in order to improve food safety knowledge.

CHAPTER II

LITERATURE REVIEW

The World Health Organization (WHO) (2011) declares that food safety is a very serious issue, because more than 85% (1.9 million out of 2.2million) of the victims are children who consume unsafe foods that have the potential to result in diarrheal diseases or cancers. WHO (2007) defines food borne illnesses “as diseases, usually either infectious or toxic in nature, caused by agents that enter the body through the ingestion of food”.

In order to combat the worldwide incidence of food borne illnesses and thus reduce its burden, the World Health Organization developed an educational tool in 2001 titled, “The Five Keys to Safer Food”. These keys are: keep clean, separate raw and cooked, cook thoroughly, keep food at safe temperatures, and use safe water and raw materials (WHO 2010). It was designed to address personal hygiene, sanitation, cross-contamination, and time-temperature control measures which are major determinants of safe food. Most member countries have modified and used these fundamental values to inform food handlers on ways to improve food safety.

In Trinidad and Tobago, there is cause for concern with regard to enforcement since of the 42,973 reported cases in the Caribbean over the period 1981 to 2005, most of the foodborne illnesses (16,229; 38%) were reported from this country (CAREC 2008).

Most pathogens are found predominantly in meat, seafood, poultry, dairy products, eggs and nuts, because they provide all the optimal conditions necessary for survival and replication. Chemical and physical hazards are usually introduced to foods as a result of improper handling, storage or compromised packaging materials. Implementing food safety management programs such as Hazard Analysis Critical Control Points (HACCP) are highly recommended as they identify critical control points and eliminate these hazards during the food production process.

Table 1: List and classification of the contaminants identified by the Caribbean Epidemiology Centre (CAREC) as most threatening in this region

Classification	Examples
Bacteria	<p><i>Vibrio cholerae</i> (cholera)</p> <p><i>Salmonella</i> (salmonellosis)</p> <p><i>Shigella</i> (shigellosis)</p> <p><i>Campylobacter</i> (campylobacteriosis)</p> <p><i>Escherichia coli</i> (E. coli O157:H7)</p> <p><i>Listeria</i> (listeriosis)</p>
Natural toxins	<p>Mycotoxins (aflatoxins and ochratoxin A)</p> <p>Marine biotoxins</p> <p>Cyanogenic glycosides and toxins</p> <p>Toxins in mushroom</p>
Prion	Bovine spongiform encephalopathy (BSE) (mad cow disease)
Chemical	<p>Persistent organic pollutants:</p> <ul style="list-style-type: none"> ➤ Dioxin ➤ Polychlorinated biphenyls(PCBs)
Metals	<p>Mercury</p> <p>Lead</p> <p>Cadmium</p>

Factors influencing food safety knowledge

Improvement of food safety practices in the foodservice can only be realized when food handlers have acquired food safety knowledge by education, training, and the appreciation its continuous application. This view is supported by the finding of a study conducted by Roberts et al. (2008), where it was observed that restaurant employees who underwent training were better able to respond to questions on food safety knowledge and behavior than untrained employees. The investigation proposed the need for training as an essential factor in influencing positive food safety practices, and Brannon et al. (2009) also suggested that this route may be beneficial as it also heightens awareness and serves as a stimulus for behavior modification. A comparison between fine dining and quick service restaurant employees also led to the discovery of direct causal relationships between education level and experience on food safety knowledge (Johnson et al. 2003, 61).

Their statements were opposed by the outcome of other studies which took the position that food safety practices were substandard even though employees received food safety training and were experienced (Chukwuocha et al. 2009, 245; Hertzman et al. 2007, 568). Some of the reasons cited for this contradiction were equipment and resource availability, the fast pace environment, priority of making profits over safe practices, and time pressure demands. These represent typical examples of the need to have a supportive environment in order to ensure that knowledge and practices are on par.

Chukwuocha et al. (2009) put forth the need to evaluate the effectiveness of food safety training programs on the basis of their research which found that a greater number of the food handlers were less educated. The study's findings suggest that although a program may be well arranged and presented, the information imparted may not be properly interpreted or retained by the target audience. The researchers also pointed out that more attention needs to be paid to food handlers employed at school canteens because students are the usual victims of food borne illness.

In addition to remodelling food safety education delivery, Dundes and Swann (2008) elaborated further and took the position that management also has a key role to play in the improvement of food safety compliance. They specifically suggested that managers should provide incentives as a means of positive reinforcement towards developing favourable food safety behavior. A study by Azanza et al. (2000) substantiates the importance of management by highlighting that food safety education should be a regular practice at establishments along with the provision of water and waste management services.

CHAPTER III

METHODOLOGY

Participants

Recruitment for this study was based on three criteria. The first was that all persons were employees of food establishments on the St. Augustine campus of the UWI, the second was that employees prepare foods for sale at the campus, and the third and most important requirement was that each person participated voluntarily. Adult employees of both genders in were invited to participate, by providing their truthful and honest responses to the questions asked.

This exercise was carried out during the period of February to March 2011, where 84 questionnaires were distributed to full-time and part-time employees of fourteen food establishments situated at the St. Augustine Campus of the UWI. The number of businesses was reduced from the initial count of fifteen because the supervisor of one of the fast food chain outlets declined to allow employees to take part in the study. Two possible reasons for that company's reluctance may have been the fear of negative perception of employees' food handling practices, coupled with decreased patronage. The initial number of participants consisted of 38 (45.2%) employees of fast food chain restaurants and 46 (54.8%) employees of independently owned outlets.

Design

The instrument used to collect data in this study was a questionnaire titled, 'Food safety and sanitation' (appendix 1). The document contained 40 close-ended questions and was divided into two sections that gathered personal data (questions 1 to 7) and food safety knowledge data (questions 8 to 40). Questions in the first section required responses to demographic variables: gender, age, length of experience in the foodservice industry, level of education, employer identification, and food safety training. Multiple choice questions were used in the second section to test employees' food safety knowledge.

The questions in the second section were selected from a validated food safety diagnostic test which was developed and established in 2010 by the National Restaurant Association (NRA), Educational Foundation. The completed questionnaire was examined by a senior Public Health Officer of the Public Health Inspectorate of Trinidad and Tobago, to ensure that questions assessed knowledge based on information presented at food safety lectures. The main areas of food safety: personal hygiene, cross-contamination, time-temperature control, and cleaning and sanitizing practices were examined.

Procedure

Each foodservice establishment on the campus was visited and the purpose of the research was explained to the owner, manager or supervisor. Upon agreement to participate, the number of employees was disclosed and questionnaires were delivered in labeled envelopes for distribution among employees.

Respondents were asked not to write, print or sign their names, initials, or any form of personal identification on the questionnaires. Owners, managers or supervisors were also assured that the names of the establishments will not be stated anywhere in the final report. A date and time were agreed on for collection but an extension was granted in instances where persons were unable to complete the questionnaires as promised.

Data analyses

All data collected in the 57 questionnaires were analyzed using SPSS software version 19. Responses on personal data and food safety knowledge scores were analyzed by descriptive statistics which included frequencies and cross tabulation to determine the distribution and relationship of the participant characteristics.

Bivariate correlational analyses were also conducted to determine Kendall's tau-b correlation coefficient which measured the relationships between: (1) level of education and food safety knowledge scores, and (2) length of employment in the foodservice industry and food safety knowledge scores. The effect of formal food safety training on knowledge was measured by conducting an independent samples t-test which compared the mean scores of persons who received formal food safety training with those who did not.

CHAPTER IV

RESULTS

Participant characteristics

A final tally of the number of questionnaires revealed that 57 were returned completed, 14 were returned incomplete, and 13 were never returned. Of the completed questionnaires, 19 (33.3%) were collected from fast food chain employees and the remaining 38 (66.7%) were completed from employees of independently owned establishments. The first fourteen letters of the alphabet were randomly assigned as the alternative forms of identification to the names establishments.

The frequency distribution of participants in terms of demographic variables (personal data) is presented in Table 2. The mean and standard deviation of the number of participants was 4.07 ± 2.73 , and the minimum and maximum numbers of participants were 1 and 12 respectively. The majority of respondents were full-time employees (80.7%), 76% of which were females. The largest group of twelve participants was of establishment 'I', and the smallest groups of two were employees of three independently owned outlets.

Respondents' ages ranged from late teenage to older than 46, but the 20 – 25 year old age group recorded the maximum number of participants (24.6%). Approximately half of the total respondents were 30 years old and younger. Most employees indicated that they have 1 – 3 years experience working in the foodservice industry, and 6 participants (all female) acquired more than ten years service. A significant number of employees received secondary level education, with 24.6% of progressing to the tertiary level. Two-thirds of the participants indicated that they were certified to work in the foodservice environment having received formal training in food safety.

Table 2: Frequency distribution of demographic variables (personal data) characteristics (n = 57)

Demographic variables	Frequency	Valid percent (%)
Gender		
Female	42	73.7
Male	13	22.8
No response	2	3.5
Age		
<20	2	3.5
20 - 25	14	24.6
26 - 30	11	19.3
31 - 35	10	17.5
36 - 40	4	7.0
41 - 45	5	8.8
46+	10	17.5
No response	1	1.8
Level of education		
Primary	5	8.8
Secondary	38	66.7
Tertiary	14	24.6
Length of employment in foodservice		
1 - 3 years	21	36.8
10+ years	6	10.5
4 - 6 years	9	15.8
6 months - 1 year	6	10.5
7 - 10 years	6	10.5
Less than 6 months	8	14.0
No response	1	1.8
Employment Status		
Full-time	46	80.7
Part-time	9	15.8
No response	2	3.5

Demographic variables	Frequency	Valid percent (%)
Food establishment		
A	4	7.0
B	6	10.5
C	3	5.3
D	2	3.5
E	2	3.5
F	6	10.5
G	4	7.0
H	5	8.8
I	12	21.1
J	4	7.0
K	3	5.3
L	1	1.8
M	3	5.3
N	2	3.5
Food safety training		
No	17	29.8
No response	2	3.5
Yes	38	66.7

The following table shows that 60% (3 of 5) of the persons who were educated at the primary level were also trained in food safety. This percentage increased at the secondary level, with a recorded percentage of 68.4% (26 of 38), but a slight decrease to 64.3% (9 of 14) was observed at the tertiary level.

Table 3: Cross tabulation between level of education and food safety training

		Food Safety training			
		No	No response	Yes	Total
Education level	Primary	2	0	3	5
	Secondary	10	2	26	38
	Tertiary	5	0	9	14
Total		17	2	38	57

The table below shows a 50% percent distribution between trained and untrained employees with more than 10 years service. The same pattern involving identical numbers of employees was also observed in the 6 months to 1 year employment group. The group with the highest number of trained 34.2% (13 of 38) and untrained 41.2% (7 of 17) employees reported having 1 – 3 years experience, while the minimum number of untrained employees 5.9% (1 of 17) indicated that they served 4 – 6 years and 7 – 10 years.

Table 4: Cross tabulation between length of employment and food safety training.

		Food Safety training			Total
		No	Yes	No response	
Length of employment	No response	0	1	0	1
	6 months or fewer	2	5	1	8
	6 months - 1 year	3	3	0	6
	1 - 3 years	7	13	1	21
	4 - 6 years	1	8	0	9
	7 - 10 years	1	5	0	6
	10+ years	3	3	0	6
Total		17	38	2	57

Food safety knowledge scores

Table 5 is used to cross tabulate the variables: level of education, length of employment, food establishment and food safety training with food safety knowledge scores. Percent ranges were used as an alternative to the actual score out of 33 to summarize and present data in a reader friendly format.

The food safety knowledge scores ranged from a minimum of 2 out of 33 (6.1%) to a maximum of 28 out of 33 (84.9%), and the mean score and standard deviation were 15.28 ± 5.216 (46.3% \pm 15.8%). The information presented in Table 2 reveals that 63.2% of the participants scored less than 50% (≤ 16 out of 33), 14% scored between 50 to 59 percent, 19.3% of the respondents earned marks between 60 and 69 percent, and 3.5% scored within the 80 – 89 percent range. No one scored within the other ranges of 70 – 79% and 90 – 100%.

The two persons who scored the highest percentages indicated that they received secondary level education, yet twelve times as many participants who also received the same level of education scored less than 50% on the assessment. More than half the number of employees who received tertiary level education were unable to answer 17 or more of the questions correctly. There was however, an equal distribution of three participants who earned percentages in the ranges of 50 – 59 and 60 – 69. Of the five participants who stated that they were educated at the primary level, one person managed to earn a score greater than 50% which fell within the 60 – 69 percent category.

The pair of best performing employees held longer years of service, with one person indicating that they acquired more than 10 years experience, while the other had 7 – 10 years. Nine of the 11 participants who obtained a score between 60 – 69 percent had 1 – 3 years experience in the foodservice industry, and the other two persons who also scored within this range were working for less than 6 months. Half the number of participants who earned a score in the 50 – 59 percent bracket also had 1 – 3 years employment while a quarter of the total number in the group worked for less than 6 months. Overall however, for each category employment time, most persons scored less than 50% on food safety knowledge.

As expected, the participants who scored the highest marks also received formal food safety training. There was an almost equal distribution of trained and untrained persons who acquired percentages within the second highest category, while three times the number of untrained employees who earned percentages within 50 to 59 was trained. Within the <50% score category, 66.7% of the employees indicated that they were trained, 27.8% reported that they were untrained and 5.6% gave no response.

The two employees who obtained scores within the range of 80 – 89% are both employed at one of the fast food chain outlets on the campus. Just over half of the respondents from establishment ‘I’ which had the highest number of participants, attained percentages within the ranges of 50 – 59 and 60 – 69. The highest scores obtained by employees of independently owned establishments were within the 60 – 69 percent range, and four persons employed by two businesses successfully earned them. All participants of six of the fourteen food establishments in this study did not score more than 50% on the assessment. Among the six is a fast food chain outlet.

Table 5: Frequency distribution of food safety knowledge scores in percentage ranges in relation to demographic variables (n=57)

Demographic variable	Food safety knowledge score (%)				Total
	<50	50 – 59	60 – 69	80 - 89	
Level of education					
Primary	4	0	1	0	5
Secondary	24	5	7	2	38
Tertiary	8	3	3	0	14
Length of employment					
1 - 3 years	8	4	9	0	21
10+ years	5	0	0	1	6
4 - 6 years	8	1	0	0	9
6 months - 1 year	5	1	0	0	6
7 - 10 yrs	5	0	0	1	6
less 6 months	4	2	2	0	8
No response	1	0	0	0	1
Food safety training					
No	10	2	5	0	17
No response	2	0	0	0	2
Yes	24	6	6	2	38
Food establishment					
A	3	1	0	0	4
B	3	3	0	0	6
C	2	1	0	0	3
D	2	0	0	0	2
E	1	1	0	0	2
F	2	1	1	2	6
G	4	0	0	0	4
H	2	0	3	0	5
I	5	1	6	0	12
J	4	0	0	0	4
K	3	0	0	0	3
L	1	0	0	0	1
M	3	0	0	0	3
N	1	0	1	0	2

Areas of strength and weakness

Tables 6 to 9 present the numbers and percentages of participants who chose the correct answers to some of the questions examining knowledge of hygiene, contamination, time and temperature control, and cleaning and sanitation measures. The information shows that participants were more knowledgeable about hygiene practices, but less informed where cleaning and sanitation, contamination, and time and temperature control measures are concerned.

Table 6: The overall number and percentage of participants who answered questions based on hygiene correctly

CATEGORY EXAMINED: Hygiene	
Questions asked in questionnaire	Number of correct responses
Q. What should be used to dry hands after washing them? A. Single-paper towel	53 (93%)
Q. To work with food, a food handler with a hand wound must A. Bandage the wound and wear a single-use glove	29 (50.9%)
Q. How should food handlers keep their fingernails? A. Short and unpolished	53 (93%)

Table 7: The overall number of participants who answered questions based on contamination correctly

CATEGORY EXAMINED: Contamination	
Questions asked in questionnaire	Number of correct responses
<p>Q. Using one set of cutting boards for raw potentially hazardous (time/temperature control of safety) food and another set of cutting boards for ready-to-eat food reduces the risk of</p> <p>A. Cross-contamination</p>	46 (80.7%)
<p>Q. The three potential hazards to food are biological, physical and...</p> <p>A. Chemical</p>	32 (56.1%)
<p>Q. Why should food NOT be store in a galvanized container?</p> <p>A. Acids in the food can leach zinc into the food</p>	17 (29.8%)

Table 8: The overall number of participants who answered questions based on time and temperature control correctly

CATEGORY EXAMINED: Time and temperature control	
Questions asked in questionnaire	Number of correct responses
<p>Q. What is the temperature range of the temperature danger zone?</p> <p>A. 41°F to 135°F (5°C to 57°C)</p>	12 (21.1%)
<p>Q. What is one way that food should NEVER be thawed?</p> <p>A. At room temperature`</p>	20 (35.1%)
<p>Q. Hot potentially hazardous (time/temperature control of safety) food that has been held below 135°F (57°C) for over 4 hours should be</p> <p>A. Thrown out immediately</p>	26 (45.6%)

Table 9: The overall number of participants who answered questions based on cleaning and sanitation correctly.

CATEGORY EXAMINED: Cleaning and sanitation	
Questions asked in questionnaire	Number of correct responses
Q. A backup of raw sewage has occurred in the kitchen. What should happen next? A. Close the affected area and clean it	50 (87.7%)
Q. What is sanitizing? A. Reducing the number of pathogens on a surface to safe levels	25 (43.9%)
Q. How should a prep table be cleaned and sanitized? A. Clean and rinse the surface, sanitize the surface, and air-dry	16 (28.1%)

In addition to the presentation of correct responses in Tables 6 to 9, a frequency analysis of the number of correct and incorrect responses to all the food safety knowledge questions was carried out. It revealed that less than 50% of the participants were able to correctly respond to 19 of the 33 (58%) questions asked, but over 90% of the participants answered two questions correctly. Both questions tested knowledge on hygiene and they are included in Table 6. The only question to which all participants responded was related to physical contamination; however, only 2 of the 57 persons were correct in their choice of answer. Many persons felt that the answer to reducing this type of contamination was ‘washing hands before handling food’ but this procedure is carried out to reduce microbial (biological) contamination.

Food safety assessment in other areas such as receiving and storage showed that fifty persons (87.7%) gave the correct response to the question of inspecting food items upon delivery but only eight employees knew that foods kept in dry storage must not touch the walls. Approximately 16% (9) of the participants were able to identify the first step in developing a HACCP plan, while about 44% (25) knew the purpose of material safety data sheets. An alarming number of only 12.3% (7 of 57) of the employees gave the accurate response to identifying rodent infestation and half of the number of participants knew that salmonella is the most common food borne bacterium.

Hypothesis testing

The null hypothesis that no positive association exists between education level and food safety knowledge has to be rejected based on the results presented below in Table 7. The information shows that a positive relationship does exist between the two variables although it is not strong and significant (Kendall's tau-b = 0.067, n = 57, p = 0.294).

Table 10: Bivariate correlational analysis of the relationship between education level and food safety knowledge

		Percentage		
		Range	Education level	
Kendall's tau_b	Percentage	Correlation	1.000	.067
	Range	Coefficient		
		Sig. (1-tailed)	.	.294
		N	57	57
Education level	Correlation	.067	1.000	
	Coefficient			
	Sig. (1-tailed)	.294	.	
	N	57	57	

Correlation is significant at the 0.01 level

The correlational analysis to test the null hypothesis that there is no direct correlation between length of employment in the foodservice industry and food safety knowledge yields a coefficient of -0.133, $p = 0.121$ as shown in Table 8. This means that the null hypothesis is supported by the data, and that there is a weak inverse relationship between the two variables.

Table 11: Bivariate correlational analysis of the relationship between length of employment and food safety knowledge

			Percentage Range	Length of employment
Kendall's tau_b	Percentage Range	Correlation Coefficient	1.000	-.133
		Sig. (1-tailed)	.	.121
		N	57	57
Length of employment	Length of employment	Correlation Coefficient	-.133	1.000
		Sig. (1-tailed)	.121	.
		N	57	57

Correlation is significant at the 0.01 level

Table 12: Independent samples t-test comparing means food safety knowledge scores between groups of participants who are formally trained and untrained in food safety

	Food Safety training	N	Mean	Std. Deviation	Std. Error Mean
Number Correct Answers	NO	17	15.71	4.896	1.187
	YES	38	15.42	5.325	.864

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Number Correct Answers	Equal variances assumed	.190	.664	.188	53	.852	.285	1.517	-2.758	3.328
	Equal variances not assumed			.194	33.375	.847	.285	1.468	-2.701	3.271

Based on the Levene's test, the variances of the samples are assumed equal because the significance value $0.664 > 0.05$. The test is one-tailed, so the p-value for equality of means would be 0.426 which is greater than the 0.05 significance level. The null hypothesis that there is no difference between means is therefore accepted.

CHAPTER V

DISCUSSION AND CONCLUSION

This study shows that although a significant percentage of foodservice employees (66.7%) were trained in food safety, a considerable majority did not possess the expected level of knowledge to reflect distinction from untrained employees. The evaluation of food safety knowledge revealed that 36.8% of the trained employees and 41.2% of the untrained employees scored higher than 50% (Table 5). A total of 63.2% (36 of 57) of the participants scored below 50%, and only 3.5% (2 persons) acquired percentages within the 80 – 89% range. Employees were most knowledgeable about hygiene practices and had a fair amount of knowledge on cleaning and sanitation procedures. They were least acquainted with time and temperature control measures and forms of contamination.

Many (46 of 57) knew that time and temperature control was the key to managing microbial growth but they were unable to identify other factors which contribute to its proliferation. Employees generally lacked knowledge on the temperature danger zone, the storage temperatures for meat, fish and poultry, proper thawing methods, and the time limit for which foods are deemed safe when kept below 135°F (57°C). Although a significant number of persons failed to identify the correct steps involved in hand washing and sanitation procedures, 53 (93%) persons were fully aware that it is improper to handle food with long and painted fingernails and it is best to use single-use paper towels to dry hands after washing them.

These areas of strength and weakness in knowledge are most likely due to the fact that many employees are very familiar with what constitutes proper hygiene as a result of repeated exposure and practice, but seldom perform more technical procedures such as time and temperature monitoring, and proper sanitization measures. Many employees may also be unable or unwilling to carry out these procedures as advised, due to time constraints and unavailability of resources (Brannon et al. 2009).

Factors associated with food safety knowledge

In an attempt to measure the association between higher education level and food safety knowledge, the Kendall's tau-b correlational analysis was carried out. The results supported the research hypothesis that a positive relationship between the both variables does exist. Although this relationship was found to be weak, it implied that there is a minimal tendency for increased food safety knowledge as education level is elevated. This information lends further support to the finding of a study conducted by Johnson et al. (2003) who found that employees who worked at fine dining establishments were more knowledgeable about food safety practices than employees who worked at quick service restaurants. The fine dining restaurant employees were educated at the tertiary level, while most quick service restaurant employees possessed their highest level of education at the secondary level.

In the case of this study, it was also observed that as level of education progressed from primary to tertiary level, the percentage of persons who scored above 50% also increased. The pass rate increased from 20% (1 of 5) to 36.8% (14 of 38) and finally 42.9% (6 of 14) among tertiary level participants (Table 5).

The second factor which was noted and tested in this study was length of employment in the foodservice industry. It was chosen to determine if there was a positive relationship between food safety knowledge and longer terms of service among participants. In this instance, the research hypothesis was not supported since the correlational analysis revealed that a weak (stronger value than education level) and indirect association existed between the variables. This meant that persons with longstanding years of service had lower levels of food safety knowledge than employees who are junior in experience. The findings contradict those of Brannon et al. (2009) and Johnson et al. (2003) which stated that employees tended to have higher levels of food safety knowledge as they became experienced in the operations.

In this study, the highest percentage of employees who scored above 50% had 1 – 3 years employment in the foodservice industry. This was closely followed by the group of employees with less than 6 months employment, while the group with ten years and more of employment reported a pass rate of 16.7%.

Limitations

Some of the limitations faced while conducting this research were employee rotation to establishments located off-campus. This interfered with the collection of data, because persons left the establishment and no account was given on the whereabouts or stage of completion of the questionnaires. Another issue which negatively affected questionnaire completion was short staffing. The supervisor of one establishment reported that it was difficult to complete the document during working hours, since all staff members were needed to carry out multiple tasks throughout the day. The results of the study may not be a true representation of the practices by all employees at the campus due to the fact that one of the largest staffed establishments declined to allow employees to participate.

Conclusion

In spite of the limitations of this study, the results indicate that there is need for urgent intervention in order to increase food safety knowledge among foodservice employees on the campus. Many persons were unaware of the critical areas of food safety and sanitation and this is highly indicative of the tendency to be less cautious when handling food. It implies that there is an increased risk of contracting food borne illness, since many are less informed about contaminants and cleaning and sanitization procedures. This observation was the same regardless of education level, length of employment in the food service, and most surprisingly food safety training.

The results highlight the dire need for evaluating and restructuring the content and mode of food safety education delivery. There are a number of ways in which this is possible, one of these include remodelling the food safety education training system to include practical and theoretical components. Participants will receive hands-on experience in measures to reduce contamination, they would be trained to correctly read and interpret measurements (e.g. thermometers), and they will be guided on proper cleaning and sanitation measures. Assessments of both components should be conducted at the end of training, to measure the effectiveness of delivery and to encourage participants to retain and apply food safety principles.

Another possible way to bring about improvement is by conducting follow-up or seasonal training sessions and seminars with employees. Public health professionals can work together with managers, owners and supervisors to maintain food safety awareness and practices at food establishments. Managers need to recognize that it is imperative for them to put systems in place that would encourage employees to practice safe food handling. Some of these include the introduction and enforcement of HACCP and SOPs, the acquisition of appropriate resources and services, and revision of policies.

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