University foodservice employees' food safety knowledge, attitudes, practices, and training

by

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TABLE OF CONTENTS

LIST OF TABLES

Abstract

Food safety is a critical issue facing the foodservice industry. Foodservice workers play a major role in preventing outbreaks of foodborne illness and meeting the goal of serving safe food. The purpose of this study was to assess foodservice employees' knowledge, attitudes, practices, and training regarding food safety at one university. Comparisons of food safety knowledge, attitudes, practices, and training were made between student and full-time employees.

Two questionnaires were used for this study. A 5-part questionnaire was developed to assess student and full-time employees' food safety knowledge, attitudes, practices, and training. A 1-page questionnaire was developed and sent to Iowa State University Dining managers to determine food safety topics included in training or orientation for student employees, and to determine perceptions of student employees' food safety practices compared to those of full-time employees. Student employees returned 221 questionnaires for a 40% response rate. Thirty-eight questionnaires were completed by full-time employees for a 42% response rate. Sixteen questionnaires were completed by managers for an 84% response rate.

SPSS 11.0 for Windows was used for data analysis. Descriptive statistics summarized data. Analysis of variance (ANOVA) examined differences in food safety knowledge, attitudes, practices, and training between student and full-time employees. ANOVA and correlations assessed relationships among employees' demographic characteristics and mean total scores for food safety knowledge, attitudes, and practices.

Multiple linear regression tested relationships among employees' food safety knowledge, attitudes, practices, training, and demographic variables.

Full-time employees had higher ($p \leq 0.001$) mean total scores for food safety knowledge, attitudes, practices, and training than student employees. Full-time employees were least knowledgeable about sanitizer concentrations. Student employees lacked knowledge about the importance of handwashing, time and temperature control, and sanitizer concentrations. Student employees lacked training about preventing cross contamination and the temperature danger zone. Student employees' food safety knowledge, attitudes, and training had a significant positive influence on their food safety practices ($p \leq 0.001$).

Emphasis on food safety training for student employees is needed to ensure these employees have appropriate food safety knowledge and attitudes and to make sure practices are followed. Mangers need to consider strengthening food safety training related to proper handwashing procedures, time and temperature control, cross contamination, and sanitizer concentrations for student employees.

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CHAPTER 1. INTRODUCTION

Food safety is a critical issue facing the foodservice industry. The estimated number of foodborne illnesses in the United States (U.S.) each year and the subsequent economic cost emphasizes the importance to consumers and the foodservice industry. It is estimated that approximately 76 million illnesses, 325,000 hospitalizations, and 1,800 deaths are related to foodborne illnesses each year in the U.S. (Mead et al., 1999). According to the U.S. General Accounting Office (GAO) (1996), estimated annual costs related to foodborne illnesses ranged from $5 billion to more than $22 billion.

With much media coverage about foodborne illness incidents, consumers today have an awareness of food safety and sanitation issues. Research conducted by the National Restaurant Association in 1997 found that over 95% of the consumers surveyed said knowing restaurant workers were trained in safe food handling was an important factor in making them believe restaurants had the ability to serve safe food (Strauss, 1999). An understanding of food safety procedures and the potential factors that cause foodborne illness is very important for all the food handlers. Cohen, Reichel, and Schwartz (2001) stated "only knowledgeable, motivated, and skilled employees who are trained to follow the proper procedures together with management that effectively monitors employees' performances can ensure food safety" (pp. 6-7). Foodservice workers play a major role in the prevention and control of outbreaks of foodborne illness.

Foodservice employees' knowledge and attitudes toward food safety are vital to the prevention of foodborne illnesses. Cain (1998) stated that although there are many types of equipment and tools to help foodservice operators prepare and serve food safely, these are

useless, if employees do not take food safety seriously. Harrington (1992) mentioned that knowledge of food safety is a major requirement for restaurant operators in order to serve safe food and operate restaurants successfully.

University foodservice managers typically employ a large number of part-time employees to provide flexibility in staffing (Neumann, Stevens, & Graham, 2001). It is not uncommon that university foodservice managers hire many part-time student employees with no foodservice experience or international student employees. In addition, many student employees work in university foodservice for only one or two semesters and leave for employment in other fields (Fiihr, 2001). As a result, student employees may have less awareness of and concern about principles of food safety than full-time employees. It is very important for managers to educate both student and full-time employees about food safety, train them to use appropriate food handling procedures, and monitor their performance.

Much research published on the causes of foodborne illness concludes that it can be caused by employees' lack of food safety knowledge or poor personal hygiene (Bryan, 1988; Cohen, Reichel, & Schwatrz, 2001; GAO, 1996; Harrington, 1992). However, little research has focused on both student (part-time) and full-time university foodservice employees' food safety knowledge, attitudes, practices, and training.

Purpose of Research

The goal of this study was to assess foodservice employees' food safety knowledge, attitudes, practices, and training at Iowa State University. Specific objectives of this research were to:

1) Determine if there were differences in food safety knowledge, attitudes, practices, and training between student and full-time employees.

2) Examine if there were differences in employees' food safety knowledge, attitudes, practices, and training among different dining centers in one university foodservice department.

3) Determine if employees' demographic characteristics influence their food safety knowledge, attitudes, and practices.

4) Examine relationships among employees' food safety knowledge, attitudes, practices, and training.

5) Identify food safety training needs for university foodservice employees.

Significance of the Study

Previous research studies have focused on full-time employees' food safety knowledge, attitudes, and practices in restaurant operations, temporary food facilities, and institutional foodservices. However, minimal research has focused on both student and full-time employees' knowledge, attitudes, and practices of food safety in university foodservice. Results from this study will provide a comparison between student and full-time employees in one university setting. Results of this study will provide baseline data and guide the ISU Dining management team in developing a training program that would fill gaps in employee knowledge and attitudes to improve food safety practices.

Definitions

The following terms and definitions were used in this study:

Contaminants: "Presence of harmful substances not originally present in the food" (NRAEF, 1999, p. 1-8).

Cross contamination: "Transfer of harmful substances or disease-causing microorganisms from one food product to another through direct contact, or contact with utensils, equipment, work surfaces, or employees' hands or clothing" (NRAEF, 1999, p. G-4).

Foodborne illness: "A disease that is carried or transmitted to people by food" (NRAEF, 1999, p. 1-2).

Personal hygiene: "Sanitary health habits that include keeping body, hair, and teeth clean, maintaining good health, wearing clean clothes, and washing hands regularly, especially when handling food and beverages" (NRAEF, 1999, p. G-12).

Sanitation: "The application of cumulative heat or chemicals on cleaned food-contact surfaces that, when evaluated for efficacy, is sufficient to yield a reduction of 5 logs, which is equal to a 99.999% reduction, of representative disease microorganisms of public health importance" (FDA, 2001).

Temperature danger zone: "The temperature range between 41°F and 140°F within which most foodborne microorganisms rapidly grow and reproduce" (NRAEF, 1999, p. G-16).

Training: "A systematic process through which the human resources in the hospitality industry gain knowledge and develop skills by instruction and practical activities that result in improved performance" (Tanke, 2001, p. 167).

Training program: "A structured sequence of events that leads to learning" (NRAEF, 1999, p. G-16).

CHAPTER 2. LITERATURE REVIEW

This literature review is organized into four sections: impact of food safety; food safety practices in foodservice; knowledge, attitudes, and practices of food safety; and food safety training.

Impact of Food Safety

The Incidence of Foodborne Illness

The estimated number of foodborne illnesses in the U.S. each year highlights the importance of food safety in the foodservice industry. A report released by the Centers for Disease Control and Prevention (CDC) estimates that 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths can be attributed to foodborne illnesses in the U.S. each year (Mead et al., 1999). According to estimates provided by several studies conducted by the U. S. General Accounting Office (GAO) (1996), between 6.5 million and 81 million cases of foodborne illness, with as many as 9,100 resulting deaths, occurred every year from 1986 to 1996. A total of 2,751 outbreaks, which caused 86,058 persons to become ill, were reported during 1993 to 1997: 489 in 1993; 653 in 1994; 628 in 1995; 477 in 1996; and 504 in 1997. About 75% of these cases were caused by bacterial pathogens (Olsen, MacKinon, Goulding, Bean, & Slutsker, 2000).

According to the CDC, between 1990 and 1999 nearly 300 outbreaks of foodborne illness were reported in all levels of schools (elementary, middle, high, and college and university) with an estimated 16,000 individuals affected. Because not all foodborne illnesses in schools were routinely reported, a higher number of outbreaks may actually have

occurred. Data also showed an increase in the number of school-related outbreaks reported to the CDC between 1990 and 1999: 68 outbreaks were reported between 1990 to 1993, 111 outbreaks were reported between 1994 to 1997, and 113 outbreaks were reported between 1998 to 1999. These include outbreaks caused by foods in the school meal programs as well as foods brought from home (GAO, 2002).

Daniels et al. (2002) investigated foodborne illness outbreaks in U.S. schools by reviewing reports from state and local health departments of outbreaks occurring in primary and secondary schools, college, and universities from January 1973 to December 1997. Results of this study showed that 604 outbreaks were reported from schools and resulted in 49,963 illnesses, 1,514 hospitalizations, and 1 death. An etiologic agent was determined for 40% of these outbreaks. With a known etiology, most outbreaks (85%) were caused by bacterial pathogens, followed by chemical agents (7%), viral agents (6%), and parasitic pathogens (1%). The majority of these school outbreaks (460 outbreaks) were related to foods prepared on school premises. Improper storage and holding temperatures, contamination by food handlers, inadequate cooking, contaminated equipment, and food obtained from unsafe sources were the most commonly reported practices that contributed to these outbreaks.

According to the CDC and state health department records for the U.S., eight out of 20 outbreaks in 1997 were associated with the school meal program and affected approximately 688 individuals. For 1998, nine outbreaks were associated with school meal programs and affected an estimated 921 individuals (GAO, 2000).

The GAO reported that the actual number of outbreaks and foodborne illnesses could be higher than available data. Public health experts believe that many cases of foodborne

illness are not reported. Reasons foodborne illness cases are not reported include 1) an illness is not recognized as foodborne, 2) medical facilities may not report all minor foodborne illness cases, and 3) symptoms of foodborne illness are minor enough that some individuals do not seek medical attention and do not report it. In addition, public health experts and food safety officials think the risk of foodborne illness is rising based on a number of factors. First, the growth of large quantity food production and broad distribution of products that may be contaminated can cause a large number of people to become ill in many locations. Second, because of demographic changes, there are more elderly people and children who are groups at a greater risk of experiencing foodborne illness. Third, three pathogens, *Campylobacter, Listeria,* and *E.coli* 0157:H7, were unrecognized as causes of foodborne illness 20 years ago. Fourth, bacteria can be found in types of food that were not considered to be a potential source of illness. For example, *Salmonella* can be found not only in meat and poultry but also in ice cream, tomatoes, melons, alfalfa sprouts, and orange juice. Fifth, some pathogens continue to grow even under conditions that were once thought to limit growth (GAO, 1996).

Cost of Foodborne Illness Outbreaks

The estimated annual cost related to foodborne illnesses ranges from $5 billion to more than $22 billion (GAO, 1996). The reputation and financial success of a foodservice operation can be damaged by one incident of foodborne illness. In addition, a potentially life-threatening situation is presented to customers (Holdt, 1992). The costs of foodborne illness to the foodservice industry include loss of customers and sales, loss of prestige and reputation, law suits resulting in lawyer and court fees, increased insurance premiums, lowered employee morale, employee absenteeism, need for retraining employees, and

embarrassment (NRAEF, 1999). In 1992, Harrington found the cost of a foodborne illness outbreak was approximately $75,000 per establishment, and as high as $7 million for a multi-unit chain. Some operations never overcome the loss of goodwill and close permanently.

Consumer Concern and Awareness of Food Safety

Consumers are aware of and concerned about food safety issues; 83% of consumers view food safety as a very important public health issue (Allen, 2000). Brewer and Prestat (2002) collected data from 360 consumers regarding attitudes toward food safety issues and found that more than 70% of consumers were concerned or very concerned about improper food preparation and restaurant sanitation. Another study reported that 97% of consumers feel confident in the foodservice industry's ability to serve safe food only when they know food handlers participated in food safety training programs (Strauss, 1999). However, consumers' confidence in the foodservice industry's ability to serve safe food declined from 50% in 1995 to 39% in 2000 (Allen, 2000). Shin, Kliebenstein, Hayes, and Shogren (1992) found that consumers were willing to pay more for enhanced food safety. This research showed consumers would pay an additional 55 to 81 cents per meal to ensure food safety; the average extra price consumers were willing to pay to ensure food safety was $286 per person a year.

Food Safety Practices in Foodservice

One of the most important elements of ensuring food safety is proper food handling practices. Food handling practices that may cause foodborne illness include improper time and temperature management for thawing, cooking, holding, cooling, reheating of food, improper cleaning and sanitizing of equipment, poor personal hygiene, and cross

contamination (Bryan, 1988; Cohen, Reichel & Schwartz, 2001). Bryan (1988) studied factors that contributed to the occurrence of reported foodborne illness outbreaks in the U. S. between 1961 to 1982. He found improper cooling (44%) was the factor that contributed most to foodborne illness, followed by a lapse of 12 or more hours between preparing and eating (23%), and poor personal hygiene of those handling the food (18%). Improper time for cooling is one of the contributing factors to foodborne illness (FDA, 2000).

Temperature control is necessary to ensure food safety. According to the 2001 *Food Code* (FDA, 2001), to reduce the likelihood that microorganisms will grow it is important that food pass through the "danger zone" (between 41°F and 140°F) as quickly as possible by using a rapid method for heating or cooling. A proper cooling method requires time, temperature, and quantity management. Food should be cooled from 140°F to 70°F within 2 hours and from 70°F to 41°F within 4 hours by using correct cooling methods (FDA, 2001). Gilmore, Brown, and Dana (1998) stated that the timing of production is an important factor in the aesthetic appearance and safety of food. These researchers also mentioned that when the time between production and service is short, food quality is maximized.

People are primary agents for spreading contamination. Food handlers can contaminate food by transmitting microorganisms, causing a foodborne illness (NRAEF, 1999). Improper holding temperature and poor personal hygiene were two common improper food preparation practices that contributed to foodborne illness from 1988 through 1992 (Bean, Goulding, & Angulo, 1996). Good personal hygiene, effective food handling practices, and properly cleaned and sanitized work surfaces, equipment, and utensils can prevent cross contamination (NRAEF, 1999).

Gilmore, Brown, and Dana (1998) examined sanitation practices of food production as one factor of food quality in school foodservice operations. Their research showed that food handlers tended not to completely restrain their hair and did not frequently wash their hands. These researchers also observed food handlers using reusable towels to dry utensils, and they rarely sanitized small equipment/utensils, thermometers, and working surfaces. In addition, the temperatures for meat or meat alternates and hot vegetables were often in undesirable range. Only a small number of school foodservice employees answered questions regarding safe food temperatures correctly. These findings indicated that improvements were needed in the areas of food handling practices and temperature control in school foodservice.

Research shows the need for additional training and supervision to ensure standard operating procedures are followed in school foodservice. Giampaoli, Cluskey, and Sneed (2002) found the most frequent inappropriate food handling practices in school foodservice were related to time and temperature abuse, which included lack of taking hot or cold food temperatures during pre-preparation. The second was limited thermometer availability, and third was failure to transfer foods to cold storage during preparation. These researchers also observed unsafe food handling with bare hand contact, infrequent changing of gloves between tasks, insufficient handwashing, inappropriate hair restraints, inadequate eating and drinking in food preparation areas, and improper cleaning and sanitation of utensils, equipment, and facilities.

Food Safety Knowledge, Attitudes, and Practices

Cushman, Shanklin, and Niehoff (2001) conducted a research study to measure personal hygiene practices of part-time student employees in three on-site foodservice facilities in one university. Findings of this study showed that female student employees had higher mean hygiene practice scores than male student employees. This study also showed that the length of employment with the facility or organization influenced personal hygiene practices negatively. These researchers concluded that the majority of part-time student employees performed personal hygiene practices properly.

Unklesbay, Sneed, and Toma (1998) studied students' attitudes, practices, and knowledge of food safety in three universities. Results showed that students in dietetics, food science, nutrition, and health programs had higher attitude scores compared to students in other majors. Females, upperclassmen, graduate students, and those who took at least one course related to food safety had higher mean scores for food safety knowledge, attitudes, and practices than males, freshmen and sophomores, and those who had not taken a food safety course. These researchers suggested that all educators in food-related disciplines should educate college students about the importance of consumer food handling behaviors and the fact that consumers share responsibility of food safety.

Wie and Strohbehn (1997) studied the impact of a sanitation and food safety course on attitudes and knowledge of hospitality students. These researchers analyzed data from 68 students required to take a sanitation and safety course in the hospitality major. Researchers compared students' knowledge and attitudes toward sanitation and food safety before and after completion of the course. Results of this study showed students' knowledge and attitudes improved after completion of the course. They concluded that offering a sanitation

and food safety training course, coupled with continuing education, was very important to students.

Hsu and Huang (1995) analyzed 178 questionnaires from nine university residence hall foodservices in the U.S. to identify sanitation knowledge, attitudes, and behaviors of university foodservice non-managerial workers. Results indicated that foodservice workers were most knowledgeable about dishwashing procedures (91.9%) and mold-related food poisoning issues (88.6%). Respondents were least knowledgeable about microorganisms (68.2%). Results also showed that respondents had positive sanitation attitudes and behaviors. Variables influencing sanitation knowledge, attitudes, and behaviors were educational level, age, gender, work experience, and amount of employee training. These authors concluded that design of future training programs should allow employees to apply the new knowledge they learn in real life situations and work environments. It is recommended that managers of university foodservice should conduct food safety training on a routine basis for both new employees and current employees and update new food safety knowledge and materials when those become available. Repeated training could improve employees' food safety knowledge, increase employees' positive attitudes toward food safety, and influence their food safety behaviors.

Henroid and Sneed (in press) evaluated food handling practices, presence of prerequisite food safety programs, and employees' food safety knowledge and attitudes in 40 Iowa school foodservice operations to serve as the basis for implementing hazard analysis critical control point (HACCP) programs in school foodservice operations. These researchers found that employees had high food safety knowledge (15.9 ± 2.4 out of 20 points) and overall positive food safety attitudes (ranging from 4.2 to 4.8 out of 5 points).

However, they found proper food handling practices often were not followed in many school foodservice operations. Areas identified for improvement included inadequate taking and recording of food temperatures, infrequent and improper handwashing, inappropriate food cooling and thawing, and inadequate checking and recording of sanitizer concentrations. This study showed that although employees had high food safety knowledge and positive attitudes toward food safety, employees did not always follow acceptable food safety practices.

In a study of food safety practices and readiness to implement HACCP programs in assisted-living facilities in Iowa, Sneed, Strohbehn and Gilmore (in press) identified a number of food safety practice concerns in assisted-living foodservice. These researchers found that employees were least knowledgeable about food cooling and thawing practices, sanitizer concentration, and minimum end-point cooking temperatures. Researchers observed that handwashing sometimes was inappropriate, effective hair restraints were not used often, food temperature monitoring and recording were infrequent, and sanitizer concentration was not checked regularly. Researchers concluded that employees in assisted-living foodservice had sufficient food safety knowledge and positive attitudes toward food safety, but food safety practices still needed to improve, which was consistent with findings in the Henroid and Sneed study (in press).

Manning (1994) examined the food safety knowledge and attitudes of workers in institutional and temporary foodservice operations. This research focused on four factors that frequently contribute to outbreaks of foodborne disease: cross contamination, cooling and reheating, personal hygiene, and temperature control. This researcher found different levels in those four factors between institutional and temporary foodservice operations and

concluded that foodservice workers from institutions appeared to have a better understanding of safe food handling than those in temporary foodservice operations. The research data also indicated that more institutional workers received formal food training through on-the-job classes or correspondence courses, which provided a positive impact on food safety knowledge and attitudes compared to temporary foodservice workers.

Cochran-Yantis et al. (1996) investigated whether there was a difference in knowledge and attitudes of food safety between restaurant operators with favorable health inspection scores and those having difficulties in achieving and maintaining acceptable standards. They concluded that restaurant operators lacking food safety knowledge or positive attitudes toward food safety principles were at a much higher risk of operating a restaurant with health code violations than operators with high knowledge and positive attitudes.

A study of 279 South Wales caterers' beliefs, attitudes, and behaviors toward safe food handling (Coleman, Griffith, & Botterill, 2000) found that most caterers had positive attitudes toward food safety. Ninety-six percent of respondents agreed that compliance with legislation had a positive impact on their confidence with regard to food safety. These authors concluded that positive attitudes toward food safety and knowledge, awareness, and implementation of food handling practices were required components for a fully effective food safety training program.

Food Safety Training

In the foodservice industry, employees are important in the prevention and control of illness, both as potential mishandlers of foods and as direct sources of transmitting

microorganisms to food (Harrington, 1992). To achieve the goal of serving safe food, food handlers must be educated that foods that have been mishandled can lead to outbreaks of foodborne illness. In order to handle food safely and change incorrect food handling behaviors, employees must be provided with accurate knowledge and be motivated to apply their knowledge. Moreover, ongoing reinforcement of training programs must be given regularly in the workplace in order to have consistently desired food handling practices (Rennie, 1994). According to Hernandez (2001), by providing food safety training programs to employees, foodservice operations can avoid enormous costs associated with an outbreak of foodborne illness, prevent the loss of reputation and revenue related to an outbreak, increase employee morale and reduce turnover, and increase customer satisfaction.

Penner, Shanklin, and Thomson (1997) stated that managers have the responsibility to train employees when they are first hired. These researchers found that managers and employees needed more food safety training than currently provided. Holdt (1992) examined the effectiveness of a food safety certification course for university foodservice managers in increasing their knowledge and attitudes toward sanitation and found that the training course improved university foodservice managers' knowledge and attitudes toward food safety based on pre- and post-test results.

Cohen, Reichel, and Schwartz (2001) analyzed the impact of an in-house sanitation training program on the performance of a catering company. This study compared the microbiological quality of 774 food samples before, during, and after the training period. There was a significant improvement of food's microbiological quality after the in-house sanitation training program; however, not all departments (preparation, cooking, portioning, bakery, and final product departments) benefited equally from the training program. They

suggested that for an in-house sanitation training program to be fully effective, consideration must be given to the different needs, situations, and environments of each departmental function. Managers of foodservice operations should avoid the one-size-fits-all approach to training.

Lydecker (1991) stated that the challenges of planning a successful food safety training program in foodservice operations included 1) scheduling blocks of time for different shifts, 2) having high turnover rates that caused a constant need for training new employees, and 3) delivering food safety concepts to employees with limited education or those who speak English as a second language. Tips for planning a training program to overcome these challenges included using video as a training tool, providing the training program at different time periods (beginning of employment and after the employee is familiar with working procedures), using "show and tell" techniques, separating training program into short and focused sections, and having posters or manuals to reinforce training.

The goal of food safety training is to fill the gap between what employees are required to know in order to perform their jobs and what they actually know (Hernandez, 2001). There are many methods and tools that can help managers train employees about food safety, such as videotapes, posters, role-playing, classroom training, or Web training. No single delivery method or tool is best for training at all levels or all employees; thus, using several methods of delivery will increase the effectiveness of training (Hernandez, 2001).

Smith and Shillam (2000) examined the effectiveness of using videotapes for food safety training. Two hundred forty foodservice workers from 36 commercial foodservice operations participated in viewing a food safety videotape. In the study, the videotape training sessions significantly improved knowledge of safe food handling practices for the

majority of workers, based on pre- and post-test results. These authors concluded that the education session increased awareness of issues related to prevention of foodborne illnesses.

Costello, Gaddis, Tamplin, and Morris (1997) evaluated two different techniques for teaching food safety principles to employees in quick service restaurants. These researchers compared the typical lecture method and a computer-assisted interactive method in terms of food safety knowledge gained and retained. Findings indicated both methods improved employees' knowledge of food safety and retention. However, the computer-assisted interactive method appeared to be a more efficient method than the lecture method based on flexibility of scheduling, convenience of training space needed, and consistency of information presented.

Summary

The estimated number of foodborne illnesses in the U. S. each year highlights the importance of food safety in the foodservice industry. According to the CDC, the number of school-related outbreaks (kindergarten through college) increased between 1990 and 1999. The reputation and financial success of a foodservice operation can be damaged by one incident of foodborne illness, and at the same time pose potentially life-threatening situations to customers (Holdt, 1992). Research shows that consumers have an increased awareness of and concern for food safety and are willing to pay more for enhanced food safety.

Foodservice operators must be aware that one of the most important elements of ensuring food safety is proper food handling practices. Food handlers can contaminate food by transmitting microorganisms that cause a foodborne illness (NRAEF, 1999). To achieve

the goal of serving safe food, employees must be trained to handle food correctly through out the flow of food.

Effective training has been shown to improve employees' knowledge, attitudes, and practices regarding food safety. However, little research has been conducted to address both student and full-time employees' knowledge, attitudes, practices, and training regarding food safety in university foodservice.

CHAPTER 3. METHODOLOGY

Sample

Iowa State University Dining (ISU Dining) includes Campus Convenience Stores (C-Stores), Campus Cafés, Catering Department, Central Bakery, Food Stores, Hawthorn Market and Café, Hazel's Kitchen, Memorial Union Foodservice Units, Residence Dining, and Vending Service. Residence Dining serves the largest group of customers, resident students.

This study only focused on Residence Dining. Every dining facility had one manager and two assistant managers except Friley Dining Center, which had one manger and three assistant managers. The population in this study included all 547 student employees, 91 full-time employees, and 19 managers working in Residence Dining at Iowa State University at the time of data collection.

In Spring 2003, Residence Dining had six dining centers: Friley, Maple-Willow-Larch, Knapp-Storms, Oak-Elm, Linden, and Wallace-Wilson. Friley Dining Center had 186 student employees and 32 full-time employees, and was the largest dining center on campus serving approximately 2000 meals per day. Maple-Willow-Larch Dining Center had 107 student employees and 18 full-time employees and served approximately 1700 meals per day. Knapp-Storms Dining Center had 90 student employees and 12 full-time employees and served approximately 1600 meals per day. Oak-Elm Dining Center had 88 student employees and 12 full-time employees and served approximately 1500 meals per day. Linden Dining Center had 59 student employees and 10 full-time employees and served

approximately 1000 meals per day. Wallace-Wilson Dining Center had 17 student employees and 7 full-time employees and served approximately 280 meals per day.

Questionnaire Design

Employee's Questionnaire

A 5-part questionnaire was developed to identify student and full-time employees' knowledge, attitudes, practices, and training received from their employment related to food safety (Appendix A). Questionnaires were color coded by dining center to allow for comparisons among different dining centers.

Part one was designed to measure employees' knowledge related to food safety and included 10 multiple-choice questions. These questions were related to general food safety knowledge such as personal hygiene, definition of foodborne illness, time and temperature control, cross contamination, glove use, and sanitizing. Respondents answered these questions by circling the correct statements. Correct answers were coded as 1, incorrect answers as 0. A total food safety knowledge score was calculated by adding all correct answers. The total food safety knowledge scores had a range of 10, from a low of zero to a high of 10. The Cronbach alpha reliability coefficient for the 10 knowledge items was 0.41.

Part two of the questionnaire included 12 questions to determine employees' attitudes toward food safety. A 5-point Likert-type rating scale, ranging from one (1) "strongly disagree" to five (5) "strongly agree", was used. Respondents were asked to indicate their attitudes by circling the appropriate response. "Strongly disagree" was coded as 1, "disagree" as 2, "neutral" as 3, "agree" as 4, and "strongly agree" as 5. A total food safety attitude score was calculated by adding responses to the 12 attitude statements, with total

scores ranging from a low of 12 to a high of 60. The Cronbach alpha reliability coefficient for the 12 attitude items was 0.83.

Part three of the questionnaire consisted of 14 questions measuring employees' on-the-job food safety practices. A 3-point rating scale was used to indicate frequency of food safety practices: always; sometimes; and never. An option of "not applicable" was provided on each practice question. "Not applicable" answers were treated as excluded cases for analyzing each food practice question. "Always" was coded 3, "sometimes" 2, and "never" 1. The Cronbach alpha reliability coefficient for the practice items was 0.72. A total food safety practice score was calculated by summing responses to the 10 questions. Four food safety practice questions: I wash raw produce before using it, I store raw food items in an area separate from cooked food, I check concentrations of sanitizing solutions used for sanitizing work surfaces or items washed in the pot and pan sink, and I store chemicals in a non-food storage room were excluded from the total score due to a high number of "not applicable" responses. The total food safety practice score ranged from a low of 10 to a high of 30.

Part four of the questionnaire was developed to identify food safety topics taught to employees during orientation or on-the-job training. This part consisted of 16 questions, and respondents answered these statements by checking yes or no. "Yes" responses were coded as 1 and "no" responses as 0. The total food safety training score was calculated by adding all yes responses, for a total score ranging from zero to 16. The Cronbach alpha reliability coefficient for the 16 training items was 0.87.

The final section collected demographic characteristics of student and full-time employees. The specific demographic information for student employees included major,

age, gender, position, country of origin, year in school, position, hours worked per week, work area(s) involved with, semesters employed by ISU Dining, foodservice work experience with non-ISU Dining, length of employment with non-ISU Dining, and frequency of food safety training in their current job. The demographic information for full-time employees included gender, age, education, length of employment with ISU Dining, frequency of food safety training in their current job, and food safety certification.

Manager's Questionnaire

A 1-page questionnaire was developed to survey ISU Dining managers to determine food safety topics included in training or orientation provided to student employees and to determine how student employees' performance compared to full-time employees' performance (Appendix B). Managers were asked to indicate whether or not there was training provided for each of 16 food handling practices by checking "yes" or "no". Managers also were asked to compare student and full-time employees' performance for each of 16 food handling practices by checking "better", "same", or "worse".

For the food safety training topics section, "yes" responses were coded as 1 and "no" responses as 0. For comparison between student and full-time employees' performance of each food safety training topic, "better" was coded as 3, "same" as 2, and "worse" as 1.

Human Subjects Approval

The research protocol and questionnaires were approved by the Iowa State University Human Subjects Research Office prior to data collection (Appendix C). Approval of the project also was obtained from the director and assistant director of ISU Dining.

Pilot Test

The questionnaire was pre-tested by 20 Iowa State University undergraduate students who work in foodservice but not ISU Dining. Participants were asked to complete the questionnaire and evaluate it for clarity, content, format, and appropriateness of questions. Three Iowa State University graduate students enrolled in the Research in Foodservice Operations course (HRIM 640x) also were asked to complete the questionnaire and to include concerns and suggestions. All suggestions were considered and used to revise the questionnaire before data collection.

Data Collection

Employees

The questionnaire and a cover letter were distributed to student employees before or after they had clocked out for a shift. The researcher also placed questionnaires under the time clock for student employees who were willing to participate in this study but were unable to be present at the time of distribution. The researcher also placed the questionnaire with a cover letter into full-time employees' mailboxes at the work place. The cover letter explained the purpose of the study and encouraged participation. Employees placed the completed questionnaires in designated sealed boxes in the managers' offices. This procedure ensured anonymity of responses. Participants were told that their responses were anonymous and would be reported as group data. Drawings for two prizes were used to increase employee participation rate.

Managers

The researcher distributed the questionnaire with a cover letter and a return envelope to each manager in the six dining centers. Managers returned completed questionnaires by campus mail. A confidential code number was assigned to each questionnaire for follow-up purposes.

Data Analyses

SPSS version 11.0 for Windows was used for all data analyses. Descriptive statistics including frequencies, means, and standard deviations were calculated for all variables as appropriate. Cronbach's alpha coefficient was used to measure overall reliability of knowledge, attitude, practice, and training items.

Analysis of variance (ANOVA) was used to examine differences in food safety knowledge, attitudes, practices, and training between student and full-time employees. ANOVA also was used to examine differences in employees' food safety knowledge, attitudes, practices, and training among different dining centers. Tukey was used for post hoc multiple comparison among dining centers.

ANOVA assessed the relationship among the full-time and student employees' demographic characteristics (study areas, gender, country, college status, position, and work experience) and the mean total scores for food safety knowledge, attitudes, and practices. Correlations were performed to determine relationships among student employees' demographic characteristics (age, hours worked per week, semesters employed by ISU Dining, length of work experience before ISU Dining, and number of food safety training sessions received) and their food safety knowledge, attitude, and practice scores.

Multiple linear regression was used to test relationships among employees' food safety knowledge, attitudes, practices, training, and demographic variables. Four multiple linear regression models were used.

The first model included employees' food safety knowledge, attitude, and training scores as independent variables and food safety practices score as the dependent variable. The second model included employees' food safety knowledge, attitude, and training scores and demographic variables as independent variables and employees' total food safety practices score as the dependent variable. For student employees, only four demographic variables (age, hours of worked in ISU Dining per week, semesters employed by ISU Dining, and position) were used. These were the only significant demographic variables identified using ANOVA comparison or correlation.

The third model included employees' food safety attitude, practice, and training scores and demographic variables as independent variables and employees' food safety knowledge as the dependent variable. The fourth model included employees' food safety knowledge, practices, training scores, and demographic variables as independent variables and employees' food safety attitudes as the dependent variable. A probability of equal to or less than 0.05 was considered significant.

CHAPTER 4. RESULTS AND DISCUSSION

A total of 275 questionnaires were returned from six ISU Dining facilities for a 42% response rate. Student employees returned 221 questionnaires for a 40% response rate. Thirty-eight questionnaires were completed by full-time employees for a 42% response rate. Sixteen questionnaires were completed by managers for an 84% response rate. The number of responses from each ISU Residence Dining Center is presented in Table 1.

Table 1. Number of Student Employees, Full-Time Employees, and Managers Participating in the Study From Each ISU Residence Dining Center (N = 275)

Dining Centers	Student Employees n (%)	Full-Time Employees n (%)	Managers n (%)
Oak-Elm	68 (77.3%)	11 (91.7%)	3 (100.0%)
Linden	30 (50.8%)	6 (60.0%)	3 (100.0%)
Maple-Willow-Larch	50 (46.7%)	6 (33.3%)	3 (100.0%)
Knapp-Storms	39 (43.3%)	6 (50.0%)	3 (100.0%)
Friley	32 (17.2%)	5 (15.6%)	2 (50.0%)
Wallace-Wilson	2 (11.8%)	4 (57.1%)	2 (66.7%)
Total	221 (40.4%)	38 (41.8%)	16 (84.2%)

Characteristics of Student Employees

Demographic characteristics of all student employees responding to the questionnaire compared to the Iowa State University (ISU) undergraduate student population are presented in Table 2. The age, country, and college of students in the study sample were similar to the population of ISU undergraduate students. Compared to the population, the study sample had a higher proportion of females and more students at the freshman and sophomore levels. Of the 221 student employees in this study, nearly one-half (47.5%) were 18 to 19 years. The mean age of student employees was 20 ± 1.6 years. About 61% of respondents were female. Approximately two-thirds (67.9%) of student employees were in the freshman or sophomore year of study. Nearly one-third (32.1%) of student employees majored in liberal arts and sciences.

The U. S. was the country of origin for 93.7% of the respondents; however, this high percentage was not representative because of the low response rate from Friley Dining Center. Friley Dining Center hired the most international students (approximately 35% of Friley student employees were international students) of the six dining centers yet only 17.2% of students responded. Another reason why 93.7% of respondents were from the U.S. may be due to language barriers of international students that made them unwilling to participate in this study.

Work characteristics of all student employees responding to the questionnaire are presented in Table 3. Thirty-three (14.9%) student employees were in student supervisor or leader positions. The total number of student supervisors or leaders at ISU Dining Centers was 53. Nearly 65% of students worked between 10 to 15 hours per week. Approximately 61% of the student employees identified experience working in food preparation areas, 86%

Table 2. Demographic Characteristics of Student Employees (N = 221) in Sample Compared to the ISU Undergraduate Student Population (N = 22,999)[a]

Characteristic	Student Sample n (%)	ISU Students n (%)
Age (years)		
18-19	105 (47.5%)	7,602 (33.1%)
20-21	81 (36.7%)	8,586 (37.3%)
22-23	27 (12.2%)	4,364 (19.0%)
24-28	6 (2.7%)	1,416 (6.2%)
Gender		
Female	135 (61.1%)	10,179 (44.3%)
Male	86 (38.9%)	12,820 (55.7%)
Country		
United States	207 (93.7%)	21,946 (95.4%)
International	14 (6.3%)	1,053 (4.6%)
College status		
Freshman	85 (38.5%)	5,762 (25.1%)
Sophomore	65 (29.4%)	4,993 (21.7%)
Junior	39 (17.6%)	5,087 (22.1%)
Senior	32 (14.5%)	6,710 (29.2%)
College major		
Liberal arts and sciences	71 (32.1%)	6,712 (29.2%)
Engineering	38 (17.2%)	4,963 (21.6%)
Business	32 (14.5%)	3,729 (16.2%)
Education	17 (7.7%)	1,948 (8.5%)
Design	15 (6.8%)	1,814 (7.9%)
Family and consumer sciences	15 (6.8%)	1,209 (5.3%)[b]
Agriculture	9 (4.1%)	2,624 (11.4%)
Undecided	6 (2.7%)	
Food science and human nutrition	5 (2.3%)	
Hotel, restaurant, and institution management	5 (2.3%)	

Note. Percentages may not total 100% due to non-response to a question.

[a] ISU undergraduate student population for Fall 2002.

[b] Data included food science and human nutrition and hotel, restaurant, and institution management majors.

Table 3. Work Characteristics of Student Employees (N = 221)

Characteristic	n (%)
Position	
Student employee	188 (85.1%)
Student supervisor/leader	33 (14.9%)
Hours worked	
<10 hrs/wk	11 (5.0%)
10-15 hrs/wk	144 (65.2%)
16-20 hrs/wk	61 (27.6%)
Areas worked	
Food preparation	
Yes	134 (60.6%)
No	87 (39.4%)
Service	
Yes	191 (86.4%)
No	30 (13.6%)
Dishroom or pots and pans	
Yes	174 (78.7%)
No	47 (21.3%)
Facility clean-up	
Yes	121 (54.8%)
No	100 (45.2%)
Nonfood contact (office, checker, or laundry)	
Yes	117 (52.9%)
No	104 (47.1%)
Semesters employed by ISU Dining	
1-2	144 (65.2%)
3-4	38 (17.2%)
5-6	24 (10.9%)
>6	13 (5.9%)

Table 3. (Continued)

Characteristic	n (%)
Previous work experience in foodservice	
Yes	112 (50.7%)
No	109 (49.3%)
Years of work experience in foodservice	
<1	36 (32.1%)
1-2	26 (23.2%)
2-3	21 (18.8%)
3-4	17 (15.2%)
>4	12 (10.7%)
Number of on-the-job food safety training received	
0	30 (13.6%)
1-2	117 (52.9%)
3-4	40 (18.1%)
5-6	8 (3.6%)
>6	1 (0.5%)

Note. Percentages may not total 100% due to non-response to a question.

in service areas, 79% in dishroom or pots and pans areas, and 53% in nonfood contact areas (office, checker, or laundry). Most student employees (98.6%) worked in more than one area. Approximately two-thirds (65.2%) of the student employees had worked for ISU Dining for one or two semesters. Student employees were asked if they had work experience in foodservice besides ISU Dining; results showed that approximately half (50.7%) of student employees had foodservice work experience outside of ISU Dining. Students who had work experience were asked the length of their work experience. About one-third (32.1%) of students had less than one year of work experience and 10.7% of student employees had more than four years experience. More than half (52.9%) indicated that they received on-the-job training about food safety one or two times and 13.6% of student employees indicated that they did not receive any food safety training.

Characteristics of Full-Time Employees

Characteristics of full-time employees are presented in Table 4. The majority of full-time employees (89.5%) were female. Hsu and Huang (1995) also reported that more than 70% of university foodservice non-managerial workers were female. The 31 to 50 age group had the highest frequency at 40.5%, followed by 32.4% between 51 to 65 years of age. Only one full-time employee (2.6%) had earned a bachelor's degree, 42.1% attended some college, and 39.5% had a high school degree. Forty-seven percent of respondents worked less than five years for ISU Dining. More than two-thirds (71.1%) of full-time employees reported that they had food safety certification. Half of full-time employees indicated that they had received food safety training in their current jobs one to three times.

Table 4. Demographic Characteristics of Full-Time Employees (N = 38)

Characteristic	n (%)
Gender	
Female	34 (89.5%)
Male	4 (10.5%)
Age (years)	
<30	9 (23.7%)
31-50	15 (39.5%)
51-65	12 (31.6%)
>65	1 (2.6%)
Education level	
High school	15 (39.5%)
Some college	16 (42.1%)
Bachelor's degree	1 (2.6%)
Years worked in ISU Dining	
≤5	18 (47.4%)
6-15	12 (31.6%)
16-25	6 (15.8%)
≤26	1 (2.6%)
Number of food safety training sessions received	
1-3	19 (50.0%)
4-6	5 (13.2%)
7-9	1 (2.6%)
10-12	4 (10.5%)
>12	3 (7.9%)
Food safety certification	
Yes	27 (71.1%)
No	5 (13.2%)

Note. Percentages may not total 100% due to non-response to a question.

Knowledge Related to Food Safety

Food safety knowledge questions were grouped into six categories: personal hygiene, foodborne illnesses, time and temperature control, cross contamination, glove use, and sanitizing. The frequency of correct responses for each food safety knowledge item for student and full-time employees is presented in Table 5.

Both student and full-time employees had a high number of correct responses when asked about the definition of foodborne illness (95.9% and 100%), cross contamination (94.1% and 97.4%), glove use (95.5% and 100%), and one of the questions about personal hygiene: "After washing their hands, employees should avoid touching their hair" (96.4% and 89.5%).

Approximately half (52.9%) of the student and one-third (29.9%) of full-time employees selected glove use over frequent handwashing when asked about the most important rule for personal hygiene; student employees had lower scores ($p \leq 0.001$) than full-time employees on this question. When asked about the temperature danger zone for potentially hazardous foods, there was a difference ($p \leq 0.001$) between student employees and full-time employees. About half (48.4%) of student employees answered the temperature danger zone question correctly while 78.9% of full-time employees answered it correctly. Full-time employees had higher ($p \leq 0.01$) scores than student employees on time and temperature control questions: "The most important factors to control the growth of bacteria are time and temperature" (94.7% and 70.1%, respectively), and "When holding hot foods for service, it is required that internal food temperatures be taken at least every two hours" (84.2% and 51.6%, respectively).

Only 39.4% of student employees correctly answered the question about an

Table 5. Comparison of the Number of Correct Responses for Each Food Safety Knowledge Item for Student (N = 221) and Full-Time (N = 38) Employees

Knowledge Items	Student		Full-Time		Sig.
	n	%	n	%	
Personal hygiene					
After washing their hands, employees should avoid touching their hair.	213	96.4%	34	89.5%	0.153
The most important rule of foodservice personal hygiene is that employees must wash their hands often.	104	47.1%	27	71.1%	0.001***
Definition of foodborne illness					
Foodborne illnesses are diseases that are carried or transmitted to people by food.	212	95.9%	38	100%	0.266
Time and temperature control					
The most important factors to control the growth of bacteria are temperature and time.	155	70.1%	36	94.7%	0.002**
When holding hot foods for service, it is required that internal food temperatures be taken at least every two hours.	114	51.6%	32	84.2%	0.000***
The temperature danger zone for potentially hazardous foods is 41° to 140°F.	107	48.4%	30	78.9%	0.000***
Under running water that is 70°F or less is an acceptable method for thawing frozen food.	87	39.4%	33	86.8%	0.000***
Cross contamination					
Cross contamination is the transfer of harmful substances or micro-organisms to food from food or from a nonfood-contact surface, such as equipment, utensils, or hands.	208	94.1%	37	97.4%	0.47

Table 5. (Continued)

Knowledge Items	Student		Full-Time		Sig.
	n	%	n	%	
Glove use					
Rita wore disposable gloves while she formed raw ground beef into patties. After she was finished, she wore the same gloves to slice smoked turkey breast for sandwich. What mistake did Rita make? She failed to change her gloves and wash her hands after handling raw meat and before handling a ready-to-eat food item	211	95.5%	38	100%	0.21
Sanitizing					
When iodine solutions (such as Mikroklene) are used for sanitizing, the item must be immersed in the solution for 30 seconds.	96	43.4%	16	42.1%	0.85

** $p \leq 0.01$
*** $p \leq 0.001$

appropriate method for thawing "Under running water that is 70°F or less is acceptable method for thawing frozen food", which was lower ($p \leq 0.001$) than the percent of full- time employees who answered the question correctly. Less than half of student employees and full-time employees (43.4% and 42.1%, respectively) responded to the sanitizing question correctly. These results were consistent with the results of Sneed, Strohbehn, and Gilmore (in press) and Henroid and Sneed (in press). These researchers found that foodservice employees were least knowledgeable of sanitizer concentration and cooling and thawing practices. However, in this study some ISU Dining Centers used warewashing machines for washing, cleaning, and sanitizing items, therefore, employees may not be required to know about concentration of sanitizing solutions.

The frequency of responses for each food safety knowledge item for student employees is presented in Table 6. About half (50.7%) of student employees believed that wearing gloves is more important than washing hands often. Fifty student employees out of 219 choose moisture and oxygen as the most important factors to control the growth of bacteria. Approximately one-third (33.5%) of student employees thought a temperature of 120°F must be maintained when holding hot food for service. For the questions related to temperature danger zone, proper method of thawing frozen food, and required time for a clean item to immerse in an iodine sanitizing solution, most student employees had incorrect knowledge. Managers at ISU Dining should emphasize these points when training student employees who are involved in these tasks.

Table 6. Frequency of Responses for Each Food Safety Knowledge Item for Student Employees (N = 221)

Knowledge Items	Students	
	n	%
Personal hygiene		
After washing their hands, employees should avoid:		
A. putting on gloves.	4	1.8%
B. talking to other co-workers.	0	0%
C. touching their hair.	213	96.4%
D. turning off the faucet with the paper towel used for drying hands.	3	1.4%
The most important rule of foodservice personal hygiene is that employees must:		
A. wear gloves at all times.	53	24.7%
B. use gloves for preparing all food items.	56	26.0%
C. wash their hands often.	104	48.4%
D. sanitize hands at end of each shift.	2	0.9%
Definition of foodborne illness		
Foodborne illnesses are diseases that are:		
A. carried or transmitted to people by food.	212	95.9%
B. caused by eating with people who are ill.	1	0.5%
C. cured by proper eating habits.	2	0.9%
D. transmitted to kitchen employees only.	4	1.8%
Time and temperature control		
The most important factors to control the growth of bacteria are:		
A. oxygen and acidity.	8	3.6%
B. moisture and oxygen.	50	22.6%
C. acidity and moisture.	6	2.7%
D. temperature and time.	155	70.1%
When holding hot foods for service:		
A. it is acceptable to use hot-holding equipment to reheat hot foods when needed.	28	12.7%
B. it is required that internal food temperatures be taken at least every two hours.	114	51.6%
C. a temperature of 120°F must be maintained.	74	33.5%
D. there is no needed to measure internal food temperature.	2	0.9%

Table 6. (Continued)

Knowledge Items	Students n	Students %
The temperature danger zone for potentially hazardous foods is:		
A. 25° to 75°F.	49	22.2%
B. 85° to 160°F.	21	9.5%
C. 72° to 110°F.	43	19.5%
D. 41° to 140°F.	107	48.4%
Which of the following methods for thawing frozen food is acceptable?		
A. In the rinse section of the 3-compartment sink in warm water	30	13.6%
B. In the sink under hot (100°F) running water	49	22.2%
C. Under running water that is 70°F or less	87	39.4%
D. On the counter until food is partially thawed, then cook it immediately	54	24.4%
Cross contamination		
Cross contamination is the:		
A. cleaning method most often used to clean food-contact surfaces that have been contaminated.	5	2.3%
B. transfer of harmful substances or micro-organisms to food from food or from a nonfood-contact surface, such as equipment, utensils, or hands.	208	94.1%
C. removal of certain bacteria from food by cooking it thoroughly.	5	2.3%
D. prevention of foodborne illnesses.	2	0.9%
Glove use		
Rita wore disposable gloves while she formed raw ground beef into patties. After she was finished, she wore the same gloves to slice smoked turkey breast for sandwich. What mistake did Rita make?		
A. She failed to change her gloves and wash her hands after handling raw meat and before handling a ready-to-eat food item.	211	95.9%
B. She failed to wash her hands before wearing the same gloves to slice the turkey breast.	2	0.9%
C. She failed to wash and sanitize her gloves before handling the turkey breast.	5	2.3%
D. She failed to wear reusable gloves.	2	0.9%
Sanitizing		
When iodine solutions (such as Mikroklene) are used for sanitizing, how long must the item be immersed in the solution?		
A. 7 seconds	28	12.7%
B. 30 seconds	96	43.4%
C. 1 minute	58	26.2%
D. 2 minute	36	16.3%

Note. Percentages may not total 100% due to non-response to a question.

Attitudes Related to Food Safety

Table 7 shows the means and standard deviations for responses to attitudinal statements from student and full-time employees. For the 12 attitudinal statements, there were 11 statements for which student employees had lower scores ($p \leq 0.05$) than full-time employees. Responses to one statement, "I believe that good employee hygiene can prevent foodborne illness" was the same for both groups.

Practices Related to Food Safety

Analysis of variance (ANOVA) was performed to compare student and full-time employees self-reported practices related to food safety (Table 8). Full-time employees had higher scores than student employees on 8 of 14 practice statements ($p \leq 0.05$).

Both student and full-time employees had the lowest frequency of practice on checking concentrations of sanitizing solutions (2.1 and 2.5, respectively). This finding was similar to results of studies by Sneed, Strohbehn, and Gilmore (in press) and Henroid and Sneed (in press). These researchers observed sanitizer concentrations were not checked and recorded regularly by employees in assisted-living facilities and school foodservice operations.

Table 7. Comparison of Mean Food Safety Attitude Scores of Student (N = 221) and Full-Time (N = 38) Employees

Attitude Items	Student		Full-Time		F	Sig.
	Mean[a]	SD	Mean[a]	SD		
I think sanitation is an important part of my job responsibilities.	4.6	0.7	4.8	0.4	5.6	0.019*
I believe that good employee hygiene can prevent foodborne illness.	4.4	0.7	4.6	0.6	1.8	0.187
I think that it is the responsibility of all food handlers to ensure that food is safe to serve.	4.4	0.6	4.8	0.4	16.5	0.000***
I am willing to change my food handling behaviors when I know they are incorrect.	4.3	0.7	4.7	0.5	10.4	0.001***
I am willing to obtain more food safety knowledge.	4.0	0.7	4.6	0.6	20.7	0.000***
It is more important to have tasty food rather than safe food. [b]	4.0	0.9	4.7	0.6	22.7	0.000***
I select a place to eat based on its reputation for good sanitation and cleanliness.	3.9	0.8	4.4	0.6	16.3	0.000***
I think that managers should educate employees on personal hygiene and sanitation regularly.	3.9	0.9	4.3	0.7	10.4	0.001***
I think that only full-time employees should receive food safety training. [b]	3.7	1.1	4.5	0.7	19.6	0.000***
I believe that food safety knowledge not only benefits my work but also my personal life.	3.7	0.9	4.4	0.7	21.6	0.000***
I am willing to attend a food safety training course.	3.5	1.0	4.4	0.8	26.3	0.000***
I believe that food safety knowledge would make me more confident about my work.	3.5	0.9	4.2	0.7	20.8	0.000***

[a] The scale for item scores ranged from strongly disagree (1) to strongly agree (5).
[b] Item was reverse scored.
* $p \leq 0.05$
*** $p \leq 0.001$

Table 8. Comparison of Mean Food Safety Practice Scores of Student (N = 221) and Full-Time (N = 38) Employees

Practice Items	Student		Full-Time		F	Sig.
	Mean[a]	SD	Mean[a]	SD		
I use gloves or utensils to handle food that is ready-to-eat.	2.9	0.4	3.0	0.2	0.3	0.559
I use a separate clean utensil for each food item.	2.8	0.6	3.0	0.2	4.0	0.047*
I wash my hands vigorously with soap and water before working with food.	2.8	0.5	3.0	0.2	6.1	0.014*
I wash raw produce before using it.	2.8	0.5	2.9	0.4	1.1	0.302
I store chemicals in a non-food storage room.	2.8	0.5	2.8	0.6	0.0	0.877
I store raw food items in an area separate from cooked food.	2.8	0.4	2.9	0.2	2.7	0.106
I wear a clean uniform, when I work in foodservice.	2.7	0.5	3.0	0.0	12.0	0.001***
I wear a hair restraint (cap or hairnet), when I work in foodservice.	2.6	0.5	3.0	0.2	14.9	0.000***
I wash my hands and change into a new pair of gloves after touching anything that may contaminate my hands, when I prepare or serve food.	2.6	0.7	3.0	0.2	8.8	0.003**
I drink or eat food while I am serving or preparing food.[b]	2.5	0.6	2.7	0.5	0.1	0.829
I clean and sanitize work surfaces after each task.	2.5	0.7	2.7	0.5	1.6	0.204
When I am in doubt about the safety of a previously cooked food, I report it to the supervisor.	2.2	1.0	2.9	0.3	15.0	0.000***
I pay attention to expiration dates on foods and do not use foods that have passed the expiration date.	2.2	1.2	2.9	0.3	13.2	0.000***
I check concentrations of sanitizing solutions used for sanitizing work surfaces or items washed in the pot and pan sink.	2.1	0.8	2.5	0.6	5.7	0.018*

[a] The scale for responses was never (1), sometimes (2), and always (3).
[b] Item was reverse scored.
* $p \leq 0.05$
** $p \leq 0.01$
*** $p \leq 0.001$

Training Components Related to Food Safety

Student and full-time employees were asked to indicate what food safety components had been included in training that they have received while employed at ISU Dining. Managers also were asked to indicate what food safety components were included in training given to student employees. Table 9 shows the frequencies and comparison of food safety components included in training from student and full-time employees' perspectives.

All full-time employees reported that they had received the food safety component "Preventing cross contamination"; however, only 61% of student employees indicated that they have received it. The majority (92.1%) of full-time employees also reported that they had received information about "Temperature danger zone where microorganisms can grow rapidly", but only about half (52.1%) of student employees reported they had received it.

Among 16 food safety topics, there was only one component "Procedures for cleaning and sanitizing glassware, silverware, and dishes" on which full-time employees had a lower percentage than student employees. This result perhaps reflected the high number of student employees assigned to dishroom duties compared to a very small number of full-time employees. Full-time employees reported more training on 11 of 16 food safety topics ($p \leq 0.05$) than student employees.

Table 9. Comparison of Food Safety Training Provided to Student (N = 221) and Full-Time (N = 38) Employees

	Student		Full-time			
Training Components	**n**	**%**	**n**	**%**	**F**	**Sig.**
Proper work attire (e.g. hair restraint, uniform)	214	97.7%	38	100%	0.9	0.349
Use of gloves	207	95.0%	38	100%	2.0	0.158
General personal cleanliness	192	88.9%	37	97.4%	2.6	0.106
Procedures for cleaning and sanitizing glassware, silverware, and dishes	190	86.8%	28	75.7%	3.1	0.080
Proper handwashing	188	86.2%	37	97.4%	3.8	0.053
Reporting illness and injury	185	84.5%	37	97.4%	4.6	0.032*
Policies regarding eating and drinking in work area	178	81.3%	36	94.7%	4.2	0.040*
Procedures for cleaning and sanitizing utensils, equipments, and food contact surfaces	177	80.8%	37	97.4%	6.5	0.012*
Hand maintenance (e.g. short fingernails, no nail polish)	175	80.3%	38	100%	9.3	0.003**
Safe serving procedures	168	76.7%	36	94.7%	6.5	0.011*
Use of thermometers and taking temperatures of food	163	74.4%	36	94.7%	7.8	0.006**
Types of chemicals used in the dining center and how to safely store and use	157	71.7%	35	92.1%	7.3	0.007**
The relationship between personal hygiene and the spread of disease	155	70.8%	37	97.4%	12.6	0.000***
Holding foods for service	154	70.6%	36	94.7%	10.13	0.002**
Preventing cross contamination	133	60.7%	38	100%	24.38	0.000***
Temperature danger zone where microorganisms can grow rapidly	113	52.1%	35	92.1%	23.03	0.000***

* $p \leq 0.05$
** $p \leq 0.01$
*** $p \leq 0.001$

Table 10 presents the frequencies and comparison of food safety components that were included in training from student employees' and managers' perspectives. Student employees and managers had one difference ($p \leq 0.05$) on the component "Preventing cross contamination" among sixteen food safety topics. Only 60.7% of student employees reported that they have received training about preventing cross contamination. However, most managers (86.7%) believed that information about preventing cross contamination was provided to student employees. Both student employees and managers had the lowest percentages (52.1% and 50%, respectively) for "Temperature danger zone where microorganisms can grow rapidly". In addition, about 13.2% of student employees reported that they did not receive training on proper handwashing procedures. These results indicated that the areas of cross contamination, temperature danger zone, and proper handwashing need to improve when training student employees.

Student Employees' Performance Related to Food Safety

Managers were asked to compare student employees' performance related to food safety practices as a group to full-time employees as a group. Table 11 presents results of that comparison. The majority of managers indicated that student employees had lower or the same performance as full-time employees on most food safety practices. Particularly, more than 80% of managers believed that student employees performed worse on "Proper work attire (e.g. hair restraint, uniform)" (81.3%) and "Preventing cross contamination" (81.3%) than full-time employees.

Table 10. Comparison of Food Safety Training Provided from the Perspective of Student Employees (N = 221) and ISU Dining Managers (N = 16)

	Student		Manager			
Training Components	**n**	**%**	**n**	**%**	**F**	**Sig.**
Proper work attire (e.g. hair restraint, uniform)	214	97.7%	16	100%	0.37	0.543
Use of gloves	207	95.0%	16	100%	0.84	0.360
General personal cleanliness	192	88.9%	14	87.5%	0.03	0.866
Procedures for cleaning and sanitizing glassware, silverware, and dishes	190	86.8%	15	93.8%	0.65	0.420
Proper handwashing	188	86.2%	15	93.8%	0.73	0.394
Reporting illness and injury	185	84.5%	14	87.5%	0.10	0.747
Policies regarding eating and drinking in work area	178	81.3%	16	100%	3.65	0.057
Procedures for cleaning and sanitizing utensils, equipments, and food contact surfaces	177	80.8%	16	100%	3.76	0.054
Hand maintenance (e.g. short fingernails, no nail polish)	175	80.3%	15	93.8%	1.77	0.185
Safe serving procedures	168	76.7%	14	87.5%	0.99	0.321
Use of thermometers and taking temperatures of food	163	74.4%	14	87.5%	1.37	0.244
Types of chemicals used in the dining center and how to safely store and use	157	71.7%	12	75.5%	0.08	0.777
The relationship between personal hygiene and the spread of disease	155	70.8%	12	75.0%	0.13	0.720
Holding foods for service	154	70.6%	11	68.8%	0.03	0.873
Preventing cross contamination	133	60.7%	13	86.7%	4.06	0.045*
Temperature danger zone where microorganisms can grow rapidly	113	52.1%	8	50.0%	0.05	0.873

* $p \leq 0.05$

Table 11. Managers' Comparison of Student and Full-Time Employees' Performance Related to Food Safety Practices (N = 16)

	Worse		Same		Better	
Food Safety Practices	**n**	**%**	**n**	**%**	**n**	**%**
Proper work attire (e.g. hair restraint, uniform)	13	81.3%	3	18.8%	0	0%
Preventing cross contamination	13	81.3%	1	6.3%	1	6.3%
Hand maintenance (e.g. short fingernails, no nail polish)	12	75.0%	3	18.8%	1	6.3%
Policies regarding eating and drinking in work area	11	68.8%	5	31.3%	0	0%
Temperature danger zone where microorganisms can grow rapidly	11	68.8%	4	25.0%	1	6.3%
Proper handwashing	9	56.3%	6	37.5%	1	6.3%
Safe serving procedures	9	56.3%	6	37.5%	1	6.3%
Holding foods for service	8	50.0%	7	43.8%	1	6.3%
Procedures for cleaning and sanitizing utensils, equipments, and food contact surfaces	6	37.5%	9	56.3%	1	6.3%
Use of thermometers and taking temperatures of food	6	37.5%	9	56.3%	1	6.3%
The relationship between personal hygiene and the spread of disease	5	31.3%	10	62.5%	1	6.3%
Types of chemicals used in the dining center and how to safely store and use	5	31.3%	10	62.5%	1	6.3%
Procedures for cleaning and sanitizing glassware, silverware, and dishes	3	18.8%	12	75%	1	6.3%
General personal cleanliness	2	12.5%	13	81.3%	1	6.3%
Reporting illness and injury	2	12.5%	11	68.8%	3	18.8%
Use of gloves	1	6.3%	12	75.0%	3	18.8%

Note. Percentage may not total 100% due to non-response to a question.

Food Safety Knowledge, Attitudes, Practices, and Training by Employee Status and Dining Centers

Analysis of variance (ANOVA) was performed to compare mean total food safety knowledge, attitude, practice, and training scores of student and full-time employees (Table 12). Full-time employees had higher ($p \leq 0.001$) mean total scores for food safety knowledge, attitudes, practices, and training than student employees. In this study full-time employees had higher food safety knowledge, attitude, and practice scores than at least one published study. Hsu and Huang (1995) reported that university foodservice workers had a mean sanitation knowledge score of 7.8 out of 10 (78%), attitude score of 68.8 out of 80 (86%), and behavior score of 124.6 out of 150 (83%). Sneed, Strohbehn, and Gilmore (in press) and Henroid and Sneed (in press) also reported that employees in assisted-living facilities and school foodservice operations had high knowledge of food safety and positive attitudes toward food safety. Wie and Strohbehn (1997) found that hospitality students had a mean attitude toward sanitation and food safety score of 4.1 out of 5.0 before taking a sanitation food safety course and 4.3 out of 5.0 after taking the course.

Table 12. Comparison of Mean Total Food Safety Knowledge, Attitude, Practice, and Training Scores of Student (N = 221) and Full-Time (N = 38) Employees

	Scores							
	Knowledge[a]		Attitude[b]		Practice[c]		Training[d]	
Employee Status	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Full-time employees	8.5	1.1	54.0	4.8	28.8	1.1	15.2	2.0
Student employees	6.9***	1.5	47.7***	5.6	25.8***	3.5	12.6***	3.6

*** $p \leq 0.001$
[a] Total possible knowledge score = 10
[b] Total possible attitude score = 60
[c] Total possible practice score = 30
[d] Total possible training component score = 16

Mean total scores for food safety knowledge, attitudes, practices, and training of student employees in five dining centers are presented in Table 13. ANOVA was used to compare student and full-time employees' mean total food safety knowledge, attitude, practice, and training scores based on dining centers. Wallace-Wilson Dining Center was excluded due to the small sample size (only two student employees responded). This model was significant. Food safety attitudes and training component scores of student employees were different ($p \leq 0.05$) among the five dining centers.

Post hoc multiple comparisons showed that student employees at Oak-Elm Dining Center had higher ($p \leq 0.05$) mean food safety attitude score compared to student employees in Knapp-Storms Dining Center. In addition, student employees at Maple-Willow-Larch Dining Center had a higher ($p \leq 0.05$) food safety training score than student employees in Oak-Elm and Knapp-Storms Dining Centers.

Full-time employees' mean total knowledge, attitudes, practices, and training component scores in each dining service center also were compared (Table 13). Results showed no significant difference among six dining centers on full-time employees' food safety knowledge, attitudes, practices, and training component mean total scores.

Table 13. Comparison of Mean Total Scores of Food Safety Knowledge, Attitude, Practice, and Training of Student (N = 219) and Full-Time (N = 38) Employees in ISU Dining Centers

	Scores*							
	Knowledge[a]		Attitude[b]		Practice[c]		Training[d]	
Dining Center	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Student Employees								
Friley	7.3	1.5	47.4^{AB}	4.8	25.8	4.8	12.5^{AB}	3.7
Linden	7.1	1.7	48.0^{AB}	5.3	25.8	3.4	13.1^{AB}	3.4
Maple-Willow-Larch	6.9	1.4	47.8^{AB}	6.2	26.5	3.0	14.2^{A}	2.2
Oak-Elm	6.6	1.4	49.0^{A}	5.1	25.5	3.2	11.6^{B}	4.0
Knapp-Storms	6.6	1.6	45.4^{B}	5.9	25.7	3.3	11.9^{B}	3.9
Full-Time Employees								
Maple-Willow-Larch	9.0	0.9	53.5	5.1	28.8	0.8	15.2	0.3
Wallace-Wilson	8.8	0.5	54.5	2.6	29.3	1.0	15.5	0.6
Linden	8.7	0.8	55.2	3.9	29.5	0.5	15.5	0.8
Friley	8.4	0.5	54.2	5.8	28.2	1.3	15.6	0.5
Oak-Elm	8.4	1.5	53.3	5.9	28.5	1.4	14.9	3.3
Knapp-Storms	7.7	1.2	54.0	5.0	29.0	1.3	15.2	2.0

*Mean scores in a column with different letters are different at 0.05 level.
[a] Total possible knowledge score = 10
[b] Total possible attitude score = 60
[c] Total possible practice score = 30
[d] Total possible training component score = 16

Impact of Student Employees' Demographic Characteristics on Food Safety Knowledge, Attitudes, and Practices

Correlations were performed for the mean total food safety knowledge, attitude, and practice scores and demographic characteristics (age, hours worked/per week, semesters employed by ISU Dining, length of work experience before ISU Dining, and number of food safety training sessions received) of student employees (Table 14). As student employees' age increased, food safety attitude and practice scores increased ($r = .168$; $P < .013$ and $r = .152$; $P < .025$). When hours worked increased, practice scores increased ($r = .136$; $P < .046$). Also, as semesters employed by ISU Dining increased, knowledge and practice scores increased ($r = .163$; $P < .016$ and $r = .154$; $P < .022$). Cushman, Shanklin, and Niehoff (2001) found a negative correlation between personal hygiene practices and length of employment in the facility of the organization. In their study, as length of employment in the facility increased, personal hygiene practices of part-time student employees decreased.

No significant relationships were found for the length of work experience before working in ISU Dining and the number of food safety training sessions received at ISU Dining with mean total food safety knowledge, attitude, and practice scores of student employees. When student employees' knowledge and attitude scores increased ($r = .146$; $P < .031$ and $r = .440$; $P < .000$), practice scores increased.

Table 14. Correlations of Mean Total Food Safety Knowledge, Attitude, and Practice Scores and Demographic Characteristics of Student Employees (N = 221)

	1.	2.	3.	4.	5.	6.	7.	8.
1. Food safety knowledge	—							
2. Food safety attitude	.115	—						
3. Food safety practice	.146*	.440**	—					
4. Age	.005	.168*	.152*	—				
5. Hours worked/ per week	.053	.042	.136*	.276**	—			
6. Semesters employed by ISU Dining	.163*	.052	.154*	.604**	.368**	—		
7. Length of work experience before ISU Dining	.061	.116	.175	.279**	.088	.070	—	
8. Training received	.126	.085	.127	.154*	.169*	.248**	.092	—

* $p \leq 0.05$
* *$p \leq 0.01$

ANOVA was performed to assess the relationship among the student employees' demographic characteristics (study areas, gender, country, college status, position, and work experience) and mean total scores for food safety knowledge, attitudes, and practices. Results showed that student employees' study areas, gender, country, college status, and work experience did not affect food safety knowledge, attitudes, and practices (Tables 15). These results were inconsistent with the results of Cushman, Shanklin, and Niehoff (2001) and Unklesbay, Sneed, and Toma (1998). Cushman, Shanklin, and Niehoff (2001) found that part-time female student employees in university foodservice had higher scores in personal hygiene practices than males. Unklesbay, Sneed, and Toma (1998) found that college students' demographic characteristics (study areas, gender, college status) influenced their food safety knowledge, attitudes, and practices.

Significant differences were found between students who worked as regular student employees and those who worked as student supervisors or leaders. Results showed student supervisors or leaders had higher ($p \leq 0.05$) attitude and practice scores than did regular students.

Table 15. Comparison of Mean Total Scores of Food Safety Knowledge, Attitudes, and Practices of Student Employees Based on Demographic Characteristics (Study Areas, Gender, Country, College Status, Position, and Work Experience) (N = 221)

	Scores					
	Knowledge[a]		Attitude [b]		Practice [c]	
Characteristics	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Study areas						
Hotel, restaurant, and institution management	8.4	1.3	53.6	2.9	26.0	5.8
Design	7.5	1.5	47.2	5.8	25.1	3.2
Food science and human nutrition	7.2	1.9	48.0	9.8	24.8	6.6
Liberal arts and science	7.1	1.4	46.2	5.3	25.5	3.2
Business	6.7	1.5	48.0	6.2	26.9	2.4
Family and consumer science	6.7	1.5	47.9	4.9	27.3	2.3
Education	6.7	1.5	48.5	5.8	25.8	2.5
Agriculture	6.4	2.2	50.1	6.4	26.6	3.9
Engineering	6.3	1.5	47.3	4.6	25.0	4.3
Undecided	6.2	1.2	49.5	7.1	24.5	4.8
Gender						
Female	6.9	1.5	48.1	5.2	26.1	3.3
Male	6.8	1.6	47.0	6.2	25.4	3.7
Country						
United States	6.9	1.5	47.6	5.6	25.8	3.4
International	6.1	1.5	48.4	6.6	25.7	4.5

Table 15. (Continued)

	Scores					
	Knowledge[a]		Attitude [b]		Practice [c]	
Characteristics	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
College status						
Freshman	6.8	1.5	47.3	5.3	25.4	3.7
Sophomore	7.1	1.5	47.0	6.1	26.0	3.1
Junior	6.4	1.6	48.2	5.1	25.8	3.5
Senior	7.1	1.6	49.5	5.7	26.7	3.5
Position						
Regular student employee	6.8	1.5	47.4*	5.7	25.6*	3.6
Student supervisor	7.3	1.5	49.5*	4.8	27.2*	2.2
Work experience						
Yes	6.9	1.5	47.8	6.0	25.8	3.4
No	6.8	1.5	47.6	5.3	25.8	3.5

* $p \leq 0.05$
** $p \leq 0.01$
[a] Total possible knowledge score = 10
[b] Total possible attitude score = 60
[c] Total possible practice score = 30

Impact of Full-Time Employees' Demographic Characteristics on Food Safety Knowledge, Attitudes, and Practices

ANOVA was performed to assess relationships among demographic variables and food safety knowledge, attitudes, and practice scores of full-time employees. Independent variables included gender, age, education level, years worked in ISU Dining, training received from current job, and food safety certification. The dependent variables were food safety knowledge, attitude, and practice scores. Results of food safety knowledge, attitudes, and practices by full-time employees' demographic characteristics are presented in Table 16.

Full-time employees' food safety knowledge and attitudes were related ($p \leq 0.05$) only to food safety certification. Full-time employees with food safety certification had higher knowledge and attitude scores than full-time employees without food safety certification. Hsu and Huang (1995) also reported that university foodservice employees who attended sanitation training programs had more positive sanitation behaviors. Sneed, Strohbehn, and Gilmore (in press) and Henroid and Sneed (in press) found that foodservice employees with food safety certification had higher knowledge than those employees who were not certified.

None of the demographic characteristics were related to full-time employees' food safety practices. These findings were inconsistent with results of the study conducted by Hsu and Huang (1995) that found that food workers with higher education had more sanitation knowledge and more positive behaviors. These researchers also reported that respondents' work experience in foodservice and gender influenced scores for sanitation knowledge and behaviors.

Table 16. Comparison of Mean Total Score for Food Safety Knowledge, Attitudes, and Practices of Full-Time Employees Based on Demographic Characteristics (N = 38)

	Scores					
	Knowledge[a]		Attitude[b]		Practice[c]	
Characteristics	Mean	SD	Mean	SD	Mean	SD
Gender						
Female	8.5	1.1	54.1	4.8	28.8	1.1
Male	8.0	1.4	53.3	5.3	29.0	1.4
Age (Years)						
<30	8.3	1.2	51.1	6.5	28.1	1.3
31-50	8.4	1.0	55.1	3.6	28.9	1.2
51-65	8.5	1.2	54.7	4.5	29.3	0.8
>65	10.0	0.0	52.0	0.0	29.0	0.0
Education level						
High school	8.7	1.1	54.9	4.6	28.7	1.2
Some college	8.4	1.2	53.7	5.1	28.6	1.1
Bachelor's degree	9.0	0.0	57.0	0.0	30.0	0.0
Years work in ISU Dining						
≤5	8.3	1.2	53.1	5.7	28.6	1.2
6-15	8.9	0.8	53.9	4.3	29.0	1.1
16-25	8.0	1.4	55.8	3.1	28.8	0.8
≥26	9.0	0.0	57.0	0.0	30.0	0.0
Number of food safety training received						
1-3	8.3	1.2	53.0	5.1	28.8	1.2
4-6	9.0	0.7	55.2	3.3	28.8	1.1
7-9	7.0	0.0	60.0	0.0	29.0	0.0
10-12	8.5	1.3	55.0	3.6	28.3	1.7
>12	9.0	1.0	55.7	6.7	28.3	0.6
Food safety certification						
Yes	8.7*	1.0	55.4**	4.0	28.8	1.0
No	7.6*	1.1	49.0**	5.2	28.0	1.6

* $p \leq 0.05$
** $p \leq 0.01$
[a] Total possible knowledge score = 10
[b] Total possible attitude score = 60
[c] Total possible practice score = 30

Multiple Linear Regression

Four multiple linear regression models were used to test relationships among student employees' food safety knowledge, attitudes, practices, training, and demographic variables. The first model included student employees' food safety knowledge, attitude, and training scores as independent variables and food safety practices score as the dependent variable. The model was significant ($F = 29.68$, $p = 0.000$), and attitudes ($\beta = 0.40$, $p = 0.000$) and training ($\beta = 0.30$, $p = 0.000$) both had an independent influence on practices (Table 17). The percentage of explained variance (R^2) for the model was 0.29, which indicates that 29% of the variance in food safety practice scores is explained by the three predictor variances. This finding was similar to results of Cohen, Reichel, and Schwartz's study (2001) that showed that providing sanitation training programs to employees improved food safety.

Table 17. Multiple Regression Model Beta Estimates for Predicting Student Employees' Food Safety Practices Based on Food Safety Knowledge, Attitudes, and Training (N = 221)

Variable	Model
Food safety knowledge	.09 (1.60)
Food safety attitudes	.40*** (6.87)
Food safety training	.30*** (5.25)
R-Square	.29
Adjusted R-Square	.28
F-Statistic	29.68
p-value for F-Statistic	< .0001

Note. Values enclosed in parentheses represent t-values.
*** $p \leq 0.001$

The second model included student employees' food safety knowledge, attitudes, training scores, and four demographic variables: age, hours of worked in ISU Dining per week, semesters employed by ISU Dining, and position as independent variables and student employees' food safety practices score as the dependent variable. The model was significant ($F = 13.08$, $p = 0.000$), and attitudes ($\beta = 0.39$, $p = 0.000$) and training ($\beta = 0.30$, $p = 0.000$) both had an independent influence on practice scores (Table 17). However, no student employees' demographic variables were significant predictors for food safety practice score. The percentage of explained variance (R^2) for this model was 0.31, which was little improvement over the model without the demographic variables.

Table 18. Multiple Regression Model Beta Estimates for Predicting Student Employees' Food Safety Practices Based on Food Safety Knowledge, Attitudes, Training, and Demographic Variables (N = 221)

Variable	Model	
Food safety knowledge	.08	(1.37)
Food safety attitudes	.39***	(6.39)
Food safety training	.29***	(4.96)
Age of student employees	.03	(.40)
Hours worked	.04	(.61)
Semesters employed	.05	(.55)
Position	.04	(.49)
R-Square	.31	
Adjusted R-Square	.28	
F-Statistic	13.08	
p-value for F-Statistic	< .0001	

Note. Values enclosed in parentheses represent t-values.
*** $p \leq 0.001$

The third model included student employees' food safety attitude, practice, and training scores, and four demographic variables as independent variables and student employees' food safety knowledge as the dependent variable. This model was significant ($F = 2.09$, $p = 0.046$) (Table 19). However, only age of student employees ($\beta = -0.18$, $p = .036$) and number of semesters employed by ISU Dining ($\beta = 0.27$, $p = 0.01$) had an independent influence on food safety knowledge. Surprisingly, food safety attitudes and training did not have a significant influence on food safety knowledge. The percentage of explained variance (R^2) for the model was very low (0.07).

Table 19. Multiple Regression Model Beta Estimates for Predicting Student Employees' Food Safety Knowledge Based on Food Safety Attitudes, Practices, Training, and Demographic Variables (N = 221)

Variable	Model	
Food safety attitudes	.10	(1.24)
Food safety practices	.11	(1.37)
Food safety training	-.03	(-.46)
Age of student employees	-.18*	(-2.11)
Hours worked	-.01	(-.17)
Semesters employed	.27**	(2.61)
Position	-.02	(-.28)
R-Square	.07	
Adjusted R-Square	.03	
F-Statistic	2.09	
p-value for F-Statistic	< .046	

Note. Values enclosed in parentheses represent t-values.
* $p \leq 0.05$
** $p \leq 0.01$

The fourth model testing the contribution of student employees' food safety knowledge, practice, and training scores, and four demographic variables in explaining student employees' food safety attitudes was significant ($F = 9.00$, $p = 0.000$) (Table 20). Food safety practices ($\beta = 0.43$, $p = 0.000$), age of student employees ($\beta = 0.21$, $p = 0.009$), and number of semesters employed by ISU Dining ($\beta = -0.22$, $p = 0.018$) had an independent influence on food safety attitudes. The percentage of explained variance (R^2) for the model was 0.23.

Table 20. Multiple Regression Model Beta Estimates for Predicting Student Employees' Food Safety Attitudes Based on Food Safety Knowledge, Practices, Training, and Demographic Variables (N = 221)

Variable	Model	
Food safety knowledge	.08	(1.24)
Food safety practices	.43***	(6.39)
Food safety training	-.05	(-.72)
Age of student employees	.21**	(2.65)
Hours worked	-.03	(-.46)
Semesters employed	-.22*	(-2.39)
Position	.14	(1.78)
R-Square	.23	
Adjusted R-Square	.21	
F-Statistic	9.00	
p-value for F-Statistic	< .0001	

Note. Values enclosed in parentheses represent t-values.
* $p \leq 0.05$
** $p \leq 0.01$
*** $p \leq 0.001$

Four multiple linear regression models also were conducted to test relationships among full-time employees' total scores for food safety knowledge, attitudes, practices, training, and demographic variables (gender, age, education level, years employed by ISU Dining, number of food safety training sessions received, and food safety certification). None of these models were significant.

CHAPTER 5. CONCLUSIONS

This chapter consists of four sections. First, a summary of this research study is presented. Second, some limitations of this study are identified. Third, recommendations for future research are discussed. Finally, applications drawn from this study are made.

Summary of the Research

The purpose of this study was to assess foodservice employees' knowledge, attitudes, practices, and training regarding food safety at Iowa State University. Furthermore, comparisons of food safety knowledge, attitudes, practices, and training were made between student and full-time employees.

Two questionnaires were used for this study. A 5-part questionnaire was developed to identify student and full-time employees' knowledge, attitudes, practices, and training related to food safety. A 1-page questionnaire was developed to survey the ISU Dining managers to determine the food safety topics included in training or orientation provided to student employees and to determine how student employees' performance compared to full-time employees' performance. A total of 275 questionnaires was collected from six ISU Dining facilities for a 42% response rate. Two hundred and twenty-one questionnaires were completed by student employees, 38 questionnaires were completed by full-time employees, and 16 questionnaires were returned by managers. SPSS 11.0 for Windows was used for data analysis.

Results showed that full-time employees had higher ($p \leq 0.001$) mean total scores in food safety knowledge, attitudes, practices, and training than student employees. Full-time

employees most frequently answered sanitizer concentrations question incorrectly. Findings indicated that student employees lack knowledge about the appropriate rule of handwashing, time and temperature control, and sanitizer concentrations. Both student and full-time employees were neutral that food safety knowledge would make them more confident about their work. For food safety practices, checking sanitizer concentrations needs increased attention if it is an important task for employees jobs. However, student and full-time employees in some ISU Dining Centers may not be required to have the knowledge of sanitizer concentrations and check sanitizer concentrations due to using warewashing machines in these facilities. Results of the training section showed student employees did not receive information about preventing cross contamination and the temperature danger zone. Results of comparison of food safety training provided from the perspective of student employees and managers showed these two groups had a different perspective on "Preventing cross contamination". From the ISU Dining managers' perceptions, student employees had lower or similar performance on food safety practices than full-time employees.

Differences in employees' food safety knowledge, attitudes, practices, and training among six residence dining centers in ISU Dining were examined. Differences were found for student employees' food safety attitudes and training among different dining centers. No difference was found on full-time employees' food safety knowledge, attitudes, practices, and training among six residence dining centers.

Among characteristics of student employees, age, position (regular student or student supervisor or leader), hours worked, and semesters employed by ISU Dining influenced food

safety knowledge, attitudes, and practices. Among characteristics of full-time employees, only food safety certification affected food safety knowledge and attitudes.

Results of multiple linear regression analysis indicated that student employees' food safety knowledge, attitudes, and training were related positively to their food safety practices. Furthermore, age of student employees and semesters employed by ISU Dining had a positive influence on student employees' food safety knowledge and attitudes. However, results of multiple linear regression analysis did not show any influence of full-time employees' food safety knowledge, attitudes, training, and demographic characteristics on their food safety practices.

The key finding for this research was that there were significant differences in food safety knowledge, attitudes, practices, and training between student and full-time employees in university foodservice. Furthermore, student employees' food safety knowledge, attitudes, and training had a significant positive influence of food safety practices.

Limitations

Some limitations should be noted when reading this study. First, this study used a convenience sample of student and full-time employee from one Midwest university; thus, results may not be representative of university foodservice in other states. Second, results of the study are limited to residence dining. Findings may not be generalized to other divisions of university foodservice such as the central bakery, cafeteria, and catering department. Third, results cannot be generalized to other types of food establishments such as restaurants and cafeterias. Fourth, managers' characteristics, such as personality and length of employment at ISU Dining, could impact their observations of student and full-time

employees' food safety performance. Furthermore, student and full-time employees' food safety practices in this study were self-assessed; thus, the results of food safety practices may be different than results using observational methods.

Future Research

This research suggests several studies for future research. First, student employees had lower mean food safety knowledge, attitude, practice, and training scores than full-time employees in university foodservice; thus, additional research is needed to investigate the causes of this difference between student and full-time employees and to develop strategies to overcome these differences. Second, university foodservice managers have the primary responsibility to provide food safety training programs to student employees. Research to investigate university foodservice managers' perceptions of food safety training for student employees and to determine barriers for managers to provide training programs to student employees should be conducted.

Third, a study of university employees' food safety practices using an external reviewer would be useful to compare differences in employees' food safety practices between self-assessed and observation methods. In addition, research to investigate how student employees transfer food safety knowledge, attitudes, and training to food safety practices is recommended. Furthermore, the questionnaire developed in this study could be used to conduct post-tests after the offering of food safety training programs to evaluate program effectiveness. A follow-up study conducted in a few years could document changes in student employees' food safety knowledge, attitudes, practices, and training.

Applications

There was a significant difference between student and full-time employees in food safety knowledge, attitudes, practices, and training. In addition, the majority of managers indicated that student employees had lower or the same performance as full-time employees on most food safety practices. An efficient food safety training program for student employees in university foodservice should be developed to ensure student employees have appropriate levels of food safety knowledge and attitudes, and demonstrate these in practices. When student employees gain more food safety knowledge and positive attitudes from training, they could apply the knowledge in food handling practices and improve their food safety performance. Managers need to consider giving food safety training not only during student employee orientation, which usually is held at the beginning of the semester, but also in the middle of semester as a reminder to student employees. Managers may develop a checklist of food safety components to ensure all of food safety components are covered during food safety orientation and training. In addition, a CD-ROM food safety training program is a flexible, cost-effective, and easy to use training method; it also will ensure student employees receive a consistent message. Results of this research should be useful for university foodservice managers to develop food safety training programs for student employees.

Results showed that student employees lacked knowledge and training about proper handwashing procedure, time and temperature control, cross contamination, and sanitizer concentration. Results of this study indicate a need for initial and continuous training in these areas. Mangers need to consider strengthening training in these areas.

Comparison of food safety training provided from the perspective of student employees and managers revealed that most managers (86.7%) believed that the information about preventing cross contamination was provided to student employees, but only 60.7% of student employees reported that they received this training. Emphasis on preventing cross contamination is needed in training for student employees to overcome this difference.

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APPENDIX A. COVER LETTER AND SURVEY INTRUMENT FOR EMPLOYEES

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Dear Employee,

My name is Shu-Ying Lin and I am a graduate student at Iowa State University in Foodservice and Lodging Management. I am conducting research about employees' food safety knowledge, attitudes, and practices in university foodservice. I need your help with this research. It will take approximate 15-20 minutes to complete the questionnaire. Your participation in this study is voluntary and anonymous. My professor and I are the only ones who will see your responses. Your responses will be held in the strictest confidence and reported only as group data.

In appreciation for you participation, your name will be included in a drawing for two prizes:

$ 50 North Grand Mall Gift Certificate
$ 30 North Grand Mall Gift Certificate

Please place the completed questionnaire in the designated confidential box in the manager's office before **April 28**. Your response is very important to the success of this study and will provide useful information for university foodservice managers. If you have any questions regarding this research study, don't hesitate to contact Dr. Jeannie Sneed or me.

Thank you for your time and assistance.

Sincerely,

Shu-Ying Lin
Graduate Student
Tel: 515-294-4636
shuying@iastate.edu

Jeannie Sneed, PhD, RD, SFNS
Associate Professor
Tel: 515-294-8474
jsneed@iastate.edu

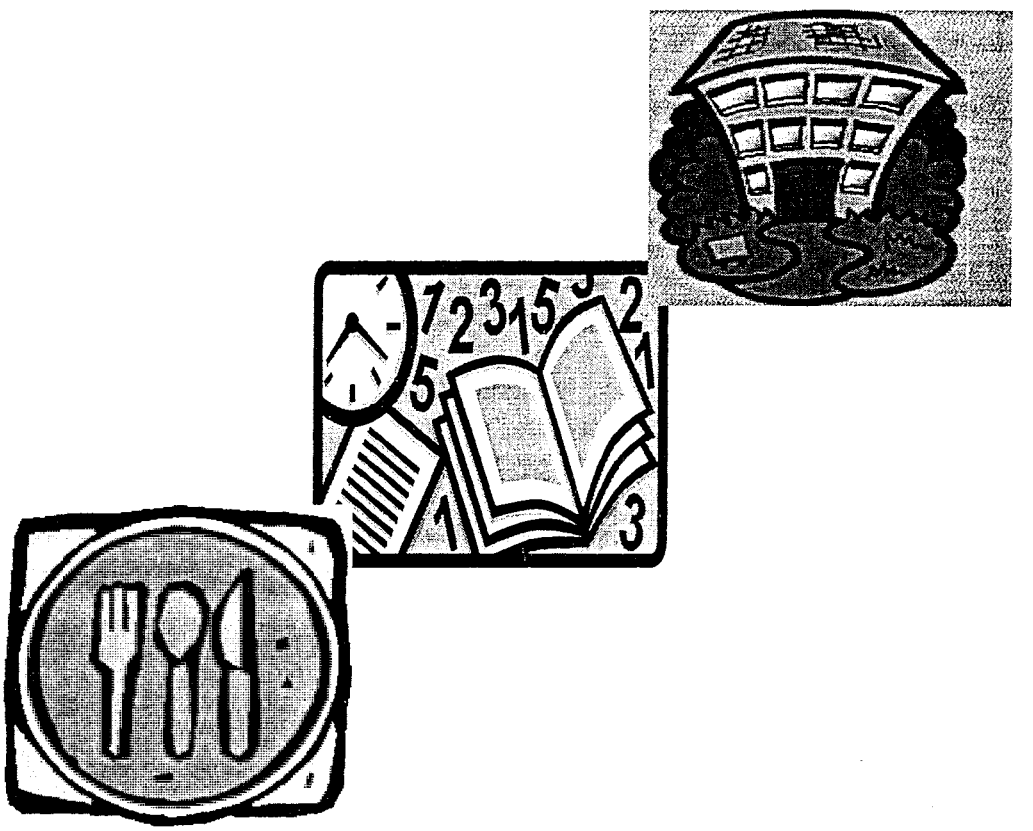
For Drawing Purpose Only

Please fill out your name and e-mail address and put it into the drawing box. The drawing will be held at the end of April, 2003. Winners will be notified by e-mail.

Name:_____ E-mail:_____

Food Safety

in College and University Foodservice



Foodservice and Lodging Management
Iowa State University
7 E MacKay
Ames, IA 50011-1120
(515) 294-4636

Part I: What do you know?

Instructions: Please read each statement and circle the answer that you believe is correct.

1. The most important rule of foodservice personal hygiene is that employees must:

   A. wear gloves at all times.
   B. use gloves for preparing all food items.
   C. wash their hands often.
   D. sanitize hands at end of each shift.

2. After washing their hands, employees should avoid:

   A. putting on gloves.
   B. talking to other co-workers.
   C. touching their hair.
   D. turning off the faucet with the paper towel used for drying hands.

3. Foodborne illnesses are diseases that are:

   A. carried or transmitted to people by food.
   B. caused by eating with people who are ill.
   C. cured by proper eating habits.
   D. transmitted to kitchen employees only.

4. The temperature danger zone for potentially hazardous foods is:

   A. 25° to 75°F.
   B. 85° to 160°F.
   C. 72° to 110°F.
   D. 41° to 140°F.

5. The most important factors to control the growth of bacteria are:

   A. oxygen and acidity.
   B. moisture and oxygen.
   C. acidity and moisture.
   D. temperature and time.

6. Cross contamination is the:

   A. cleaning method most often used to clean food-contact surfaces that have been contaminated.
   B. transfer of harmful substances or micro-organisms to food from food or from a nonfood-contact surface, such as equipment, utensils, or hands.
   C. removal of certain bacteria from food by cooking it thoroughly.
   D. prevention of foodborne illnesses.

7. Which of the following methods for thawing frozen food is acceptable?

   A. In the rinse section of the 3-compartment sink in warm water
   B. In the sink under hot (100°F) running water
   C. Under running water that is 70°F or less
   D. On the counter until food is partially thawed, then cook it immediately

8. Rita wore disposable gloves while she formed raw ground beef into patties. After she was finished, she wore the same gloves to slice smoked turkey breast for sandwich. What mistake did Rita make?

   A. She failed to change her gloves and wash her hands after handling raw meat and before handling a ready-to-eat food item.
   B. She failed to wash her hands before wearing the same gloves to slice the turkey breast.
   C. She failed to wash and sanitize her gloves before handling the turkey breast.
   D. She failed to wear reusable gloves.

9. When holding hot foods for service:
   A. it is acceptable to use hot-holding equipment to reheat hot foods when needed.
   B. it is required that internal food temperatures be taken at least every two hours.
   C. a temperature of 120° F must be maintained.
   D. there is no needed to measure internal food temperature.

10. When iodine solutions (such as Mikroklene) are used for sanitizing, how long must the item be immersed in the solution?

   A. 7 seconds
   B. 30 seconds
   C. 1 minute
   D. 2 minutes

Part II: What do you think?

Instructions: Please read each statement. Indicate your agreement to the statement by circling your response, using the following scale:

SD = Strongly Disagree D = Disagree N = Neutral A = Agree SA = Strongly Agree

1. I select a place to eat based on its reputation for good sanitation and cleanliness.	SD	D	N	A	SA
2. I think sanitation is an important part of my job responsibilities.	SD	D	N	A	SA
3. I am willing to obtain more food safety knowledge.	SD	D	N	A	SA
4. I am willing to attend a food safety training course.	SD	D	N	A	SA
5. I believe that good employee hygiene can prevent foodborne illness.	SD	D	N	A	SA
6. It is more important to have tasty food rather than safe food.	SD	D	N	A	SA
7. I think that managers should educate employees on personal hygiene and sanitation regularly.	SD	D	N	A	SA
8. I think that it is the responsibility of all food handlers to ensure that food is safe to serve.	SD	D	N	A	SA
9. I think that only full-time employees should receive food safety training.	SD	D	N	A	SA
10. I believe that food safety knowledge would make me more confident about my work.	SD	D	N	A	SA
11. I believe that food safety knowledge not only benefits my work but also my personal life.	SD	D	N	A	SA
12. I am willing to change my food handling behaviors when I know they are incorrect.	SD	D	N	A	SA

Part III: What do you do?

Instructions: Please read each food handling behavior performed at work. Indicate the frequency in which you engage in this practice by circling your response, using the following scale:

N = Never S = Sometimes A = Always N/A = Not Applicable

1.	I wear a clean uniform, when I work in foodservice.	N	S	A	N/A
2.	I wear a hair restraint (cap or hairnet), when I work in foodservice.	N	S	A	N/A
3.	I wash my hands vigorously with soap and water before working with food.	N	S	A	N/A
4.	When I am in doubt about the safety of a previously cooked food, I report it to the supervisor.	N	S	A	N/A
5.	I use gloves or utensils to handle food that is ready-to-eat.	N	S	A	N/A
6.	I use a separate clean utensil for each food item.	N	S	A	N/A
7.	I wash my hands and change into a new pair of gloves after touching anything that may contaminate my hands, when I prepare or serve food.	N	S	A	N/A
8.	I wash raw produce before using it.	N	S	A	N/A
9.	I store raw food items in an area separate from cooked food.	N	S	A	N/A
10.	I pay attention to expiration dates on foods and do not use foods that have passed the expiration date.	N	S	A	N/A
11.	I check concentrations of sanitizing solutions used for sanitizing work surfaces or items washed in the pot and pan sink.	N	S	A	N/A
12.	I drink or eat food while I am serving or preparing food.	N	S	A	N/A
13.	I clean and sanitize work surfaces after each task.	N	S	A	N/A
14.	I store chemicals in a non-food storage room.	N	S	A	N/A

Part IV: What is your training?

Instructions: Please indicate which food safety topics have been included in training you have received at your current ISU workplace by checking ***yes*** or ***no***.

		Training Received	
		Yes	**No**
1.	Components of good personal hygiene:		
	a. Hygienic hand practices:		
	Proper handwashing	_____	_____
	Hand maintenance (e.g. short fingernails, no nail polish)	_____	_____
	Use of gloves	_____	_____
	b. General personal cleanliness	_____	_____
	c. Proper work attire (e.g. hair restraint, uniform)	_____	_____
	d. Reporting illness and injury	_____	_____
	e. Policies regarding eating and drinking in work area	_____	_____
2.	The relationship between personal hygiene and the spread of disease	_____	_____
3.	Procedures for cleaning and sanitizing utensils, equipments, and food contact surfaces	_____	_____
4.	Procedures for cleaning and sanitizing glassware, silverware, and dishes	_____	_____
5.	Preventing cross contamination	_____	_____
6.	Protecting food during service:		
	a. Holding foods for service	_____	_____
	b. Safe serving procedures	_____	_____
7.	Temperature danger zone where microorganisms can grow rapidly	_____	_____
8.	Use of thermometers and taking temperatures of food	_____	_____
9.	Types of chemicals used in the dining center and how to safely store and use	_____	_____

Part V: What about you? (Student Employee)

Instructions: Please answer the following questions about yourself to help us analyze results of this questionnaire.

1. What is your major? _____
2. What is your age? _____
3. What is your gender?
   A. Female
   B. Male
4. Where are you from?
   A. United States
   B. International
5. What is your college status?
   A. Freshman
   B. Sophomore
   C. Junior
   D. Senior
   E. Graduate student
   F. Other, please specify:_____
6. What is your position?
   A. Student employee
   B. Student supervisor or leader
7. How many hours do you work in ISU Dining Centers per week? _____hours
8. What work area(s) you involved with? (Circle all that apply)
   A. Food preparation
   B. Service
   C. Dishroom or pots and pans
   D. Facility clean-up
   E. Nonfood contact (office, checker, or laundry)
   F. Other, please specify:_____
9. How many semesters have you worked for ISU Dining Centers? _____semester(s)
10. Have you worked in a foodservice operation such as a restaurant, hospital, college, or other commercial/noncommercial operation?
    A. No
    B. Yes
       → **If yes,** how long did you work in foodservice before ISU?
       _____year(s) _____month(s)
11. In your current job, how many times have you received on-the-job training about food safety practices? _____time(s)

Thank you for participating in this study.

Part V: What about you? (Full-Time Employees)

Instructions: Please answer the following questions about yourself to help us analyze results of this questionnaire.

1. What is your gender?

   A. Female
   B. Male

2. What is your age?

   A. 30 years or younger
   B. 31-50 years
   C. 51-65 years
   D. Older than 65 years

3. Which of the following best describes your education level?

   A. High school
   B. Some college
   C. Bachelor's degree
   D. Graduate degree

4. How many years have you been employed in the ISU Dining Centers?

   A. 5 years or less
   B. 6-15 years
   C. 16-25 years
   D. 26 years

5. In your current job, how many times have you received training about food safety practices?
   _____time(s)

6. Do you have a food safety certification?

   A. Yes
   B. No

Thank you for participating in this study.

APPENDIX B. COVER LETTER AND SURVEY INTRUMENT FOR MANAGERS

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of Family and Consumer Sciences
Department of Apparel, Educational studies, and Hospitality Management
1055 LeBaron Hall
Ames, Iowa 50011-1120
515 294-7474
FAX 515 294-6364
e-mail aeshm@iastate.edu

Dear Manager,

My name is Shu-Ying Lin and I am a graduate student at Iowa State University in Foodservice and Lodging Management. I also am a graduate student assistant manager in Linden and Oak-Elm Halls. I am conducting research pertaining to employees' food safety knowledge, attitudes, and practices in university foodservice. I need your help with this research.

Enclosed is a questionnaire that should take about 15 minutes to complete. The questionnaire is coded only for follow-up purpose. Participation is voluntary. Please be assured that all responses will be reported as group data, and your individual responses will be held confidential. Please complete the questionnaire and return it to me in the enclosed envelope by campus mail before **April 28**.

Your response is very important and will provide useful information to make this study valuable to foodservice managers. I will be happy to share study results with all ISU Dining Center managers. If you have any questions regarding this research study, don't hesitate to contact Dr. Jeannie Sneed or me.

Thank you for your time and assistance.

Sincerely,

Shu-Ying Lin
Graduate Student
Tel: 515-294-4636
shuying@iastate.edu

Jeannie Sneed, PhD, RD, SFNS
Associate Professor
Tel: 515-294-8474
jsneed@iastate.edu

Facility Code_____

Managers' Perceptions of Food Safety Training and Employees' Performance

Instructions:

(1) Please indicate by checking ***yes*** or ***no*** if each of the food safety topics is included in training given to student employees in your operation.

(2) Please compare student employees' performance as a group related to each food safety area to full-time employees' as a group by checking ***better***, ***same***, or ***worse***.

		(1) Training Provided to Students		(2) Students' Performances Compared to Full-Time Employees		
1	Components of good personal hygiene:	Yes	No	Better	Same	Worse
	a. Hygienic hand practices:					
	Proper handwashing	___	___	___	___	___
	Hand maintenance (e.g. short fingernails, no nail polish)	___	___	___	___	___
	Use of gloves	___	___	___	___	___
	b. General personal cleanliness	___	___	___	___	___
	c. Proper work attire (e.g. hair restraint, uniform)	___	___	___	___	___
	d. Reporting illness and injury	___	___	___	___	___
	e. Policies regarding eating and drinking in the work area	___	___	___	___	___
2	The relationship between personal hygiene and the spread of disease	___	___	___	___	___
3	Procedures for cleaning and sanitizing utensils, equipments, and food contact surfaces	___	___	___	___	___
4	Procedures for cleaning and sanitizing glassware, silverware, and dishes	___	___	___	___	___
5	Preventing cross contamination	___	___	___	___	___
6	Protecting food during service:					
	a. Holding foods for service	___	___	___	___	___
	b. Safe serving procedures	___	___	___	___	___
7	Temperature danger zone where microorganisms can grow rapidly	___	___	___	___	___
8	Use of thermometers and taking temperatures of food	___	___	___	___	___
9	Types of chemicals used in the dining center and how to safely store and use	___	___	___	___	___
10	How many students are employed in your operation? _____ students					

Please return to: Shu-Ying Lin
Foodservice and Lodging Management
Iowa State University
7 E MacKay
Ames, IA 50011-1120

Thank you for your time and participation!

APPENDIX C. HUMAN SUBJECTS REVIEW APPROVAL FORM

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office of Research Compliance
Vice Provost for Research and
Advanced Studies
2810 Beardshear Hall
Ames, Iowa 50011-2036
515 294-4566
FAX 515 294-7288

TO: Shu-Ying Lin

FROM: Ginny Austin, IRB Coordinator

RE: **IRBID** # 03-457

DATE REVIEWED: April 3, 2003

The project, "University Foodservice Employees' Food Safety Knowledge, Attitudes, and Practices" has been declared exempt from Federal regulations as described in 45 CFR 46.101(b)(2).

> (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

To be in compliance with ISU's Federal Wide Assurance through the Office of Human Research Protections (OHRP) all projects involving human subjects, must be reviewed by the Institutional Review Board (IRB). Only the IRB may determine if the project must follow the requirements of 45 CFR 46 or is exempt from the requirements specified in this law. **Therefore, all human subject projects must be submitted and reviewed by the IRB.**

Because this project is exempt it does not require further IRB review and is exempt from the Department of Health and Human Service (DHHS) regulations for the protection of human subjects.

We do, however, urge you to protect the rights of your participants in the same ways that you would if IRB approval were required. This includes providing relevant information about the research to the participants. Although this project is exempt, you must carry out the research as proposed in the IRB application, including obtaining and documenting (signed) informed consent, if applicable to your project.

Any modification of this research should be submitted to the IRB on a Continuation and/or Modification form to determine if the project still meets the Federal criteria for exemption. If it is determined that exemption is no longer warranted, then an IRB proposal will need to be submitted and approved before proceeding with data collection.

cc: AESHM
Jeannie Sneed

HSRO/OCR 9/02