## FOOD SAFETY KNOWLEDGE OF UNDERGRADUATE NUTRITION MAJORS VS. HOSPITALITY MANAGEMENT MAJORS

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# FOOD SAFETY KNOWLEDGE OF UNDERGRADUATE NUTRITION MAJORS VS. HOSPITALITY MANAGEMENT MAJORS (71 pp)

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The purpose of this study was to compare food safety knowledge among undergraduate hospitality majors versus nutrition majors. The four hypotheses included there being a difference in food safety knowledge between hospitality management majors and nutrition majors, between freshmen, sophomores, juniors and seniors within each major, between participants who are ServSafe certified and those who are not, and participants with food service experience and those without. This was a nonexperimental, two-way factorial design, with independent variables including major and education level of student. Dependent variables included food safety knowledge on five subsections of food safety and total food safety knowledge. Undergraduate nutrition majors and hospitality majors completed the statistically validated Food Safety Knowledge Questionnaire, FSKQ. The scores for each scale, which corresponded to a section in the test, were calculated by adding the total points earned within each section. Means and standard deviations for knowledge scores from each section were reported along with the total. Data was analyzed using SPSS software with significant data required to have a p value of ≤0.05. A 2x4 factorial ANOVA was performed on each subscale knowledge section and overall. Results suggested that food safety knowledge does not appear to be any different among hospitality management and nutrition students, or students who are ServSafe certified or not. However, there appears to be a significant differences educational level, which may be due to class order.

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#### **CHAPTER I**

#### **INTRODUCTION**

Food safety is described as conditions and practices that preserve the quality of food by preventing contamination and foodborne illnesses (University of Maryland Medical Center, 2016). The concept of food safety is an ever present, all-encompassing force throughout everyday life, from foodservice establishments to preparing food within the home. There are five principles that encapsulate the basis of food safety as described by the World Health Organization (WHO); "keep clean; separate raw and cooked; cook thoroughly; keep food at safe temperatures; and use safe water and raw materials (WHO, 2006)."

Food safety is also an issue within the context of food production on a larger scale, which lead to the passing of the Food Safety Modernization Act (FSMA) by the U.S. Congress. Within the context of regulation, the FSMA was the largest piece of food legislation since the Federal Food, Drug and Cosmetic (FDC) Act of 1938 (U.S Food & Drug Administration, 2011). The FSMA greatly improved the food safety landscape by providing more oversight and protection throughout the entirety of the food production cycle (FDA, 2011). One of the biggest goals for the FSMA was to move away from the more reactive position seen previously, of handling contamination within the food chain after they happened, to a proactive, approach of preventing outbreaks before they happen.

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Consumer food safety knowledge is a critical aspect of overall public health within any given population. Unfortunately, food safety knowledge among most consumers, independent of culture, educational levels, and socio-economic status, is substandard (Wilcock, Pun, Khanona, & Aung, 2004). While this lack of food safety knowledge among the consumer population is troubling, even more troubling is the lack of adequate education nutrition and hospitality majors are receiving throughout their undergraduate education (Scheule, 2000). An issue for both groups of students is that proper food safety education and training are not being adequately implemented into classrooms (Scheule). Nutrition and hospitality management students are going into the workforce ill-prepared to handle food safety risks, which directly affects consumers' health.

#### **Problem Statement**

Approximately 1 in every 6 Americans (48 million people) get sick, 128,000 are hospitalized, and 3,000 die each year of foodborne illnesses (Center for Disease Control, 2016). A major contributor to this is an overall lack of food safety knowledge among consumers, food service workers, and the general population. (Jevsnik, Hlebec &Raspor, 2006; Wilcock, Pun, Khanona, & Aung, 2004; Verbeke, Frewer, Scholderer & DeBrander, 2007; Brewer, Rojas, 2008). A rapidly changing shift in the way consumers produce, buy and consume food provide a challenging "catch-up" for food safety laws, education and application (Sneed, Strohbehn, 2008; Bredbenner et al. 2008; Fatimah, Boo, Sambasivan & Salleh, 2011; Long, 2016; Nyachuba, 2010). Studies have shown that consumers do not have an adequate understanding of the principles of food safety, yet act in such a way that suggest they do (Wilcock, Pun, Khanona, & Aung; Brewer, Sprouls & Craig; Brewer & Rojas 2007). Consumers are oblivious to their ignorance and confident that their improper food safety actions do not put them or others at risk (Sneed, Strohbehn, 2008).

Undergraduate education is a key junction for food safety education, be it for an average student or nutrition and hospitality management students. An issue for the public and consumers, is that neither of these groups are being adequately educated on food safety (Gross, Harris, 2002). Dietitians are expected to be the most knowledgeable sources of food and nutrition information within the healthcare field, yet even with their extensive education they can still have inadequate knowledge regarding food safety (Gross, Harris). Research has shown that nutrition majors have typically less classroom experience with food safety than their hospitality management counterparts, with food safety education being spread throughout multiple classes instead of concentrated into one or two solely focusing on food safety (Gross, Harris, Short, Chittooran, 2004). Undergraduate nutrition students, who will likely become dietitians, and hospitality management majors, poised to become food service managers, share responsibility for food safety once they enter their respective career fields.

#### **Purpose Statement**

The purpose of this study was to compare foods safety knowledge among undergraduate hospitality majors versus nutrition majors.

#### **Research Hypotheses**

- There is a difference in food safety knowledge between hospitality majors and nutrition majors.
- There is a difference in food safety knowledge between freshmen, sophomores, juniors and seniors within each major.
- 3. There is a difference in food safety knowledge between participants who are ServSafe certified and those who are not.
- 4. There is a difference in food safety knowledge between participants who have food service experience and those who do not.

#### **Operational Definitions**

 Nutrition majors: Students enrolled in an undergraduate Bachelor of Science in nutrition program. For the purpose of this study, the program fulfills the Didactic Program in Dietetic requirements of the Accreditation Council for Education in Nutrition and Dietetics (ACEND) which allows graduates to be eligible for admission into ACEND accredited internships.

- Hospitality management majors: Students enrolled in an undergraduate hospitality management program that is accredited by the Accreditation Commission for Programs in Hospitality Administration (ACPHA). Hospitality management students are prepared for well-compensated positions as managers in restaurants, hotels, hospitals, conference centers, and other foodservice and hospitality venues.
- Food safety knowledge: A measurable quantity of knowledge regarding food safety as determined by the Food Safety Knowledge Questionnaire (FSKQ).

#### **Chapter II**

#### **REVIEW OF LITERATURE**

#### **Definition of Food Safety**

Food safety in its simplest form is described as "conditions and practices that preserve the quality of food. These practices prevent contamination and foodborne illnesses (University of Maryland Medical Center, 2016)." There are several components of food safety that should affect the day to day operations of foodservice organizations, personal food preparation and overall public health. Two of the most commonly cited standards that organizations use for their bases of food safety is the World Health Organization (WHO) "Five Keys to Safer Food Manual" and the "Food Code" published by the Food and Drug Association (FDA). The WHO's "Five Keys to Safer Food Manual" breaks down food safety into five easy to manage and comprehend categories that are applicable in many situations, from food service to food preparation in the home (WHO, 2006). The WHO's "Five Keys to Safer Food" have overlapping information and protocol with a standing FDA program "Be Food Safe", which takes aspects of the "Food Code", and separates food safety into four categories "Clean," "Separate," "Cook," and "Chill" (USDA, 2016).

The first of the WHO's categories refers to keeping everything clean within the food service process, from hands to cooking surfaces and utensils (WHO). This is one of the most basic and simple actions within regarding food safety

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procedures that can have the biggest impact on the rest of the food production cycle. If food service employees' hands are not washed, or washed incorrectly, it can taint the rest of the food production process. The WHO puts a strong emphasis on keeping the entire food production cycle clean detailing the importance of keeping production surfaces clean to prevent the growth of microorganisms, as well as the sanitation of plates and utensils (WHO).

The WHO emphasizes the importance of separating raw and cooked food to prevent cross contamination, and then cooking those foods thoroughly (WHO). The WHO focuses heavily on the danger of microorganisms and their overall risk to individual health through foodborne illnesses. The separation of raw and cooked food is one the most important actions individuals can take when preparing food to prevent cross contamination between the raw food, which has a higher risk for microbial growth, and cooked food (WHO). The WHO also puts an emphasis on making sure all food is cooked thoroughly, citing 70°C as a safe temperature for most meats, while suggesting individuals use cooking thermometers (WHO). Storing food at safe temperatures is one of the most important and often overlooked aspects of food safety that the WHO addresses (WHO). The WHO recommends not leaving cooked food at room temperature for longer than two hours, and avoiding the danger zone of food safety by refrigerating food below 5°C, and reheating food to at least 60°C before serving (WHO). Within the context of food storage, the WHO also includes their recommendations for proper thawing techniques which include not thawing

frozen foods at room temperature and cooking foods promptly after they are thawed (WHO).

The final element of food safety the WHO addresses is the use of safe water and raw materials (WHO). On a practical level this focuses on making sure the food that individuals cook with, consume, and use at any step in the food production process are safe. Within this context safe refers to food and water that does not have any harmful microorganisms or chemicals that could cause illness or disease (WHO). The WHO suggests making sure foods used are processed for safety, for example pasteurized milk, washing fruits and vegetables before consuming, and avoiding eating food that is past it's expiration date (WHO). Most of the sentiments seen throughout WHO's view on using safe water and raw materials are echoed in the Academy of Nutrition and Dietetics (AND) position statement on Food and Water Safety that reads as follows:

All people should have access to a safe food and water supply. The Academy supports science-based food regulations and recommendations that are applied consistently across all foods and water regulated by all agencies and incorporate traceability and recall to limit food and waterborne outbreaks. Registered dietitian nutritionists and dietetic technicians, registered, are encouraged to participate in policy decisions, program development, and implementation of a global food safety culture (AND, 2014).

#### **Food Safety Modernization Act**

Even though the United States has one of the safest food chain supplies in the world, food safety issues continue to be an issue (Strauss). The U.S. Centers for Disease Control (CDC) estimates nearly that "each year nearly 48 million people (roughly 1 in 6 Americans) are sickened, 128,000 are hospitalized, and 3,000 people die from preventable foodborne illnesses (CDC, 2016). Because of continuing issues such this, in 2011, U.S. Congress passed the Food Safety Modernization Act (FSMA). The FSMA was the largest piece of food safety legislation in over 70 years, since the Federal Food, Drug and Cosmetic (FDC) Act of 1938 (U.S Food & Drug Administration, 2011). One of the biggest goals of the FSMA is to put the FDA in a more proactive position regarding food safety, rather than the more reactive position seen previously. The FDA breaks down the FSMA into five distinct yet equally important aspects that work together to improve the safety of the food chain.

The first of these aspects is preventative control, which, for the first time, grants the FDA "legislative mandate to require comprehensive, prevention-based controls across the food supply (USDA)." Preventative control aims to change the way the FDA approaches foods safety as whole, switching their method from being reactive, dealing with food safety issues or outbreaks after they happen, to preventing them from happening in the first place. What this means in practice is that the FDA requires all food facilities to "evaluate the hazards in their operations, implement and monitor effective measures to prevent contamination, and have a plan in place to take any correction actions that are necessary (FDA)." While that requirement covers food facilities the FDA also put in place "sciencebased standards for the safe production and harvesting of fruits and vegetables to minimize the risk of serious illnesses or death," which is aimed directly at farmers (FDA). One the final aspects of preventative control allowing the FDA to "hold food companies accountable for preventing contamination" which they consider a "significant milestone in the efforts to modernize the food safety system (FDA)."

The second aspect is inspection and compliance, "an important means of holding industry accountable for their responsibility to produce safe product (FDA)." Within the context of foods safety, the FDA plans to meet changing food production methods by "applying [their] inspection resources in a risk-based manner (FDA)." With the FSMA the FDA also makes a strong commitment to changing preexisting food safety inspection methods by "innovating...its inspection approaches to be the most efficient and effective with existing resource (FDA)." The third aspect is imported food safety, a necessary step considering approximately 60% fresh fruits and vegetables and 80% of seafood in the U.S. are imported, an amount which equals around 15% of the entire food supply chain within the U.S. (Strauss, 2011). Specific to imported food the FDA "requires importers to perform supplier verification activities to ensure imported food is safe, authorizes [the] FDA to refuse admission to imported food if the foreign facility or country refuses to allow an FDA inspection, authorizes [the] FDA to require certification, based on risk criteria, that the imported food is in

compliance with food safety requirements", and "provides an incentive for importers to take additional food safety measures by directing FDA to establish a voluntary program through which imports may receive expedited review for their shipments if the importer as taken certain measures to assure the safety of the food (FDA)."

The fourth aspect is response. This basically speaks to the new found authority the FDA received with the FSMA, in that is gives the FDA "mandatory recall authority for all food products (FDA)." The hope is that in establishing new rules and regulations among the various steps and processes within the food supply chain this would be a seldom used power, however the FDA does state it is a "critical improvement in [it's] ability to protect the public health (FDA)." The fifth and final aspect is the concept of enhanced partnerships. With this concept the FDA indicates its commitment to "strengthening existing collaboration among all food safety agencies – Federal, state, local, territorial, tribal, and foreign" in order to help achieve a higher standard of food safety and in turn, greater public health (FDA). Within the FSMA there is also provisions to help build and improve upon existing "state, local, territorial and tribal food safety officials and authorizes grants for training, conducting inspections, building capacity of labs and food safety programs, and other food safety activities (FDA)." These provision hope to put more food safety responsibility on the local level which would prevent it from reaching the federal level, again being proactive rather than reactive.

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One of the most important aspects of the FSMA is that it gives the FDA more power over the entire food chain (Strauss). As it previously stood, the FDA had control of overseeing approximately 80% of food supply with the U.S. (Strauss). The U.S Department of Agriculture (USDA) supervises the handling of meat, poultry and other products not covered by the FSMA (Strauss). When the FSMA passed, it gave the FDA a more wide-reaching authority which it used to establish more up-to-date food safety standards and practices. For example, in the past, if an outbreak occurred within a food product, the FDA relied upon food companies to voluntarily recall their products from stores (Strauss). With the FSMA, the FDA now has the power to establish standards for food safety procedures that effect farmers, food processors and in turn, food recalls.

The FSMA also included seven rules that were designed to make the food safety processes uniform across a variety of industries and businesses sizes. Of these rules 6 of them have been put into full effect including, "Produce Safety Regulation, Preventative Controls for Human Food Regulation, Preventative Controls for Animal Food Regulation, Foreign Supplier Verification Programs, 3rd Party Accreditation of Auditors, Mitigation Strategies to Protect Food Against Intentional Adulteration (FDA)." The last of these rules, dealing with Sanitary Food Transportation Regulations, went into effect March 31st 2016. However, it is proving difficult for some smaller companies to achieve as "only a few companies fully understand the complexities of [the] regulations and what they need to accomplish to be compliant with FSMA (Labs, 2016)." Fortunately, the FDA Is being somewhat lenient and "teach while determining compliance" of most food service operations (Labs).

Within the scope of FSMA compliance, small and very small companies struggle the most to meet the changed laws (Grover, Chopra & Mosher, 2016). The FDA uses three classifications to describe facilities for the purpose of the FSMA; very small, small, and other. Even though they are not the same size and may function differently, they agree that the "FSMA is a much-needed set of regulations...and will be a strong stepping stone for future research (Grover, Chopra & Mosher)."

#### **Current Food Safety Issues**

Consumers are eating less meals at their home, which puts more pressure on retail food service tonsure food safety is maintained (Sneed & Strohbehn, 2008). As of 2014, the FDA reported that about a third of every food dollar consumers spend is on food prepared away from the home (FDA Economic Research Center, 2016). This is a broad category that includes everything from institutional food service, fast food, or prepared food at grocery stores. This puts an increased burden of responsibility on food service employees and managers to ensure that proper food safety procedures are followed. Consumers are generally becoming more aware of food safety issues than they were previously (Sneed & Strohbehn). The media is more attuned to cover outbreaks of foodborne illness than in previous years, which has led to an increase in public perception and awareness of foodborne illnesses and food safety risks (Nyachuba, 2010). While consumers may not practice perfect food safety procedures in their personal life, they are concerned with overall restaurant sanitation. After several years of diminishing confidence surrounding food safety in restaurants, consumer attitudes are rebounding (Sneed & Strohbehn). This increased trust and confidence should persuade those responsible for food safety to maintain strict food safety procedures. While consumers may not know all of the specifics regarding food safety procedures or proper food handling, they do realize the importance of overall cleanliness and hygiene of a food service location and workers (Fatimah, Boo, Sambasivan & Salleh, 2011). A 2011 study ranked cleanliness and hygiene third in what influences consumers to eat at specific food service establishments, after food variety and convenience of location (Fatimah, Boo, Sambasivan & Salleh).

With an aging consumer population, there is an increased risk of foodborne illness (Sneed & Strohbehn). While an aging population is by no means a new phenomenon, the U.S. population is aging at an astonishing rate; by 2030 one in five Americans will be age 65 or older (U.S. Census Bureau, 2014). The biggest issue within this population is the elderly's overall decrease in immune function. Elderly individuals who prepare their own meals may have never learned the basics of proper food safety, or may have forgotten them. Even the elderly who no longer prepare their own meals, such as those who receive home-delivered meals or live at an assisted-living facility, are still at risk for foodborne illness due to improper food safety practices (Sneed & Strohbhen). A massive change within the demographics of the foodservice workforce is challenging traditional food safety training and education (Sneed & Strohbhen). The foodservice workforce is skewing younger than in previous years with more than half of foodservice workers, including managers, being younger than 30 years of age. As the workforce shifts younger, there is a new challenge to educate these employees on food safety concept they have little if any exposure to. The typical food service worker is now described as a "white female younger than 30 years of age, single, working an average of 25 hours per week, and living in a household with two or more wage earners (Sneed & Strohbhen)." These foodservice workers also have a lower literacy levels than previous generations of workers, which makes education efforts challenging.

The way food is being procured poses a challenge for the foodservice industry. As more consumers prefer GMO-free, locally grown, and organic produce, a new set of issues come into the foreground of food safety (Long, 2016). While many consumers may view these foods as better for you, any possible additional benefit can be overshadowed by incorrect food safety procedures. To combat these issues, many distributors are inspecting local farms, insuring they are following proper food safety procedures (Long).

Overall, poor personal hygiene is a constant issue within the foodservice industry. Food workers who do not practice proper personal hygiene is increasing, with improper hand washing occurring at a rate ranging from 34% for hospitals to 73% for restaurants (FDA National Retail Food Team, 2009). Hand washing is the most effective way to prevent contaminating foods with organisms from the gastrointestinal tract. Along with improper handling of food, contaminated equipment proves a substantial risk for foodborne illness in the foodservice industry. The FDA reported that the cleaning and sanitizing of surfaces and utensils typically exceeds a 40% noncompliance rate (FDA National Retail Food Team). The protection of food from contamination is a complex and interrelated process that is of concern from origin to serving of food. For example, an investigation into an outbreak of *Campylobacter jejune* revealed the cause was lettuce, cross contaminated from raw chicken via unwashed hands, that eventually lead to the exposure of cooking utensils and countertops throughout the restaurant (Sneed & Strohbehn).

A newer issue within the field of food safety is the concept of food defense. After the terrorist attack of 2001, the federal government passed the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (Bioterrorism Act), which in turn gave the FDA increased authority and responsibility in insuring the food supply remains safe (FDA.gov, 2009). The Bioterrorism Act is divided into titles that all specifically relate to public health and safety including "National Preparedness of Bioterrorism and Other Public Health Emergencies," "Enhancing Controls on Dangerous Biological Agents and Toxins," "Protecting Safety and Security of Food and Drug Supply," and "Drinking Water Security and Safety (Bioterrorism Act, 2002)." This is pertinent

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to the food service industry because food service managers are responsible for making sure food is secure and being prepared for any emergency.

#### **Effective Food Safety Education**

Food safety should be of serious concern to nutrition and hospitality management students. These students will eventually act as gatekeepers, protecting the public from food safety issues. Food service managers "must take responsibility for service of safe food and training of employees (Scheule, 2000)." This responsibility is not to be taken lightly by food service managers, they have essentially been given the trust of any individual who eats food that is prepared under their management, be it customer at a restaurant, or a patient at a hospital.

For food safety to be such a serious and widespread issue, the current state of food safety education within nutrition and hospitality management programs could be considered lacking by some. Among dietetics undergraduate programs 40% required students to receive 16 hours or more of food safety classes, while only 38% require dietetic students to complete safety certification exam (Gross & Harris, 2002). There seems to be a unifying theme among dietetic and hospitality management majors alike; food safety is important, but it is hard to dedicate as much time to it as needed. Dietetic instructors, specifically DPD directors, agree that "food safety is an important issue within dietetics education" but are generally unsure of how important it should be and whether or not requiring food safety certifications among dietetic students would be a benefit to the educational process (Gross & Harris). Many state and local laws within the food service industry are beginning to require food safety education courses (i.e. ServSafe) among food service managers and employees, in hopes to circumvent the spread of foodborne illnesses and other food safety issues (Short & Chitooran, 2004). The educational process regarding food safety seems to focus more on knowledge of food safety alone and less on knowledge gained through activities such as "teaching, supervising, developing and training," while giving a much lower importance to "HACCP, microbial aspects of food safety, and cleaning or sanitizing" all of which are essential to the food safety process (Gross & Harris). However, many programs try and compensate for this by implementing ServSafe, a program which is operated by the National Restaurant Association (NRA), certification for students, a process that covers concepts from "time and temperature control, preventing cross-contamination, cleaning and sanitizing, safe food preparation, receiving and storing food (ServSafe, 2016)."

There are even differences in priorities of educating future dietitians in food safety among the undergraduate and internship level. The AND, has three competencies for dietetic interns to achieve regarding food safety and risk management (Commission on Dietetics Registration, 2016). This puts food safety closer in importance to clinical knowledge. However, on an undergraduate level, only thirty-four percent of dietetics programs require or offer food safety certifications (Scheule). Within undergraduate programs, nutrition classes incorporate food safety principles into several nutrition courses while hospitality management classes will have one of two specific courses on the subject (Scheule). The Accreditation Commission for Programs in Hospitality Administration, ACPHA, the accreditation agency for hospitality management programs, also puts an emphasis on food safety, as evidenced by one of their learning outcomes which states students should be able to "Demonstrate the use and care of food preparation equipment and the preparation and storage of food using principles of food safety (ACPHA, 2014)."

One of the more important aspects of food safety, Hazard Analysis Critical Control Points (HACCP), is generally seen as "lower in importance than many other items" by dietetics educators (Scheule). Many undergraduate dietetics programs spread their food safety education throughout several classes rather than giving one or two specific classes focusing solely on food safety. Many DPD directors cite the already full curriculum as an issue to overcome when considering incorporating more food safety classes into the dietetics curriculum (Scheule). Another issue that arises is how specific education should be made for the specific undergraduate student. Dietetic students, specifically those that go onto become Dietitians are more likely to go into a variety of fields, from food service manager to WIC dietitians, and the food safety knowledge necessary varies widely. When considering the importance of food safety, hospitality management majors are "likely to be involved in serving children and the elderly in commercial establishments and other food service organizations (Scheule)." There seems to be a disconnect between dietetics education and the expectations of practicing dietitians. Within the current food and nutrition field, dietitians are being trained as the experts in food and nutrition, including food safety, but they

are not being provided with enough food safety education throughout their education.

#### Food Safety Knowledge in the U.S. Among General Population

Consumer food safety knowledge is a critical aspect of overall public health within any given population. Unfortunately, food safety knowledge among most consumers, independent of culture, educational levels, and socio-economic status, is substandard (Wilcock, Pun, Khanona, & Aung, 2004). Food safety knowledge and education is a complex and multifaceted tapestry, that spans from food producers and retailers to public health authorities and consumer health educators (Wilcock, Pun, Khanona & Aung). Food safety attitudes of consumers can be broken into six separate but related concerns, including chemical issues, health issues, spoilage issues, regulator issues, deceptive practices, and ideal situations (Brewer, Sprouls & Craig, 1994). These six factors indicate that consumers do show some concern for the overall safety of their food, as three of the six are directly related to food safety, chemical, spoilage and regulatory. In fact, most consumers are willing to pay a premium price on their products, be it in restaurants or when purchasing food, if the food's safety is guaranteed (Brewer, Sprouls & Craig).

Nearly half of consumers consider the food they eat to be very safe, with a few minor concerns for the food's safety with regards to foodborne illnesses and food handling (Brewer & Rojas 2007). While this may indicate an increase in consumer knowledge, it more likely represents their overall ignorance to every

day food safety issues. The issue of food safety within the consumer field is a problem that starts by informing consumers "about temperature control, correct food preparation practices and cross-contamination...the ubiquity of microorganisms, a comprehensive description of food-borne illnesses, and prevention strategies (Wilcock, Pun, Khanona & Aung)." No single organization can take responsibility for the education of consumers regarding food safety, it is a shared issue that should involve the health community, food service industry and the local, state and federal government who should focus education efforts on "high-risk groups, as well as those preparing food for people in these groups (Wilcock, Pun, Khanona & Aung)."

Even when consumers are concerned about food safety, they are usually concerned about non-issues. Consumers "generally uncertain about the safety and quality of their food, despite the fact the food supply has never been safer and better controlled (Verbeke, Frewer, Scholderer, & Debrander 2006)." Due to overall lack of food safety education consumers tend to overestimate the risk of being exposed to a contaminated product (Wilcock, Pun, Khanona & Aung). While oftentimes the issue is an overall lack of food safety information, when some consumers are provided with "concrete information aiming at reducing food safety uncertainty [they]...do not attend to or process this information (Wilcock, Pun, Khanona, & Aung)." This speaks to a wider issue among consumers, even when they do get information about food safety, they don't apply that information to their lives, which leads to continuing the actions that may have implications on their or their families' health and wellbeing.

One of the more difficult aspects of food safety is that consumers as a whole don't realize where their food comes from or the complexity that is required to keep the food supply safe (Jevsnik, Hlebec & Raspor, 2006). There are gaps in food safety knowledge that lead to consumers making uninformed and risky actions. One example of these knowledge gaps is the fact many consumers do not realize the importance of maintaining a cold chain, that is keeping cold/frozen foods cold from the time they are purchased from when they are prepared (Jevsnik, Hlebec & Raspor). Some of the more concerning knowledge deficients within the general population are incorrect knowledge regarding defrosting practices (improper cooling and reheated of cooked foods), lack of knowledge about proper refrigeration temperatures, and knowledge about how to avoid cross-contamination of foods (Jevskin, Hlebec & Raspor).

## **Among College Aged Population**

College aged populations exhibit just as many, if not more, food safety problems than the general population. Much like the general population, college students exhibited a high level of confidence regarding their food safety behaviors (e.g. proper food handling, sanitation, and food preparation procedures) despite not having proper knowledge of the subject (Booth, Hernandez, Baker, Grajales & Pribbs, 2013). The college age population, as a whole, believes they know the basics of food safety, such as avoiding cross contamination and practicing proper disinfection procedures, but few exhibit many of these practices under observation (Abbot, Byrd-Bredbenner, Schafffner, Bruhn & Blalock 2007). This lack of knowledge no doubt and continues to the overall lack of food safety knowledge in among the general population. A 2007 study observed that college students' seldom practice one of the most effective ways of preventing foodborne illness, washing their hands before and after handling food (Abbot, Byrd-Bredbenner, Schaffner, Bruh & Blalock). This same study found that college students also have a negligible at best usage of food thermometers when preparing food, despite knowing they are one of the easiest ways to practice food safety.

Research devoted to specifically food safety behaviors among a college age population is limited, however it does seem to agree that young adults are in need of more thorough food safety education, be it in the high school, undergraduate or community setting (Abbot, Byrd-Bredbenner, Schaffner, Bruh & Blalock). While most college health education focuses more on topics such as alcohol and substance abuse, sexual health and nutrition, there is a need to inform the college age population about proper food safety (Morrone & Rathbun, 2005). Education at the undergraduate level catches the population at a critical junction within their lives, they are still open to learning and many students are one their own for the first time, preparing meals for themselves, and are in need of food safety education, a skill that will benefit them the rest of their lives (Morrone & Rathbun). This education should be specific and focus on the overall risk of foodborne illness, prevention of cross contamination, and proper food handling techniques, which would hopefully translate into a practical, real world improvement of food safety practices.

While college ages students are not typically considered a high-risk group when considering food safety issues, they become one of the most at risk groups due to risky food behaviors. A study focusing on the University of Maine, found that while students did have a decent understanding of populations at risk for foodborne illness, they had poor knowledge of the foods that poise the biggest risk for foodborne illness (Furk, Caulder & Camire). College age students typically engage in food safety behaviors that put them at a higher risk than the general population (Morrone & Rathbun). For the most part the less they know about food safety, the more positive their attitudes are towards foods safety issues (Booth, Hernandez, Baker, Grajales & Pribbs). Essentially they are unaware of all the risk associated with improper food handling and overall food safety procedures so they believe there is nothing wrong their current behaviors. To put the college age population in perspective to the general population, a 2015 study that tested the food safety knowledge among University of Maine undergraduate students, and found that their knowledge was comparable to a large national survey done against the entire consumer population (Ferk, Calder, Camire, 2016). However, one area they did not appear as knowledgeable was regarding the sources of foodborne pathogens and high risk foods, such as sliced melons, sprouts and unpasteurized juice (Ferk, Calder & Camire).

#### Measurement of Food Safety Knowledge

An issue that plagues food safety education is the fact that there are few reliable ways to measure overall food safety knowledge exist (Mederios, et al. 2004). This makes it difficult to determine if educational measures and efforts that are benefitting individuals. Within the past several years there has been a push to develop instruments that provide a thorough and accurate picture of food safety knowledge (Mederios, et al.). The need for a standardized questionnaire or survey that can accurately capture the knowledge of a population could greatly improve the field of food safety education. What measuring food safety knowledge does is let healthcare professionals, food service staff, and government agencies, such as the FDA and the USDA, know where to focus their efforts with regards to informing the public.

One frequently used food safety test is Carol Byrd-Bredbenner's Food Safety Knowledge Questionnaire (FSKQ), developed in 2007. The FSKQ was developed out of a necessity for a more accurate and thorough way to measure food safety knowledge within a given population (Bryd-Bredbenner, Wheatley, Schaffner, Bruhn, Blalock, and Maurer, 2007). Serious consideration was given when developing the FSKQ to be sure it was both accessible to a general population, hence it being at a grade 7 reading level, while covering a wide variety of food safety topics. Most food safety knowledge tests cover several overriding themes and topics, as well as areas of concern, that are essential to a general population. The FSKQ asked questions that can be divided into five broad, yet related categories including; "cross contamination prevention & disinfection procedures", "safe times/temperatures for cooking/storing food", "groups at greatest risk for foodborne disease", and "common food sources of foodborne disease pathogens (Bryd-Bredbenner et al.)." Similarly, is the food safety knowledge scale that groups questions into five categories including; "practice personal hygiene," "cook foods adequately," "prevent cross-contamination," keep foods at safe temperature," and "avoid foods from unsafe sources (Meirdos et al.)." In practice, most of these surveys are asking the same thing, but some of them are more thorough while others more concerned with behavior and attitudes.

However, testing food safety knowledge is not the only effective way to gain perspective on how an individual or group will act within the context of food safety. To gain a true understanding and a complete picture, researchers often look at consumer behaviors with regards to foods safety, that is how they apply the knowledge that they already have within the context of food safety procedures. One such study, developed by Nevlin Sanlier in 2008, measured not only food safety knowledge among young adult consumers but how they applied or practiced that knowledge to their lives (Sanlier, 2008).

#### **Chapter III**

#### METHODOLOGY

## Design

The purpose of this study was to compare food safety knowledge of undergraduate hospitality majors versus nutrition majors at varying education levels. The study was a non-experimental two-way factorial design. The independent variables were major of the student, hospitality management or nutrition, and the educational level or year of school of the student, freshman sophomore, junior, and senior. The dependent variables were food safety knowledge on 5 areas of food safety knowledge and total food safety knowledge. This study was approved by the Institutional Review Board at Kent State University.

#### Sample

Participants in the study were Kent State University students currently enrolled in Hospitality Management and Nutrition programs. The inclusion criteria included nutrition students who were enrolled in the Didactic Program of Dietetics, while inclusion criteria for hospitality management majors included having that field as their major of study, within both the pre-professional and professional phase the program. All participants were enrolled in nutrition and/or hospitality management classes spring of 2017.

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#### **Instruments of Measure**

The Food Safety Knowledge Questionnaire (FSKQ) consists of five sections which include, Cross Contamination Prevention/Disinfection Procedures, Safe Times/Temperatures for Cooking/Storing Food, Foods that Increase Risk of Foodborne Disease, Groups at Greatest Risk for Foodborne Disease, and Common Sources of Foodborne Disease, with a total of 39 questions (Appendix A). The FSKQ is a statistically validated instrument with a reliability of 0.92 as computed by using Livingstons' Coefficient for criterion-referenced tests (Bryd-Bredbenner, Wheatley, Schaffner, Bruhn, Blalock & Maurer, 2007). The FSKQ was administered as a paper and pencil survey. The questionnaire also included a demographic questionnaire including: student's educational level, major, minor, age, gender, ethnicity, if they had job experience within the food service industry and if they were ServSafe® certified (Appendix B). Participants were also asked to select which classes they had completed from within their major.

#### Procedures

Before the study began, instructors granted permission for their students to complete the FSKQ during class time. A consent form was attached to the first page of the questionnaire informing students of the amount of time it would take to complete, possible risks and benefits of completing the questionnaire, and that all responses, including demographic information would be kept confidential. Student participation was voluntary. Participants did not provide their name or any other distinguishing information on the questionnaire aside from the demographic information. The procedures for both hospitality management and nutrition majors was the same. Questionnaires were given to students in a variety of class levels. Student participation was voluntary. The classes that participated included Nutrition, Applied Nutrition, Experimental Methods in Nutrition, Advanced Nutrition, Food Study, Introduction to the Profession: Dietetics, Sanitation and Safety Principles and Practices, Legal Issues in the Hospitality Industry, Hospitality Marketing, and Layout and Design of Food Service Operations, and Introduction to Hospitality Management. Students who were enrolled in more than one of these classes were asked not to complete the survey twice. The questionnaire was paper and pencil and students were given 20 minutes to complete the survey. The survey was administered by the researcher.

#### Scoring

Questionnaires were hand scored using Bryd-Bredbenner's original scale (Figure 1). Each correct answer was awarded one point. The scores for each scale corresponded to a section in the test and were calculated by adding the total number of points earned within each section. The scores for each section were then summed to compute the total food safety knowledge. Appendix C includes the correct answers to the FSKQ.
#### Table 1

*Food Safety Knowledge Questionnaire Scoring* (Bryd-Bredbenner, Wheatley, Schaffner, Bruhn, Blalock, and Maurer, 2007)

Scale Name	Possible Points	Livingston Reliability Coefficient
Cross contamination prevention & disinfection procedures	0 to 16	0.78
Safe times/temperatures for cooking/storing food	0 to 14	0.72
Foods that increase risk of foodborne disease	0 to 21	0.87
Groups at greatest risk for foodborne disease	o to 7	0.80
Common food sources of foodborne disease pathogens	0 to 8	0.72
Total	0 to 66	0.02

## **Data Analysis**

Means and standard deviations for knowledge scores from each section were reported along with the total. Data was analyzed using SPSS software. A 2x4 factorial ANOVA was performed on each subscale knowledge section (i.e. cross contamination prevention & disinfection procedures) and overall. Bonferroni post-hoc analysis was used to test for significance where differences were found. A p-value of p≤0.05 was selected for determining significance.

#### **CHAPTER IV**

#### JOURNAL ARTICLE

#### Introduction

The Center for Disease Control and Prevention (2016) states approximately 1 in every 6 Americans (48 million people) get sick, 128,000 are hospitalized, and 3,000 die each year of foodborne illnesses. A major contributor to this is an overall lack of food safety knowledge among consumers, food service workers, and the general population. (Jevsnik, Hlebec &Raspor, 2006; Wilcock, Pun, Khanona, & Aung, 2004; Verbeke, Frewer, Scholderer & DeBrander, 2007; Brewer, Rojas, 2008). A rapidly changing shift in the way consumers produce, buy and consume food provide a challenging "catch-up" for food safety laws, education and application (Sneed, Strohbehn, 2008; Bredbenner et al. 2008; Fatimah, Boo, Sambasivan & Salleh, 2011; Long, 2016; Nyachuba, 2010). Studies have shown that consumers do not have an adequate understanding of the principles of food safety, yet act in such a way that suggest they do (Wilcock, Pun, Khanona, & Aung; Brewer, Sprouls & Craig; Brewer & Rojas 2007).

Undergraduate education is a key junction for food safety education, be it for an average student, or more specifically, nutrition and hospitality management students. Undergraduate nutrition students, who will likely become dietitians, and hospitality management majors, poised

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to become food service managers, share the biggest burden for being responsible for the future of food safety. An issue for the public and consumers, is that neither of these groups are being adequately educated on food safety (Scheule, 2000). This is especially true for nutrition majors, who will more than likely become dietitians, who are considered the foremost experts on food and nutrition (Scheule). Dietitians are expected to be the most knowledgeable sources of food and nutrition information within the healthcare field, yet with inadequate education they can oftentimes come up short (Gross, Harris, 2002).

Research has shown that nutrition majors have typically less classroom experience with food safety than their hospitality management counterparts, with food safety education being spread throughout multiple classes instead of concentrated into one or two solely focusing on food safety (Short, Chittooran, 2004). This lack of food safety knowledge suggests a need for more comprehensive and thorough food safety education among consumers, college students, and especially dietetics and hospitality management students. The purpose of this study is to compare foods safety knowledge among undergraduate hospitality majors versus nutrition majors. The hypotheses include there being a difference in food safety knowledge between hospitality majors and nutrition majors, and between freshmen, sophomores, juniors and seniors within each major.

#### Methodology

The study was non-experimental two-way factorial design approved by the Institutional Review Board at Kent State University, comparing food safety knowledge among undergraduate hospitality majors versus nutrition majors at varying education levels. The independent variables were major of the student, hospitality management or nutrition, and the educational level or year of school of the student, freshman sophomore, junior, and senior. The dependent variables were food safety knowledge on 5 subsections of food safety knowledge and total food safety knowledge.

## Participants

Participants in the study were Kent State University students currently enrolled in Hospitality Management and Nutrition programs. The inclusion criteria included nutrition students who were enrolled in the Didactic Program of Dietetics, while inclusion criteria for hospitality management majors included having that field as their major of study, within both the pre-professional and professional phase the program. Both set of students were enrolled in nutrition and hospitality management classes spring of 2017.

## **Instruments of Measure**

The Food Safety Knowledge Questionnaire (FSKQ) consists of five sections which include, Cross Contamination Prevention/Disinfection Procedures, Safe Times/Temperatures for Cooking/Storing Food, Foods that Increase Risk of Foodborne Disease, Groups at Greatest Risk for Foodborne Disease, and Common Sources of Foodborne Disease, with a total of 39 questions (Appendix A). The FSKQ is a statistically validated instrument with a reliability of 0.92 as computed by using Livingstons' Coefficient for criterion-referenced tests (Bryd-Bredbenner, Wheatley, Schaffner, Bruhn, Blalock & Maurer, 2007). At the beginning of the questionnaire, participants were asked to provide demographic information including: student's grade levels, major, gender, ethnicity, if they had had a job within the food service industry and if they were ServSafe® certified (Appendix B). Major was included in the instance that there were nutrition majors in a hospitality management class and vise-versa. The FSKQ was administered as a paper and pencil survey.

## Procedures

Before the study began, instructors granted permission for their students to complete the FSKQ during class time. A consent form was attached to the first page of the questionnaire (Appendix C) informing students of the amount of time it would take to complete, possible risks and benefits of completing the questionnaire, and that all responses, including demographic information would be kept confidential. Student participation was voluntary. Questionnaires were given to students in a variety of class levels. The classes that participated included Nutrition, Applied Nutrition, Experimental Methods in Nutrition, Advanced Nutrition, Food Study, Introduction to the Profession: Dietetics, Sanitation and Safety Principles and Practices, Legal Issues in the Hospitality Industry, Hospitality Marketing, and Layout and Design of Food Service Operations, and Introduction to Hospitality Management. Students were asked not to complete the survey twice due to the possibility of having multiple classes within each department per semester. The questionnaire was paper and pencil and students were given 20 minutes to complete the survey. The survey was administered by the researcher.

## Scoring

Questionnaires were hand scored using Bryd-Bredbenner's original scale for the test (Bryd-Bredbenner, Wheatley, Schaffner, Bruhn, Blalock & Maurer). Each correct answer was awarded one point. The scores for each scale, which correspond to a section in the test, were calculated by adding the total points earned within each section. The scores for each section were then summed to compute the total food safety knowledge.

#### **Data Analysis**

Means and standard deviations for knowledge scores from each section were reported along with the total. Data was analyzed using SPSS software version 24 . A 2 x 4 factorial ANOVA was performed on each of the five knowledge subsections as well as the overall knowledge scores. Significance was set at a p-value of ≤0.05. A Bonferroni post-hoc analysis was used to determine specific significant differences.

### Results

The demographic data of the participants are highlighted in Table 2. Participants were evenly distributed between nutrition and hospitality management majors giving a total of 206 participants. One participant was excluded for completing less than 50% of the questionnaire, bringing the total sample size to 205. Most participants were female (78.1%). The majority of participants were Caucasian, followed by African American, Asian Pacific Islander, while Hispanic and Other were the least represented. The education year of students were prominently juniors and seniors. Students with jobs within the food service industry was reported at 83.4%, while only 37.1% of students reported being ServSafe certified.

## Table 2.

Demographics of Undergraduate Hospitality Management and Nutrition Students Participating in Food Safety Knowledge Study (n=205)

Demographics		Total % (n)
Major	Hospitality Management	44.8% (92)
	Nutruon	55.2% (113)
Gender	Male	21.9% (45)
	Female	78.1% (160)
Ethnicity	Caucasian	81.5% (167)
	African American	9.3% (19)
	Hispanic	2.9% (6)
	Asian Pacific Islander	3.4% (7)
	Other	2.9% (6)
Education Year	Freshman	11.7% (24)
	Sophomore	14.6% (30)
	Junior	34.2% (70)
	Senior	39.5% (81)
Job in Food Servic	e Yes	83.4% (171)
	No	16.7% (34)
ServSafe Certified	Yes	37.1% (76)
	No	62.9% (129)

#### **Knowledge Assessment Subsections**

The FSKQ consists of five different sections including Cross Contamination Prevention/Disinfection Procedures; Safe Times/Temperatures for Cooking/Storing Food; Foods that Increase Risk of Foodborne Disease; Groups at Greatest Risk for Foodborne Disease; and Common Food Sources of Foodborne Disease. Table 3 details the scores (means and standard deviation) within each subsection, broken down by major, and educational year. The overall averages score for Hospitality Management students was  $43.9\pm7.3$ , Nutrition students was  $48.2\pm8.3$ .

#### Food Service Experience and SafeServ Certification

Table 4 details the difference in score between students who have had jobs in the food service industry, and those that are SafeServ certified. Pairwise comparison revealed no significant difference in knowledge between those who have had jobs within the food service industry and those who haven't (p=0.519), and no significant difference in knowledge between participants who were ServSafe certified and those who were not (p=0.123).

## Table 3.

Food Safety Knowledge Questionnaire Scores by Subsection in Food Safety Knowledge Study

	Hospitality Male	Management Female	Nutrition Male	Female
Subsection 1ª				
Freshmen	13.0±0.0	$13.0\pm2.1$	11.0±1.4	$11.5 \pm 2.1$
Sophomore	10.5±4.9	$11.6 \pm 2.5$	11.0±0.0	$11.5 \pm 2.7$
Junior	12.1±2.4	12.5±1.8	$12.8 \pm 1.2$	11.7±1.9
Senior	12.8±1.4	13.8±1.9	13.1±1.8	$12.9 \pm 1.7$
Subsection 2 <sup>b</sup>				
Freshmen	11.0±0.0	8.2±2.3	8.5±0.7	7.6±2.3
Sophomore	6.0±0.0	8.4±2.4	6.0±0.0	6.6±3.7
Junior	9.6±2.6	9.4±2.3	$11.3\pm0.5$	9.4±1.8
Senior	10.8±1.8	9.9±1.9	10.1±2.1	9.3±2.1
Subsection 3 <sup>c</sup>				
Freshmen	10.0±0.0	14.5±3.0	$11.5 \pm 2.1$	10.9±3.8
Sophomore	10.0±1.4	$12.4\pm3.3$	13.0±0.0	10.8±4.3
Junior	13.5±4.4	$12.5 \pm 3.1$	14.8±4.3	$13.5 \pm 4.2$
Senior	14.7±3.7	13.4±3.6	13.8±3.5	13.8±3.5
Subsection 4 <sup>d</sup>				
Freshmen	5.0±0.0	4.7±1.3	4.5±0.7	$5.2 \pm 1.5$
Sophomore	3.0±1.4	5.5±0.9	5.0±0.0	4.3±2.2
Junior	5.7±1.4	$5.3 \pm 1.1$	$5.2 \pm 1.5$	5.7±1.4
Senior	5.1±1.7	5.2±1.2	5.6±0.9	5.6±0.9
Subsection 5 <sup>e</sup>				
Freshmen	4.0±0.0	$3.0\pm2.2$	$1.5\pm0.7$	2.6±1.3
Sophomore	1.0±0.0	$3.2\pm1.4$	1.0±0.0	$3.0\pm2.0$
Junior	$3.5 \pm 1.6$	$3.4\pm1.7$	$5.5\pm1.7$	$3.5\pm1.9$
Senior	$3.5\pm1.7$	$3.5\pm1.9$	4.0±2.3	$3.8 \pm 1.8$

<sup>a</sup>Cross Contamination Prevention/Disinfection Procedures. 16 points possible. <sup>b</sup>Safe Times/Temperatures for Cooking/Storing Foods. 14 points possible. <sup>c</sup>Foods that Increase Risk of Foodborne Disease. 21 points possible. <sup>d</sup>Groups at Greatest Risk for Foodborne Disease. 7 points possible.

<sup>e</sup>Common Food Sources of Foodborne Disease. 14 points possible.

## Table 4.

Average Scores per FSKQ Subsection by Participants with Food Service Experience and ServSafe Certification

	Food Service Experience	ServeSafe Certified	n	$\overline{X} \pm SD$
Subsection 1ª	Yes	Yes	74	3.5±1.8
		No	97	$3.5\pm1.9$
	No	Yes	2	$3.5 \pm 2.1$
		No	32	3.2±1.8
Subsection 2	o Yes	Yes	74	10.1±1.9
		No	97	9.1±2.1
	No	Yes	2	9.0±0.1
		No	32	7.4±3.0
Subsection 39	e Yes	Yes	74	13.3±3.6
		No	97	13.3±3.9
	No	Yes	2	$15.5 \pm 4.9$
		No	32	12.1±3.6
Subsection 4	<sup>d</sup> Yes	Yes	74	5.4±1.3
		No	97	3.3±3.9
	No	Yes	2	5.0±1.4
		No	32	4.9±1.7
Subsection 5	e Yes	Yes	74	3.5±1.8
Ũ		No	97	3.5±1.9
	No	Yes	2	$3.5\pm2.1$
		No	32	3.2±1.8

<sup>A</sup>Cross Contamination Prevention/Disinfection Procedures. 16 points possible. <sup>B</sup>Safe Times/Temperatures for Cooking/Storing Foods. 14 points possible. <sup>C</sup>Foods that Increase Risk of Foodborne Disease. 21 points possible. <sup>D</sup>Groups at Greatest Risk for Foodborne Disease. 7 points possible. <sup>E</sup>Common Food Sources of Foodborne Disease. 14 points possible Analysis of the overall food safety knowledge showed that the only significance was between educational level of students. The only significance was comparing freshmen to seniors, p=0.007; sophomores to juniors, p=0.005; sophomores to seniors,  $p=\le0.001$ ; juniors to sophomores, p=0.005; seniors to freshmen, p=0.007; and seniors to sophomores,  $p=\le0.001$ .

### Table 5.

	$\Lambda \pm 5D$	P
Sophomore	38.5±8.9	0.999
Junior	44.1±7.2	0.159
Senior	45.8±7.4	<b>0.007</b> <sup>a</sup>
Freshman	40.1±6.3	0.999
Junior	44.1±7.2	$0.005^{\mathrm{b}}$
Senior	45.8±7.4	≤ <b>0.001</b> <sup>b</sup>
Freshman	40.1±6.3	0.159
Sophomore	$38.5 \pm 8.9$	$0.05^{c}$
Senior	45.8±7.4	0.889
Freshman	40.1±6.3	<b>0.007</b> <sup>d</sup>
Sophomore	38.5±8.9	≤ <b>0.001</b> <sup>d</sup>
Junior	44 <b>.</b> 1±7 <b>.</b> 2	0.889
	Sophomore Junior SeniorFreshman Junior SeniorFreshman Sophomore SeniorFreshman Sophomore SeniorFreshman Sophomore Junior	Sophomore $38.5\pm 8.9$ Junior $44.1\pm 7.2$ Senior $45.8\pm 7.4$ Freshman $40.1\pm 6.3$ Junior $44.1\pm 7.2$ Senior $45.8\pm 7.4$ Freshman $40.1\pm 6.3$ Sophomore $38.5\pm 8.9$ Senior $45.8\pm 7.4$ Freshman $40.1\pm 6.3$ Sophomore $38.5\pm 8.9$ Senior $45.8\pm 7.4$ Freshman $40.1\pm 6.3$ Sophomore $38.5\pm 8.9$ Junior $44.1\pm 7.2$

Post Hoc Analysis of FSKQ Scores in Hospitality and Nutrition Students

<sup>a</sup> Significant difference in freshmen and senior scores.

<sup>b</sup>Significant difference in sophomore and junior/senior scores.

cSignificant difference in junior and sophomore scores.

<sup>d</sup>Significant difference in senior and freshmen/sophomore scores.

#### Discussion

The first hypothesis, that there would be a difference in food safety knowledge between hospitality majors and nutrition majors, has been rejected. The second, that there would be a difference in food safety knowledge between freshmen, sophomores, juniors and seniors within each major, has been partially accepted because there was not a significant difference among every grade level. The third and fourth hypotheses, that there would be a difference in in food safety knowledge among participants who were ServSafe certified and those with food service experience, was rejected.

While the data itself provides a thorough representation of overall food safety knowledge of the participants, comparing the results to a nationwide survey provides a more detailed and useful look at what these results mean. Figure 1 compares the results of this study to a national survey of college students (Abbot, Byrd-Bredbenner, Schaffner , Bruhn, Blalock, 2006). The 2006 national study, which used the FSKQ, consisted of students from a variety of undergraduate universities, with no college major predominating. Essentially, it was a survey of an average college population, with no food safety education within their curriculum (Abbot, Byrd-Bredbenner, Schaffner, Bruhn, Blalock). As Figure 1 illustrates, the results were essentially the same as the current study. Within the five subsections, Kent State participants scored higher in two, lower in two and tied in one. The Kent State participants seemed to perform at the same level as college students with little to no exposure to food safety. While it is encouraging the scores were not lower than the national average, it seems to suggest the food safety Kent State students are receiving makes no discernable difference in overall food safety knowledge.



**Figure 1.** *Kent State Food Safety Knowledge Compared to 2006 National Study.* (Abbot, Byrd-Bredbenner, Schaffner , Bruhn, Blalock, 2006) <sup>a</sup>Cross Contamination Prevention/Disinfection Procedures. <sup>b</sup>Safe Times/Temperatures for Cooking/Storing Foods. <sup>c</sup>Foods that Increase Risk of Foodborne Disease. <sup>d</sup>Groups at Greatest Risk for Foodborne Disease. <sup>e</sup>Common Food Sources of Foodborne Disease.

## **Cross-Contamination Prevention and Sanitation Procedures**

This is one of two sections in which participants in this study scored

higher than the national average, (73% vs. 63%). Within this study, this

subsection was the second highest scoring section overall. Participants in this

section scored better on questions that covered general disinfection techniques,

for example, the best way to wash dishes to prevent food poisoning. This

contrasts with the more specific questions, for example which individuals should not prepare food for other people to prevent foodborne illness. Questions in this section covered what could be described as "common knowledge" issues regarding food safety. Several of the questions were scenarios that students may have encountered in their day to day lives, regardless of their educational experience or college major.

#### Safe Times and Temperatures for Cooking and Storing Food

Questions within subsection 2 ask about temperatures for specific foods. Participants did better answering the questions that were not about temperatures but about proper food storage. Almost all participants knew that an open box of raisins does not have to be refrigerated to prevent food poisoning, but far less knew the correct temperature ground beef needs to reach to be safe to eat. It appears that students learn how they should store food before, during and after purchase, before and after food production but have trouble learning, or at least remembering, the proper temperatures to cook food to keep it safe. Questions that ask about temperatures also make it harder for participants to make informed guesses. Instead of being able to guess the answer through process of elimination, participants essentially must know the correct answer. These results mirror the issues found within the general consumer population, that individuals are uninformed about "temperature control, correct food preparation practices and cross-contamination prevention strategies (Willcock, Pun, Khanona & Aung, 2004)."

#### Foods that Increase Risk of Foodborne Disease

Within this subsection, participants had an easy time answering the first two questions correctly, yet had difficulty answering all of question three correctly. Question three had 25 possible answers, only 19 of which were correct. The question asked eating which foods would increase a person's risk of food poisoning. While most students could select several of the correct answers, only two answered the entirety of question three correctly. However, question one, a true or false question, and question two, asking which food is least likely to cause food poisoning, were answered correctly by most participants. Scores in this subsection were six percentage points lower than the national average of 68% correct.

#### **Groups at Greatest Risk for Foodborne Illness**

With only seven possible points available, this subsection had the highest percentage correct of any on the questionnaire. Both participants in this study and the 2006 national average scored 76% of questions correct. Most participants knew that individuals with diabetes, HIV infection and cancer were at higher risk for foodborne illness, topics asked twice in this subsection, in questions one and three. Question two caused issues for participants by asking which foods pregnant women, infants and children need to avoid. Taking into account both subsection three and four, the results parallel findings of a previous study at the University of Maine that found while students have poor knowledge of the foods that poise the biggest risk for foodborne illness, seen with participants of this study in subsection three, they did have a decent understanding of populations at risk for foodborne illnesses (Furk, Caulder & Camire). Nutrition students scored slightly higher on this subsection than hospitality students, possibly due to the emphasis on clinical information present in both this subsection and nutrition students' coursework.

#### **Common Sources of Foodborne Illnesses**

This section had the lowest percentage correct of all, with only 43% answered correctly by participants in this study. Questions in this section covered specific microorganisms that cause foodborne illnesses. While participants could identify some common foodborne illnesses such as salmonella bacteria being commonly associated from raw chicken, very few answered correctly when asked about staphylococcus, e. coli, or trichinosis. Nutrition majors scored marginally better than hospitality majors, which can most likely be attributed to nutrition majors having more emphasis on microbiology throughout their education. It is worth noting that these participants did score slightly higher than the national average of 39%. Microorganisms are a food safety risk that many consumers overlook as well as those that have formal training regarding food safety (Wilcock, Pun, Khanona & Aung). Scores within this subsection help confirm that not all consumers are concerned about microorganisms, mainly due to ignorance of the different types and potential health risk associated with them (Sneed & Strohbehn).

#### Field of Study vs. Educational Year

This study suggest that it is not field of study that makes a difference in food safety knowledge, but the educational year of the student. In fact, the only significance found in any of the variables was educational year. These results students learn the bulk of their food safety knowledge within their sophomore and junior years and forget it by the time they are seniors. Hospitality Management students take classes focusing on food safety within the first two years of their degree, the end of their freshman year or within their sophomore year.

When considering the classes, participants had taken and their influence on overall test score, Sanitation and Safety Principles, Layout and Design of Food Service Operations, Food Production and Service Management, Food Service Systems Management, and Basic Microbiology seemed to have the most positive effect on overall food safety knowledge. These classes focus more on the overall processes of food production rather than the nutritional aspects of food. Basic Microbiology is a requirement for nutrition students but not for hospitality management students, which could explain the slightly higher scores within the Common Food Sources of Foodborne Disease subsection within nutrition majors. Basic microbiology is also a class that is typically taken within the sixth semester, or junior year of nutrition students, which would also explain why the scores were higher among junior and seniors in this subsection as opposed to freshmen and sophomores.

#### ServSafe & Food Service Experience

One surprising aspect of this study is that neither ServSafe nor food service experience made a significant difference among participant's overall food safety knowledge. This seems to suggest that participants who are ServSafe certified, learn what they need to only to pass the exam, and subsequently forget specifics, keeping only the basics or common knowledge aspects of the exam. This also suggest that individuals with food service experience do not know the essentials of food safety.

In Sanitation and Safety Principles students learn the essentials of food safety and sanitation and take the ServSafe certification test within the class. This class focuses on the very specifics of food safety, essentially preparing students for the ServSafe. This class in addition to Layout and Design of Food Service Operations, could explain the slightly higher, yet not significant scores on the Foods that Increase Risk of Foodborne Disease, Knowledge of Safe Times/Temperatures for Cooking/Storing Foods, Cross Contamination Prevention/Disinfection Procedures subsections by hospitality management.

#### Limitations

Limitations within this study are mainly attributed to the FSKQ itself. While the FSKQ is statistically validated and thorough measurement tool for testing food safety knowledge, it has several issues that keep it from becoming the standard for testing food safety knowledge. One of these issues is that the test is too long for several students. With this research being conducted in the classroom students, using the time allotted within the class, some students indicated they felt rushed to complete the questionnaire and didn't have adequate time to thoroughly read every question.

The design of the test is also inconsistent, which caused confusion among some students. While several questions ask for more than one answer, such as question 10 and 11 in the Cross-Contamination Prevention/Disinfection Procedures, most questions only have one correct answer. However, several students within both fields of study answered questions that only have one correct answer with two, three or even four answers, in this situation these questions were marked incorrect even if the students did select the correct answer. The study could have also been improved on by including a control group. Comparing hospitality management and nutrition students to "normal" undergraduate students whose education has no emphasis on food safety could give useful insight into how much food safety the students have learned as opposed to how much was simply common knowledge or guesswork.

#### Strengths

The strengths of this study were that FSKQ is an incredibly thorough survey tool that incorporates some of the most important aspects of food safety. It tests participant's knowledge on a variety of food safety topics from specific foodborne illnesses to proper safety and sanitation procedures. The knowledge tested is thorough, providing a detailed look into participant's overall food safety knowledge. Another strength of this study were the participants themselves. The survey was completed by students at a variety education levels, with sample sizes being well represented within both fields of study. This allowed the survey to give an unbiased look at the food safety knowledge of the two majors, by having participants that were at the beginning of their college career, freshmen that had only had a few classes, in some cases only one, and those that are finishing out their college career, seniors who only have a few classes left until they graduate. While most participants were Caucasian females, that is in fact representative of these fields of study within an undergraduate population and accurately reflect the student population.

### Applications

The results of this study have several practical applications most of which start with an increased educational effort on many fronts. Within the academic setting, it appears that food safety isn't being taught in way that is allowing students to reach their full potential. Hospitality management and nutrition majors represent the only groups of students who have an emphasis on food safety within their curriculum and students seem to students gain the most foods safety knowledge within their sophomore and junior years, while not completely retaining it by the time they are seniors. Taking this into account, classes and coursework could be modified to ensure students learn and retain all relevant food safety information. Students could start their educational careers with classes that emphasize food safety and build on the foundation of that knowledge until they graduate. Incorporating food safety into a variety of classes could help students understand and retain the importance of food safety.

These results are consistent with current literature that suggest consumers are undereducated and overconfident in their foods safety knowledge (Brewer & Rojas). Specifically, the risky behaviors that most undergraduate students engage in, for example not cooking or refrigerating food properly, does not seem to be an isolated incident among individuals who have no food safety knowledge, but common place among almost all individuals within that age group (Morrone & Rathburn). The overall issue here is something that cannot simply be changed by modifying existing educational efforts. To reverse the trend of food safety ignorance there needs to be a culture shift that makes food safety a public health issue. By bringing this concept to the forefront of the public's attention they can make food safety measures like proper hand washing, measuring food temperature and proper food storage a part of everyday life.

The Accreditation Council for Education in Nutrition and Dietetics, ACEND, could use these results to ensure that undergraduate dietetics programs are covering enough areas of food safety to prepare students for the next step in their academic careers, dietetic internships. The Academy of Nutrition and Dietetics (AND) only has three competencies that cover food safety and risk management (Commission on Dietetics Registration, 2016). Increasing the number of competencies that cover food safety within the dietetic internship would be a relatively easy way to ensure that dietitians have the adequate experience with food safety.

This study may give insight to how students feel about food safety, that is, not much. In their minds, it is just something they learn to a pass a test, be it for a class within their major or ServSafe. A fundamental change in how students understand and are introduced. Incorporating case studies, which provide students with real examples of how and why food safety is important, could increase students' retention of food safety. Case studies are already common practice within the dietetic educational field regarding the clinical setting and issues, so introducing food safety alongside these case studies would not be anything new for students.

A similar effort could be given to updating or modifying ServSafe certification, which is the industry wide standard on food safety knowledge and application. ServSafe could be modified to fit the environment individuals would be working in. For example, a food service directors at hospitals could receive a more thorough and in-depth food ServSafe certification to better equip them for more at risk population. Within this study, individuals who were ServSafe certified did not score better than individuals who were not. More thorough education throughout the ServSafe certification process could be beneficial for anyone who is becoming ServSafe certified.

One of the more practical applications of this research is that it can give both nutrition students and hospitality management students a guideline on what

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all to cover when considering food safety topics within their careers. While this study does not consider a population that has no experience with food safety, the overall low scores give insight into what areas should covered when addressing individuals, be it patients within a clinical setting, hospital staff, or workers within the food service industry.

## Conclusion

Food safety knowledge does not appear to be any different among hospitality management and nutrition students, or students who are ServSafe certified or not. However, there appears to be a significant differences educational level, which may be due to the order of curriculum within each major. **APPENDICES** 

**APPENDIX A** 

FOOD SAFETY KNOWLEDGE QUESTIONNAIRE

## Appendix A

## Survey Questionnaire

## Please Select the Best Answer (Correct answer **bolded**) **Cross Contamination Prevention/Disinfection Procedures**

- 1. The **best** way to keep from getting food poisoning from fresh fruits and vegetables is to wash them with
  - $\Box$  regular soap
  - $\hfill\square$  hot water
  - $\hfill\square$  antibacterial soap
  - $\Box$  an antibacterial sponge

## □ cool running water

2. After you have used a cutting board to slice raw meat, chicken, or fish and need to cut other foods, which of these is the best way to prevent food poisoning?

*Choice 1:* wipe the cutting board off with a paper towel

*Choice 2* : rinse the cutting board under very hot water

*Choice 3* : turn the board over and use the other side

*Choice 4 :* wash the cutting board with hot soapy water and rinse

*Choice 5:* set the cutting board aside and use a different cutting board to cut other foods

- $\Box$  Choice 2, 3, or 5
- $\Box$  Choice 3 or 4
- □ Choice 4 or 5
- $\hfill \square$  All of the choices

3. To prevent food poisoning, the best way to wash dishes is to:

Choice 1: wash and dry them in an automatic dishwasher

*Choice 2:* soak them in the sink for several hours and wash them in the same water *Choice 3:* hand-wash them right after the meal and let them air dry

*Choice 4:* hand-wash them right after the meal and then dry the with a dish towel

- $\Box$  Choice 1 or 2
- □ Choice 1 or 3
- $\Box$  Choice 2 or 4
- $\Box$  Choice 3 or 4

 $\Box$  Any choice is fine as long as the dishes look clean

4. When should kitchen counters be washed, rinsed, and sanitized?

 $\Box$  after each use

 $\Box$  when you begin working with another type of food

 $\Box$  at 4-hour intervals if the counter is in constant use

# $\Box$ all of the above

5. Which procedure for cleaning kitchen counters is most likely to prevent food poisoning?

 $\Box$  spray with a strong sanitizing solution

 $\Box$  wash with a detergent, rinse, then wipe with a sanitizing solution

 $\Box$  wipe with a sanitizing solution, then rinse with clean water and wipe dry

 $\Box$  brush off any dirt or food pieces, then wipe with sanitizing solution

6. To prevent food poisoning, how often should the kitchen sink in your home be sanitized?

# □ daily

 $\Box$  weekly

 $\Box$  monthly

 $\Box$  only when food is going to be thawed or washed in the sink

7. Which is the most hygienic way to wash your hands?

 $\Box$  apply sanitizer, run water, rub hands together for 20 seconds, rinse hands, dry hands, rub on an antiseptic hand lotion

 $\Box$  apply soap, rub hands together for 20 seconds, rinse hands under water, dry hands, apply sanitizer

# $\Box$ run water, moisten hands, apply soap, rub hands together for 20 seconds, rinse hands, dry hands

 $\Box$  run water, moisten hands, apply sanitizer, rub hands together for 20 seconds, rinse hands, dry hands, rub on antiseptic hand lotion

8. If you have a sore on the back of your hand, should you prepare food for other people?

 $\Box$  Yes, if it isn't infected.

 $\Box$  Yes, if you put a bandage on it.

 $\Box$  Yes, if you wear a glove.

# $\Box$ Yes, if you bandage the sore and wear a glove.

 $\Box$  No, you should not prepare food until the sore heals.

9. Which should not be done when storing raw meat, fish, or poultry in the refrigerator?

 $\Box$  place it in the coldest part of the refrigerator.

 $\Box$  set it in a larger container before refrigerating.

 $\Box$  place it on the lowest shelf in the refrigerator.

 $\Box$  leave it in the package it came in.

# $\Box$ all should be done when storing raw meat, fish, or poultry.

10. To prevent food poisoning, which of these individuals should not prepare food for other people? (*Check <u>all</u> that apply*)

# $\Box$ a person with diarrhea

 $\Box$  a person with severe acne

 $\Box$  a person with bandaged burns on his hands that are covered with gloves

 $\Box$  a person with a fever

 $\Box$  a person with unexplained itching

 $\Box$  a person who smokes

# $\Box$ a person with a sore throat

 $\Box$  a person with a cold

# $\Box$ a person with vomiting

- $\Box$  a person with HIV
- $\Box$  none of these individuals

11. When preparing food, you should wash your hands after touching which of these? (*Check <u>all</u> that apply*)

## □ your face

- $\Box$  clean pots and pans
- $\Box$  utensils that are being used to prepare food
- 🗆 fresh fruit
- $\Box$  dishes that came out of the dishwasher
- □ a pimple

 $\Box$  clean countertop

- $\Box$  clothing
- $\Box$  none of these

# Safe Times/Temperatures for Cooking/Storing Food

1. Which practice is most likely to cause food poisoning?

# □ leaving stuffing in a cooked turkey until it cools to room temperature

 $\Box$  stuffing turkeys just before cooking them

 $\Box$  cooking turkeys until the stuffing reaches 165° F

 $\Box$  removing the giblet bag before cooking a turkey

# 2. When is it safest to place refrigerated foods in your cart when grocery shopping?

 $\Box$  early in the shopping trip

 $\Box$  about halfway through the shopping trip

 $\Box$  near the end of the shopping trip

## $\hfill\square$ at the very end of the shopping trip, just before checking out

 $\Box$  it doesn't matter when I place them in the cart

3. What is the recommended freezer temperature for preventing food poisoning?

- □ 0° F (-18° C)
- $\Box 18^{\circ} F (-8^{\circ} C) \\ \Box 24^{\circ} F (-4^{\circ} C)$
- □ 32° F (0° C)

4. Imagine that your electricity went off and the meat, chicken, and/or seafood in your freezer thawed and felt warm. To prevent food poisoning what should you do?

## □ throw them away

 $\Box$  cook them right away

 $\Box$  see how they smell or look before deciding what to do

 $\Box$  immediately re-freeze until solidly frozen, then cook them

5. Which of the following is considered the most important way to prevent food poisoning?

 $\Box$  spray for pests in the kitchen area at least every week

 $\Box$  rarely or never serve leftovers

□ keep foods refrigerated until it's time to cook or serve them

 $\Box$  clean kitchen counters with sanitizing solutions weekly

6. For ground beef to be safe to eat, it needs to be cooked until its internal temperature reaches

```
\Box 90 {}^{\circ}F (32 {}^{\circ}C) \\\Box 125 {}^{\circ}F (52 {}^{\circ}C)
```

 $\Box 125 P(52 C)$  $\Box 160 {}^{0}F(71 {}^{0}C)$ 

 $\Box$  250 °F (121 °C)

7. What is the maximum temperature refrigerators should be to preserve the safety of foods?

□ 0 °F (-18 °C) □ 25 °F (-4 °C) □ 40 °F (4 °C) □ 45 °F (7 °C) □ 60 °F (16 °C)

8. If a family member is going to be several hours late for a hot meal, how should you store the meal to keep it safe until this person is ready to eat it?

# $\hfill\square$ store it in the refrigerator and reheat it when the person is ready to eat it

 $\Box$  store it in on the kitchen counter until the person is ready to eat it

 $\Box$  store it in a cool oven until the person is ready to eat it

 $\Box$  store it in a warm oven until the person is ready to eat it

9. All foods are considered safe when cooked to an internal temperature of

- □ 130 °F (54 °C)
- □ 140 °F (60 °C)
- □ 150 °F (66 °C)
- □ 165 °F (74 °C)

10. Which is the most accurate way of determining whether hamburgers are cooked to prevent food poisoning?

 $\Box$  cut one to check the color of the meat inside

 $\Box$  check the color of the juice to be sure it is not pink

# $\hfill\square$ measure the temperature with a food thermometer

 $\Box$  check the texture or firmness of the meat

- $\Box$  measure the length of time the hamburgers cook
- 11. Which food does not need to be refrigerated to prevent food poisoning?
  - $\Box$  fresh fruit salad
  - $\Box$  roasted ears of corn on the cob
  - $\Box$  open box of raisins
  - $\Box$  chocolate pudding
  - $\Box$  an open can of green beans
- 12. To prevent food poisoning, how long should leftover foods be heated?

## $\Box$ until they are boiling hot

- $\Box$  just until they are hot, but not too hot to eat right away
- $\Box$  just until they are at least room temperature
- $\Box$  reheating isn't necessary
- 13. What is the least safe method for thawing a frozen roast?
  - $\Box$  leave it in the refrigerator until it is thaved
  - $\Box$  leave it on the kitchen counter until it is thawed
  - $\Box$  put it in the microwave oven set to automatic defrost
  - $\Box$  put it under running water for 1 hour
- 14. What is the safest method for cooling a large pot of hot soup?
  - □ put the soup in a shallow pan and refrigerate it right away
  - $\Box$  place the cooking pot filled with soup in the refrigerator right away
  - $\Box$  transfer the soup to a clean, deep pot before refrigerating it
  - $\Box$  leave it on the counter until it cools to room temperature, then refrigerate it
  - $\Box$  add ice cubes to the soup

## Foods that Increase Risk of Foodborne Disease

- 1. Chilling or freezing eliminates harmful germs in food.
  - $\Box$  true
  - □ false

2. Which food is least likely to cause food poisoning?

 $\Box$  slices of cantaloupe left on the counter overnight

 $\Box$  baked potato that was left on the kitchen counter overnight

 $\Box$  leftover turkey eaten cold

# □ chocolate cake that was left on the kitchen counter overnight

3. Eating which of these foods will increase a person's risk of food poisoning? (*Check <u>all</u> that apply*).

□Raw oysters, clams or mussels

 $\Box$  Home canned beans, carrots, peas or potatoes right from the jar

□ Unpasteurized milk

□ Rare hamburgers

□ Leftover soup reheated until warm, but not boiling

□ Fried eggs with a runny or soft yolk

□ Raw homemade cookie dough or cake batter

□ Grilled steak served on the same plate that held the raw steak

without washing the plate

🗆 Sushi

□ Food right from the refrigerator that feels warm

 $\Box$  Meat cooked medium-well

□ Unpasteurized fruit juice

□ Cooked shellfish that have unopened shells

□ Sliced melon

 $\Box$  Foods prepared in the kitchen with a pet present

□ Fresh fruit salad stored at room temperature

 $\Box$  Frozen foods with frost build up on the package

 $\Box$  Food stored in a cabinet beside an oven

□ Fresh raw milk cheese

□ Soft food like jelly or sour cream after scraping off mold

□ Raw sprouts (alfalfa, clover, radish)

 $\Box$  Commercially canned vegetables right out of the can without re-heating them

 $\hfill\square$  Picnic foods that were stored at room temperature for more than 2 hours

 $\Box\,$  Box of rice that does not show a USDA inspection stamp

 $\Box$  None of these foods

## Groups at Greatest Risk for Foodborne Disease

1. People should be especially careful about not eating raw seafood, if they have

 $\Box$  diabetes.

 $\Box$  HIV infection.

 $\Box$  cancer.

## $\Box$ any of these diseases

2. Which foods do pregnant women, infants, and children not need to avoid?

 $\Box$  soft cheeses, cold smoked fish, cold deli salads

 $\Box$  hot dogs and lunchmeat that have not been reheated

 $\Box$  raw or undercooked eggs

# □ canned vegetables, pasteurized fruit juices

 $\Box$  These individuals do not need to avoid any type of food

3. Compared to most people, which of these individuals are more likely to get sick or seriously ill from harmful germs in food? (*Check <u>all</u> that apply)* 

 $\Box$  preschool children

 $\Box$  teenagers

□ pregnant women

□ older people (ager 60 and over)

□ people who are HIV positive

□ cancer patients

 $\Box$  people who frequently eat at restaurants or get take-out food often

 $\Box$  none of these individuals

## **Common Food Sources of Foodborne Disease**

- 1. Salmonella bacteria can cause food poisoning. How can a food be made safe it is has salmonella in it?
  - $\Box$  cook it thoroughly
  - $\Box$  wash it under extremely hot running water

 $\Box$  freeze it for at least 3 days

 $\Box$  the food cannot be made safe

2. Staph (Staphylococcus) bacteria that cause food poisoning are most likely associated with which food?

 $\Box$  contaminated water from unfiltered mountain streams and lakes

 $\hfill\square$  food prepared by cooks with their bare hands and then left at room temperature

 $\Box$  undercooked pork, especially bacon

 $\Box$  raw or undercooked eggs and poultry

# 3. Botulism is a disease that is most likely associated with which food?

# $\Box$ canned foods

 $\hfill\square$  food prepared by cooks with their bare hands and then left at room temperature

 $\Box$  undercooked pork, especially bacon

 $\Box$  raw eggs, or raw or undercooked poultry

- 4. Listeria bacteria are most likely associated with which food?
  - $\Box$  home canned foods

 $\Box\,$  raw or undercooked beef

□ deli meats

 $\Box$  raw eggs and poultry

5. Harmful E. coli bacteria are most likely associated with which food?

 $\Box$  raw or undercooked pork

 $\Box$  sliced lunch meat

□ soft cheeses like Brie

# □ raw or undercooked beef

# 6. Trichinosis is most likely associated with which food?

 $\Box$  deli meats

# □ raw or undercooked pork

 $\Box$  soft cheeses like Brie

 $\Box$  raw or undercooked beef

7. Campylobacter bacteria are most likely associated with which food?

 $\Box$  canned food

 $\Box$  raw or undercooked pork

# $\Box$ raw or undercooked poultry

 $\hfill\square$  raw or undercooked beef

8. You may contaminate the next food you touch with salmonella bacteria if you don't wash your hands after touching:

 $\Box$  raw pork.

 $\Box$  raw sprouts and lettuce.

 $\Box$  raw beef.

 $\Box$  raw chicken

## **APPENDIX B**

# **DEMOGRAPHIC QUESTIONS**

## Appendix B

## **Demographic Questions**

\_\_\_\_\_Major

Minor

\_\_\_\_Age

Please select your year of education:

Freshman

Sophomore

Junior

Senior

## What is Your Gender:

Male

Female

Other

## What is your Ethnicity:

Caucasian

African American

Hispanic

Asian/Pacific Islander

Other

Do Not Wish to Answer

Have you had a job within the foodservice industry?	Yes	No
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Are you S	ServSafe Certified?	Yes	No
Please select **ALL** the classes you have completed.

Science of Human Nutrition	Hotel Operations
Nutrition and Dietetics: Professional Practice	Food Study
Food Production and Service Management	Nutrition
Layout and Design of Food Service Operations	Clinical Dietetics
Applied Nutrition	Community Nutrition
Nutrition for Fitness	Maternal and Child Nutrition
Cultural Aspects of Food and Nutrition	Hospitality Purchasing
Techniques of Food Production	Hospitality Marketing
Advanced Nutrition 1 & 2	Hospitality Financial Policy
Sanitation and Safety Principles	
Experimental Methods in Nutrition	
Hospitality Cost Control and Analysis	
Legal Issues in the Hospitality Industry	
Hospitality Human Resource Management	
Professional Practice in Hospitality Management	
Introduction to Hospitality Management	
Catering and Banquet Management	
Food Service Systems Management	

**APPENDIX C** 

**CONSENT FORM** 

## Appendix C

**Consent Form** 

## **Consent Form**

This study involves measuring food safety knowledge among undergraduate nutrition and hospitality management students. This study is being conducted by Natalie Caine-Bish of Kent State University and has been approved by the Kent State University Institutional Review Board. No deception is involved, and the study involves no more than minimal risk to participants (i.e the risk encountered in daily life).

Participation in the study typical takes 20 minutes and your participation and information will remain anonymous. You will be asked to complete a series of demographic questions on the next page. As a participant, you will answer the questions to the best of your ability, please do not skip answers. All responses and information in the questionnaire are treated as confidential, and in no case, will responses, answers, or demographic information from individual participants be identified. This research will not benefit you directly. However, your participation in this study will help us to better understand food safety knowledge among an undergraduate population.

If you are taking this class on a graduate level or have objection to completing this questionnaire, please return the questionnaire unanswered to the proctor. Your participation is voluntary and participating or not will not affect your course grade. If you, the participants have further questions about this study or your rights as participants, or if you wish to lodge a complaint or concern, you may contact the principal investigator, Doctor Natalie Caine-Bish, at 330-672-2197; or the Kent State University Institutional Review board at 330-672-2704.

If you are 18 years of age or older, understand the statements above and freely consent to participate in the study, please flip the page and begin.

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