

FOOD SAFETY KNOWLEDGE AND PRACTICES OF FOOD RECOVERY
AGENCY WORKERS BEFORE AND AFTER FOOD SAFETY TRAINING

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Master of Science

in

The School of Human Ecology

by
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B.S., Texas Christian University, 2002
May 2004

ACKNOWLEDGEMENTS

I would like to express my deep appreciation to Dr. Michael Keenan who served as one of my major professors on this project. His concern for his students and colleagues is extraordinary, and his enthusiasm regarding the field of nutrition is inspiring. A sincere expression of gratitude goes to my other major professor Dr. Elizabeth Reames. She is an excellent mentor, and it has truly been a blessing to work with such an amazing person. I would like to thank Dr. Maren Hegsted, a committee member who has been an incredible support to me during my time here at LSU. She has always been there to offer advice and to answer my endless questions. Also, I would like to show appreciation to Dr. Georgiana Tuuri, a committee member whose energy and smile were always sources of encouragement. A very special thank you is also extended to my family and friends for their patience, understanding, and support throughout this endeavor. Finally, thank you to the entire faculty, staff, and students of the School of Human Ecology for their thoughtfulness and endless support.

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ABSTRACT

Many food recovery agencies depend on donated food, and its safety is critical for the health of vulnerable populations. A food safety curriculum was developed for agency volunteers and paid staff of the Lower Mississippi Delta region. Examples of topics in the curriculum included: personal hygiene, food storage, transporting food safely, and HACCP. Food Safety Knowledge Pre- and Posttests (20 questions) were identical, and validity and reliability were established prior to use. Paired t-tests were performed to determine the effectiveness of the curriculum (n=190). A Food Safety Practices Survey (10 questions) demonstrating attitudes and behaviors regarding food safety practices in the agency and/or the home was given with the Food Safety Knowledge Posttest. The heading on the survey was, "After the food safety training today I plan to," and possible responses were "already doing," "yes," or "no." A Food Safety Practices Delayed Survey was administered by mail to participants 3-6 months following the food safety training. The Food Safety Practices Delayed Survey was similar to the Food Safety Practices Survey except there were four possible answer choices-- "always," "most of the time," "sometimes," and "never." Food Safety Knowledge Posttest scores (19.0 ± 0.1) were significantly ($p < 0.000$) greater than Food Safety Knowledge Pretest scores (16.6 ± 0.2). Food Safety Practices Survey results indicated that participants were already using proper food safety practices (5.8 ± 0.2), or that they plan to use proper food safety practices (4.0 ± 0.2). On the Food Safety Practices Delayed Survey (n=82) participants indicated that they "always" (8.8 ± 0.2) or "most of the time" (0.8 ± 0.1) follow proper food safety practices. Results demonstrated the food safety curriculum was used successfully to improve food safety knowledge. Food Safety Practices Survey results indicated that the

majority of food recovery agency personnel and staff were already using proper food safety practices in their agency or at home. In addition, the results from the Food Safety Practices Delayed Survey showed the participants retained the knowledge from the food safety training and a majority were “always” following proper food safety practices.

CHAPTER 1

INTRODUCTION

Food security, defined as access by all people at all times to enough food for a healthy life, is an essential component of a healthy community (1-5). The United States Department of Agriculture (USDA) monitors food insecurity and hunger through an annual survey of 50,000 households conducted by the U.S. Census Bureau. This data, published in a series of reports called *Household Food Security in the United States*, summarizes the data from this research for each year, 1995 to 2002 (1-5). Since the survey's inception in 1995, the Food Security Index has demonstrated a range of 9-12% of households in the U.S. is food-insecure (1-5). There have been fluctuations throughout these years, but the most recent food security data which comes from the *Household Food Security in the United States, 2002* study shows that food insecurity and hunger are on the rise (5). The prevalence of food insecurity increased from 10.7% of households in 2001 to 11.1% in 2002. This means that in 2002 there were 12.1 million food-insecure households in the U.S. Also in 2002 the prevalence of food insecurity with hunger increased from 3.3% to 3.5%. It is reported that 89% of American households were food secure during 2002 (5).

Not having adequate resources for a balanced, nutritious diet can compromise health and inhibit cognitive and physical development in children. Compromised health of individuals living in poverty is a characteristic of food insecurity. The latest available *Prevalence of Food Insecurity and Hunger, by State, 1996-1998* study shows that the rates of food insecurity are significantly above average in the southern states when

compared to the rest of the nation (6). This situation is especially serious in the Lower Mississippi Delta region of Louisiana, Mississippi, and Arkansas (7-9).

Food-insecure individuals, or those living in poverty are particularly susceptible to food-borne illness because of the possibility of a compromised immune system (10) and because they are more likely to frequent food recovery programs. According to the Centers for Disease Control (CDC) food-borne diseases cause an estimated 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths in the U.S. each year (11). Children, the elderly, and the immune compromised are the most affected by food-borne illness (12-14). Food recovery programs, including community outreach programs, food pantries, and food banks, have experienced an increased need for food safety education and training for the personnel and volunteers providing food to the needy population (12, 15, 16). Workers in food recovery programs need basic information about safe food handling and storage practices, in order to be able to serve the community more safely (17). The need for food recovery agencies to participate in food safety education is imperative.

Rationale for the Study

The importance of food safety has recently been emphasized through the addition of the guideline “Keep food safe to eat” which has been added to the USDA’s Dietary Guidelines for Americans 2000 (18). The goal for the study was to develop a strategy for promoting food safety among workers providing food to a vulnerable population in the Lower Mississippi Delta who utilize food recovery programs. Education of food handlers is critical to decrease the risk of food-borne illness in this population (12). Many at-risk, food-insecure individuals depend on reclaimed or rescued food, either from

establishments that donate prepared and perishable foods, soup kitchens, food banks, or even field gleaning. This food-insecure population is at an increased risk of food-borne illness because of many factors, such as poverty, a generally poorer state of health, lack of accessible medical care, and a lower educational level. Also, research shows that food safety education programs are effective in improving sanitary conditions and increasing the adoption of safe food handling behaviors (19, 20).

The importance of food safety education for the personnel and volunteers providing food to vulnerable populations who utilize food recovery agencies was recognized by the awarding of a USDA/Cooperative State Research, Education, and Extension Service (CSREES), National Integrated Food Safety Initiative (NIFSI) grant (# 2002-51110-01502) to the Louisiana State University (LSU) Agricultural Center. The project offers safe food handler training using a curriculum designed for personnel and staff of food recovery agencies in Louisiana, Mississippi, and Arkansas that is based on the National Restaurant Association's ServSafe® Manager Certification Training (21). The project's curriculum focuses on safety issues specific to rescued food such as food-borne illness, transporting food safely, and personal hygiene and hand washing, and includes several food safety fact sheets, lesson plans, posters, transparencies, and a video on transporting food safely. Two Louisiana food banks recognized the importance of food safety education for their personnel and were able to offer ServSafe® on a one-time basis using grant funding. However, this project's curriculum offers a more condensed version that can be presented in 2 hours and uses active learning experiences. Also, there is opportunity for greater participation with this curriculum because it can be offered by Extension agents.

Research Design

The study was composed of a two-part research design. The first part used a pretest-posttest knowledge design to measure participants' food safety knowledge before and after a food safety education program. This design, also called the "before and after" design, involved collecting baseline data prior to the treatment and collecting data after the treatment, that is at the program's end (22). The second part used a post-plan to adopt and a post-delayed adoption of food safety behaviors design to measure the willingness to adopt and the adoption of recommended food safety practices as a result of the program trainings. The delayed data collection was conducted approximately 3-6 months following the original training.

Objectives

The overall goal of the project was to develop a strategy for preventing food-borne illness by promoting food safety practices in personnel and volunteers providing food to a vulnerable population in the Lower Mississippi Delta who utilize food recovery programs. The objectives of the study were to develop a food safety curriculum, to administer it to food handlers that serve the vulnerable population in the Lower Mississippi Delta who utilize food recovery programs, and to determine if participation in the safe food handler trainings lead to improved food safety knowledge and adoption of recommended food safety practices in participating food recovery agency personnel and volunteers of the Lower Mississippi Delta.

Hypothesis

It was hypothesized that the development and delivery of a food safety education program for participating food recovery program personnel and volunteers would

increase food safety knowledge and adoption of safe food handling practices and presumably decrease incidence of food-borne illness in those receiving assistance.

Limitations

The most important limitation to the study was that it was not guaranteed that this food safety education program would actually make food safer for the community. This study did not involve testing the actual safety of the food, but measuring the knowledge and adoption of safe food handling practices of food recovery workers who make the food available to the community in the Lower Mississippi Delta region. Another limitation to the study involved issuing the delayed post-survey to the participants. Frequent turnover of the staff exists, and inability to locate the original participants of the study could pose a limitation.

Definitions

Food security: a physical state in which all the people in a household at all times have access to enough food for an active, healthy life. Food security requires the availability of nutritionally adequate, safe foods and the assured ability to acquire them in socially acceptable ways.

Food insecurity: a physical state of individuals and families that is characterized by their having limited access to food or a limited or uncertain ability to acquire food in socially acceptable ways.

Hunger: an uneasy or painful sensation caused by lack of food. Although food insecurity may lead to hunger, hunger is not a necessary consequence of food insecurity.

Food safety education: education dealing with the practices that keep food safe from environmental and bacterial contamination.

Assumptions

It was assumed that the sample of participants was representative of the population of personnel and volunteers involved in community food recovery and food assistance programs. It was also assumed that all responses of the participants to Food Safety Practices Survey and Food Safety Practices Delayed Survey were reliable and valid. Finally, it was assumed that the food handlers' adoption of recommended food safety practices will improve the safety of the food for the vulnerable populations who make use of the community's food recovery programs in the Lower Mississippi Delta.

CHAPTER 2

REVIEW OF LITERATURE

Food Safety

There are thousands of types of bacteria in the environment, but most of them do not cause harm. For example, there are some types of bacteria that are beneficial and keep the digestive tract healthy. When harmful bacteria, also known as pathogens, enter the food and water supply, they can cause food-borne illness and even death. Spoilage bacteria can cause foods to smell and taste bad. These bacteria can be harmful, but probably will not cause illness. Disease-causing bacteria are more serious because they usually do not make the food smell or taste bad, but they can cause illness (23).

Food-borne infections are due to pathogenic organisms. Described below are 4 of the usual causes of food-borne infections presented in descending order of their occurrence.

Table 1 Food-borne infection

Pathogen	Sources	Symptoms
<i>Campylobacter jejuni</i>	Raw or undercooked meat or poultry, raw milk, raw vegetables	Abdominal pain, bloody diarrhea, fever, chills, headache; within 2-11 hours, can last 7-14 days
<i>Escherichia coli</i> 0157H7	Rare or undercooked ground beef, uncooked fruits and vegetables, raw milk, unpasteurized apple juice	Diarrhea, severe cramping, nausea, vomiting, fever, kidney damage in children; within 1-8 days of exposure
<i>Salmonella enteritidis</i>	Eggs, poultry, unpasteurized milk, fruits, vegetables, seafood	Fever, nausea, vomiting, diarrhea, severe abdominal pain; within 12 hours to 3 days
<i>Listeria monocytogenes</i>	Unwashed fruits and vegetables, soil, water, cold cuts, hot dogs	Flu-like symptoms, encephalitis, meningitis

Campylobacter jejuni is the most common cause of diarrhea and abdominal cramps; fever, chills, and headaches are also symptoms of *Campylobacter jejuni*. Unpasteurized milk, contaminated water, and poultry are common carriers of this pathogen. Symptoms start within 2-11 hours of exposure and can last 7-14 days (23). *Campylobacter* can lead to the life-threatening Gullian-Barre syndrome (24).

Escherichia coli 0157H7 is another common cause of food-borne illness. More commonly known as *E. coli*, this pathogen is responsible for an estimated 73,000 cases of infection and 60 deaths in the U.S. each year. A well-publicized case was the *E. coli* outbreak in the Jack in the Box restaurants in 1992. For several weeks until the illnesses were traced back to *E. coli*, people across 4 states continued to eat infected hamburger meat. The incident resulted in 4 deaths and over 700 illnesses (23). Some common carriers of this pathogen are unpasteurized milk and undercooked meat. *E. coli* is more likely to contaminate ground beef than steaks or other cuts of meat because bacteria on the surface can end up inside the patty when the meat is ground. Current research reveals that unpasteurized apple ciders can also harbor *E. coli*. Symptoms include watery diarrhea within 1-8 days of exposure, then progressing to bloody diarrhea. Also nausea, vomiting, and fever occur as the infection progresses. *E. coli* can lead to kidney damage and can be life-threatening in children (23). The third most common pathogen is *Salmonella enteritidis*. *Salmonella* contaminates eggs, poultry, unpasteurized milk, fruits, and vegetables. The symptoms range from mild diarrhea to severe pain and diarrhea. The symptoms can occur 12 hours to 3 days after ingestion of the infected food (23). The fourth most common cause of food-borne infection is *Listeria monocytogenes*. The pathogen is extremely dangerous to pregnant women because it can harm the unborn

fetus. It is commonly found in unwashed fruits and vegetables, soil, and water (23). The pathogen can grow in a temperature range of 34°-113°F, and 34°F is an acceptable temperature for your refrigerator. *Listeria monocytogenes* causes severe diarrhea, flu-like symptoms, and even encephalitis and meningitis (23).

Bacteria that produce toxins and can cause food-borne illness include the following: *Staphylococcus aureus*, *Clostridium botulinum*, and *Clostridium perfringens*.

Table 2 Food-borne illness caused by toxins

Pathogen	Sources	Symptoms
<i>Staphylococcus aureus</i>	Meat, poultry, eggs, milk products	Nausea, vomiting, abdominal pain; 1-6 hours after ingestion
<i>Clostridium botulinum</i>	Soil, water, home-canned vegetables	Weakness, double vision, fatigue, diarrhea, paralysis; within 4-36 hours after ingestion
<i>Clostridium perfringens</i>	Surfaces of meat and poultry	Nausea, vomiting, abdominal pain, diarrhea; within 8-48 hours after ingestion

Staphylococcus aureus, commonly referred to as staph, is found on the hands and in the nose, intestines, and open cuts and sores of humans. Staph bacteria are one of the most common causes of skin infections in the U.S. (25) The symptoms occur 1-6 hours after ingestion and include nausea, vomiting, abdominal pain, and diarrhea, but not fever. The common carriers are salad with protein-containing ingredients, meat, poultry, eggs, and milk products. *Clostridium botulinum* is a rare, anaerobic bacteria that produces a toxin that is unusually heat resistant. Symptoms occur within 4-36 hours after ingestion of the harmful toxin and include weakness, double vision, fatigue, and diarrhea. The *Clostridium botulinum* toxin impairs the central nervous system and can be fatal if not treated properly in 3-10 days (23). Although this type of severe food poisoning is rare,

the mortality rate is high. Of the 2,320 cases in the U.S. from 1899-1990, there have been 1036 deaths attributed to *Clostridium botulinum* (26). Sources of *Clostridium botulinum* include soil, water, and home-canned vegetables (23). Illness attributed to *Clostridium perfringens* is caused by an anaerobic toxin that is found on the surfaces of meat and poultry; however, it is not as serious as *Clostridium botulinum*. It is often called the “cafeteria bug” because the usual sources include food that is improperly cooked or reheated, cooled slowly, or not kept at the correct temperature, such as when food is left out on the cafeteria line (23). Symptoms occur within 8-15 hours after ingestion and include intense abdominal pain, gas, and diarrhea (27).

Food-borne viral infections are also responsible for illness in humans. Viruses are very different from the bacteria and parasites, which cause similar illnesses (28). They are transmitted to humans via foods as a result of direct or indirect contamination of the foods with human feces (29). Some commonly found food-borne viral infections are caused by the Norovirus, Rotavirus, and Hepatitis A (30, 31).

Table 3 Food-borne viral infections

Pathogen	Frequent Sources	Symptoms
Norovirus	Oysters, salads, frozen fruit	Nausea, vomiting, diarrhea, stomach cramping
Rotavirus	Shellfish, contaminated water, salads, fruit	Vomiting, fever, watery diarrhea, abdominal pain
Hepatitis A	Water, shellfish, salads	Sudden onset of fever, malaise, nausea, anorexia, abdominal discomfort, jaundice

Noroviruses are a group of related viruses that can cause acute gastroenteritis in humans. Norovirus was recently approved as the official name for a group of viruses described as “Norwalk-like viruses.” Noroviruses are very contagious and can spread

easily from person to person. Symptoms include nausea, vomiting, diarrhea, and stomach cramping. The illness begins suddenly, but is usually brief. There are many different strains of norovirus, making it difficult to build up a long-lasting immunity; therefore norovirus illness can occur many times throughout one's life (32).

Rotavirus is the most common cause of severe diarrhea among children and results in over 600,000 deaths worldwide and 55,000 hospitalizations in the U.S. each year (33). The highest rates of illness occur among infants and young children; adults can be infected, though the sickness tends to be less severe. Rotavirus is characterized by vomiting and fever with watery diarrhea and abdominal pain for 3-8 days. In the U.S. the disease has a seasonal pattern, with annual outbreaks occurring from November to April. In 1999, the USDA approved a live virus vaccine for Rotavirus, but the Advisory Committee on Immunization Practices (ACIP) recommends that the vaccine no longer be given to infants in the U.S. because of bowel obstruction complications (33).

Hepatitis A is usually a mild illness characterized by sudden onset of fever, malaise, nausea, anorexia, and abdominal discomfort, followed by jaundice. The hepatitis A virus is found in the feces of infected people and is transmitted when susceptible individuals consume contaminated water or food. Water, shellfish, and salads are the most frequent sources. Also, contamination of foods by infected workers in restaurants is common. The hepatitis A vaccine offers the best protection against the virus (34).

The epidemiology of food-borne illness is changing (35). Over the last two decades, bacterial infections caused by *Campylobacter* and *Escherichia coli* have emerged, the incidence of illness from well-recognized pathogens such as *Salmonella* has

increased considerably, and important food-borne pathogens have become gradually more resistant to antimicrobial agents (36). Food-borne pathogens recently emerging include *Vibrio vulnificus*, *Cryptosporidium parvum*, and *Cyclospora cayetanensis*. These pathogens have been either newly described or newly associated with food-borne transmission (37).

Table 4 Emerging food-borne pathogens

Pathogen	Frequent Sources	Symptoms
<i>Vibrio vulnificus</i>	Shellfish, plankton, finfish	Gastroenteritis, septic shock; can result in death
<i>Cryptosporidium parvum</i>	Contaminated water and soil	Diarrhea, stomach cramps, slight fever
<i>Cyclospora cayetanensis</i>	Contaminated water and soil, fresh fruit, leafy vegetables	Watery diarrhea, loss of appetite, nausea, vomiting, muscle aches, fever, and fatigue

Vibrio vulnificus is a virus that has been identified in persons with underlying liver disease who were infected after eating raw oysters or being exposed to seawater (38). *Vibrio vulnificus* is associated with various marine species, such as plankton, shellfish, and finfish. The ingestion of *Vibrio vulnificus* in healthy individuals can result in gastroenteritis. In immune-compromised individuals, septic shock occurs when the microorganism enters the bloodstream, rapidly followed by death in about 50% of cases (38). *Cryptosporidium parvum*, also known as “Crypto,” is a parasite that can live in the intestine of humans and animals and is passed by stool infected with the parasite. Symptoms generally begin 2-10 days after being infected and include diarrhea, stomach cramps and slight fever, but some people have no symptoms (39). *Cyclospora cayetanensis* is a parasite spread by people ingesting food or water that has been contaminated by infected stool. *Cyclospora* has also been linked to various types of fresh

produce. It usually infects the small intestine and symptoms include watery diarrhea, loss of appetite, nausea, vomiting, muscle aches, fever, and fatigue (40).

Also, there are certain food safety issues specific to rescued food. When dealing with agencies that serve prepared meals to clients *Clostridium perfringens* can be a threat if food is left out on a serving line and not kept at the proper temperature. Most of the food recovery agencies involved in this project do not serve prepared meals to clients, but distribute canned goods, boxed foods, and other non-perishable items; therefore, some of the food-borne illnesses described above may not apply. Food safety issues specific to these foods include: *Clostridium botulinum*, which has been associated with dented or bulging canned goods and improperly heated potatoes; *Staphylococcus aureus*, norovirus, and hepatitis A which has been associated with poor personal hygiene and hand washing; and insect or rodent infestation sometimes found in stored, non-perishable items.

The U.S. government is constantly challenged with the enormous task of keeping food safe to eat. The Federal Drug Administration (FDA) along with the USDA has designed the Hazard Analysis and Critical Control Point (HACCP) system for keeping food safe throughout its flow in a food service establishment. The process involves actions to insure the safety of food through the identification of critical control points. HACCP is preventative in nature and focuses on the entire process of food service (41).

Another organization taking steps in the fight to keep food safe is the Center for Food Safety and Applied Nutrition. They are working closely with the USDA's Food Safety and Inspection Service (FSIS) and the Centers for Disease Control and Prevention (CDC) to introduce their *Fight BAC!* campaign. The campaign's focus is on keeping food safe from bacteria. It centers around 4 simple rules: clean, separate, cook, and chill.

The campaign involves educating the entire public, but is also directed towards children (42).

The CDC's Food-Borne Diseases Active Surveillance Network, or FoodNet, is another program aimed at decreasing the incidence of food-borne illness (12). The goals of FoodNet include determining how much food-borne illness results from eating specific foods, estimating the frequency and severity of food-borne diseases in the U.S. each year, and describing the epidemiology of new and emerging food-borne pathogens of bacterial, viral, and parasitic origin (43).

Also, the FSIS of the USDA has launched the Thermy campaign. It is a consumer education campaign designed to promote the use of food thermometers in the home to insure that the food reaches a temperature high enough to destroy harmful bacteria. Thermy, a life-sized thermometer who claims, "It's safe to bite when the temperature is right," is the campaign's mascot (44). These campaigns are just a few examples of how the FDA and the USDA are educating the public about food safety.

Kelly Johnston of the National Food Processors Association (NFPA) says that education is the most effective tool for combating food-borne illness. She says, "The key to reducing illness is food safety education." (45) The USDA has designated the month of September as Food Safety Education month to emphasize public awareness of food-borne illness and the safe handling practices the population should follow to help keep themselves free from the risk of food-borne illnesses. This year's theme was "Be Cool—Chill Out! Refrigerate Promptly!" The theme helps consumers to remember to put leftovers in the refrigerator shortly after serving and to discard them if not refrigerated in less than 2 hours (46).

Act No. 506 of Louisiana Regular Legislative Session states that, “On or after January 1, 1999, the state health officer and the office of public health of the Department of Health and Hospitals shall require, at a minimum the owner or designated employee of a food service establishment to hold a food safety certificate; however, the state health officer and the office of public health of the Department of Health and Hospitals shall not require more than one owner or employee per establishment to hold a food safety certificate” (47). Act 506 also says, “Those food establishments with gross food sales that are under \$125,000 must obtain a state Food Safety Certificate by July 1, 2002” (47). 2003 Louisiana legislation mandates food safety certification of all food service establishments with the exception of nursing homes and schools.

Although there are more than 250 types of food-borne diseases, most of them can be prevented if certain precautions are taken. Using good personal hygiene, cooking foods thoroughly, and keeping foods at the correct temperatures during serving and storage are rules that should be followed. Everyone is at risk for food-borne illness, but there are certain individuals who are at greater risk than others. Pregnant women, children, the elderly, and those with compromised immune systems are at an increased risk to illnesses associated with food. Also included are food-insecure individuals and those living in undesirable conditions because of poverty (12-14).

Food Security and Insecurity

Food security is defined by most as access by all people at all times to enough food for an active, healthy life. Access to nutritionally adequate, safe foods and guaranteed availability to acceptable foods in socially acceptable ways are also part of what defines food security (1-5). Food security includes the ability to obtain nutritionally

adequate, safe foods without having to depend on emergency sources of food, such as food from food banks, church pantries, or soup kitchens (1-5).

On the other hand, food insecurity is usually defined as a limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire foods in socially acceptable ways (1-5). Individuals classified as food insecure are often unable to acquire an adequate amount of food to meet essential nutritional requirements because of limited resources (48). The most severe form of food insecurity is hunger. Hunger is an “uneasy or painful sensation caused by the lack of food” (1-5, 48). Hunger is characterized by lack of food or lack of resources to acquire enough food to meet one’s physical needs (48).

Since 1995, the USDA has annually collected information on food access and adequacy and sources of food assistance for the U.S. population (1-5). The information is collected using food security surveys and reported in a series called the *Measuring Food Security in the United States*. Despite the United States’ reputation as being a rich and prosperous nation, the most recent research shows that food insecurity and hunger rates are increasing. In 2002, 11.1% (12.1 million) of U.S. households were food insecure (5). This means that at some time during the year, these households were uncertain of having, or unable to acquire, enough food for all their members because there was insufficient money or other resources. About 3.8 million households were food insecure to the extent that one or more household members were hungry because of inadequate resources at least some time during the year (5). *The Household Food Security in the United States, 2002* study showed that the prevalence of food insecurity varied among household types. Food insecurity in households with incomes below the

official poverty line, for example, \$18,244 for a family of 4 in 2002, was 38.1%. The occurrence of food insecurity in households with children headed by a single woman was 32.0%. Food insecurity in black households was 22.0%, and in Hispanic households the percent of food insecurity was 21.7 (5). In a study published in the *Journal of the American Dietetic Association* in 1996, it was determined that as food insecurity increased, the quality of food and intake of essential nutrients decreased. Participants who were considered to be food insecure in the study were significantly more likely to not meet the recommendations for vitamin C and the number of fruit and vegetable servings according to the USDA and the Department of Health and Human Services' (DHHS) standards (48). The U.S. DHHS's Healthy People 2010 included a goal of increasing food security in households to 94% by the end of the decade (49).

Hunger and food insecurity adversely affect children. Greater than 14 million children less than 18 years of age live in food-insecure households, and almost 1 in 5 children are poor (14). In 2002, children in 265,000 households were hungry because the household lacked sufficient money or resources for food (5). Alaimo and associates (14) showed that severely malnourished children are apathetic, withdrawn, passive, and have decreased motivation and heightened anxiety. Food-insecure children are more than twice as likely to repeat a grade and miss more school days. This study showed support for the hypothesis that hunger and food insecurity have negative consequences on children's academic and psychosocial development (14).

Hunger and food insecurity are even more widespread in the Southern part of the U.S. (6), particularly in the Lower Mississippi Delta (7). According to the *Prevalence of Food Insecurity and Hunger, by State, 1996-1998*, the percent of food insecure

households with hunger was at or above the national average for Arkansas, Louisiana, and Mississippi--the three states this project includes. The national average of food insecure households with hunger was 3.5%. Arkansas had the same percentage as the national average; Mississippi's rate was 4.2% and Louisiana had 4.4% of food insecure households with hunger (6). More specific data for Louisiana indicated that 684,000 people in Louisiana go hungry each year (50). In 1998, 19.1% of Louisiana's population lived in poverty (50).

The use of food pantries and emergency kitchens is associated with food insecurity. Hampl reports that food-insecure households are 24 times more likely than food-secure households to obtain food from a food pantry and are 16 times more likely to eat a meal at emergency kitchens (51). In the U.S. approximately 150,000 charitable organizations provide food to individuals with limited resources (51). According to *Household Food Security in the United States, 2002* among all food-insecure households (12.1 million), 19.3% obtained emergency food from a food pantry, church, or food bank during the 12 months before the survey. Also among the food-insecure households, 2.5% had members who ate at an emergency kitchen sometime during the 12 months before the survey (5). Data from the Greater Baton Rouge Food Bank shows that everyday more than 3,500 area residents rely on the Baton Rouge Food Bank's network for food, and of these individuals over 60% are children or the elderly (50).

The demand at some hunger-relief organizations has recently outweighed the assistance. The Greater Boston Food Bank reported that the high cost of living and the uncertainties in the job market are instigating hunger in formerly affluent Boston suburbs. One food bank serving suburban Boston saw a 43% increase in demand for food over the

past year (52). Denver-based Food Bank of the Rockies said that in general, donations are down about 15%, and requests for food are up 30-60 % (52). The Michigan-based Food Bank of Oakland County is also feeling the pressure. The organization, which provides food to 200 agencies at 300 sites throughout the county, is serving 20% more people through its member pantries (52). Also, the Houston Food Bank has seen a 45% rise in demand for its services over the past 10 months, agency officials said. If unemployment continues to rise in Houston, the relief agency expects the need for the fresh and canned food it distributes to area food banks to exceed the previous year (52). A 2001 study of food distributed by America's Second Harvest showed that demand at emergency feeding sites had increased 9% since the previous survey in 1997 (53). A study released by the United States Conference of Mayors in December of 2002, reported a 19% increase in the number of people seeking emergency food assistance (54). It is evident that food banks across the nation are seeing an increased demand for their services.

Locally, the Greater Baton Rouge Food Bank collects, stores, and distributes food to its 100-plus member agencies in 12 Louisiana parishes. In 2001, the Baton Rouge Food Bank distributed 5,320,158 pounds of food to its member agencies (50). This amounted to over \$7.9 million worth of food provided free of charge to soup kitchens, group homes, shelters, pantries and similar agencies that are part of the agency's network (50). The donated food assists thousands of people who depend upon the network daily (50). The Second Harvester's Food Bank of Greater New Orleans is a member of America's Second Harvest National Food Bank Network. Each year, Second Harvester's Food Bank distributes more than 15 million pounds of donated food to 400 social service

agencies in southern Louisiana (55). In 2003, Second Harvester's distributed 15,409,438 pounds of food, more than ever distributed since the operation began in 1983. This represents a 119% increase in the last 5 years. The food distributed in 2003 resulted in over 12 million meals provided to the hungry (55).

Similarly, the Mississippi Food Network has seen an increase in demand for its services. The Mississippi Food Network Executive Director John Alford says, "The supply of donated food is not keeping pace with the increase in needy clients." (56) The Mississippi Food Network, a Second Harvest food bank, is located in Jackson, MS, and serves 386 agencies in 74 Mississippi counties and 12 Louisiana parishes (56). When the food bank began in 1984, it distributed 193,000 pounds of food. In 2003, 14 million pounds of food were distributed (56).

In Arkansas, the Arkansas Foodbank Network is working hard to alleviate hunger for its citizens. The Arkansas FoodBank Network is also a member of the America's Second Harvest National Network. Established in 1984, it works with agency food pantries and soup kitchens in 44 Arkansas counties to solicit, secure, collect, and distribute over 8.2 million pounds of food to the hungry (57). Currently the Arkansas Foodbank serves over 40,000 families each month (57).

Hunger is a major problem in the U.S. and particularly in the Lower Mississippi Delta. Severely malnourished individuals are likely to be immune compromised, thus more susceptible to the risks of food-borne illness (12, 13). This is why safe food handling education is essential for personnel and volunteers in food recovery agencies who distribute food to those in need.

Nutrition and Immunity

Nutrition is a critical determinant of immune response, and malnutrition is the most common cause of a compromised immune system worldwide (58). It has been known that malnourished individuals are at a higher risk for infection because of an inadequate immune response. Infection then leads to inflammation, decreasing nutritional status, and further compromising the immune system. This cycle has been called the malnutrition-infection complex (59).

Protein-energy malnutrition is associated with a significant impairment of cell-mediated immunity, phagocyte function, complement system, and cytokine production (59-62). Almost any nutrient deficiency will decrease immune response, even when the deficiency state is relatively mild. Zinc, selenium, vitamin A, vitamin C, vitamin E, vitamin B₆, iron, copper, and folic acid have been shown to alter immune response (63). A study published in *Infection and Immunity* shows that vitamin A-deficiency causes an increased susceptibility to *Staphylococcus aureus* in rats because of decreased immune function (64). Another study shows the effects of selenium and zinc on the immune system. Selenium is needed for the proper function of neutrophils, macrophages, and T lymphocytes and other immune mechanisms, while zinc is required as a catalytic, structural, and regulatory ion for many enzymes, proteins, and transcription factors. Low selenium and zinc result in limited ability of the immune system to resist infection, especially in the elderly (65). In addition, a study published in the *British Journal of Surgery* shows malnutrition impairs gut barrier function. This compromised gut barrier function in malnourished individuals may facilitate gut-derived infection and sepsis (66).

Food Safety Nutrition Education

Nutrition and food safety are intertwined, and there are many examples of this relationship (67). For instance, food-borne pathogens can affect nutritional status by decreasing appetite and reducing absorption of important nutrients from the gut. Short-term diarrheal diseases are sometimes associated with the loss of some enzyme activity—namely lactase—which is important for digestion and absorption of lactose in nutritious dairy products (67). Also, some dietary advice may have food safety consequences. The “Eat 5 A Day for Better Health” campaign (68) supports the consumption of fruits and vegetables, but recently there have been public health concerns about the safety of these products in terms of food-borne illness (43). There have been an increasing number of reports linking the consumption of raw alfalfa sprouts to outbreaks of *Salmonella* and *Escherichia coli* 0157H7 (69). Other nutritious foods have been associated with food safety problems. Undercooked meats, such as beef and poultry, have been known to cause food-borne illnesses (43). This does not mean that these foods should be omitted from one’s diet because the benefits of consuming such nutritious foods far surpass the risk. This just means that food safety education and nutrition education must go hand in hand when being presented to consumers. Healthy foods must be made safe as well as nutritious (67).

Research to improve nutrition education has been of great interest recently. The question in this research is if the nutrition education leads to increased knowledge and adoption of recommended practices. The attention is not only on the evaluation, but also on the design and execution of the education program itself. Food safety education is most effective when the messages are geared toward changing the behaviors that most

likely are the causes of the food-borne illness (70, 71). Food safety education is more effective if the messages are targeted toward the specific audience (72).

A study published in 2001 was conducted to identify and classify food-handling behaviors for food safety education (73). A Delphi process, a panel of experts who come to consensus of opinion, was used to rank food-handling behaviors associated with the pathogens causing the majority of the food-borne illnesses. Problems with practicing personal hygiene ranked the highest with the most instances of food-borne illness attributed to a failure to wash one's hands thoroughly before handling foods. The study was conducted to determine exactly what behaviors and practices food safety education needed to emphasize for the most effective education (73).

An article published in *Public Health Reports* in 1998 discussed the effects of a manager-training program on sanitary conditions in restaurants (19). A food-manager training and certification program was initiated by the Boston Public Health Commission. The program involved contamination and food-borne illness, safe food handling, sanitary facilities, and employee training. Of the 62 restaurants included in the analysis, 26 restaurants were required to participate in the training program (mandatory group) because of license suspensions due to conditions threatening the public's health and safety during a previous inspection. Thirty-six restaurants participated in the training program voluntarily (voluntary group). The results show the mean inspection score increased the most for the mandatory group and only slightly for the voluntary group. The control group's scores remained constant suggesting that the improvement in the scores of the mandatory and voluntary groups were due to the training program. The study supports the hypothesis that food-manager certification and training programs can

be effective in improving sanitary conditions in restaurants. Food safety nutrition education can also result in an improvement in sanitary conditions, and therefore a reduced risk of food-borne illness (19).

In 1997, the Family and Consumer Educators in 2 North Carolina counties developed and implemented a food safety education program for food service operators (20). The program included an 18-hour food safety training for managers. The training, like the training in this project, was based on the ServSafe© curriculum developed by the Educational Foundation of the National Restaurant Association. A variety of teaching and delivery techniques were used for the training including: multi-media presentations, videos, handouts, activities, exercises, and guest lectures. The classes were held 3 hours in the afternoon 3 days a week for 2 consecutive weeks. The results of these trainings showed that 294 managers completed the training, and 267 received certification by the National Restaurant Association. The passing rate on the certification exam was 90.8%, and the average passing score was 88.67%. On follow-up evaluations, food service managers reported many positive behavior changes as a result of the program, including: increased hand washing, increased accuracy and frequency of temperature checks, increased cleaning procedures throughout the establishment, and increased communication with employees concerning what was expected of them (20). The food safety education program was successful in educating food service managers and increasing safe food handling practices.

Summary

There are hundreds of types of food-borne diseases, but most food-borne illnesses can be prevented in healthy individuals if certain precautions are taken; however, food-

insecure individuals are more susceptible to food-borne illness because of possible immune suppression. For this reason there is a need for food safety education and training for food handlers who serve this vulnerable population. Also, research suggests that food safety education is effective in increasing the adoption of safe food handling behaviors.

CHAPTER 3

METHODS

A food safety curriculum for food recovery agency personnel and volunteers of the Lower Mississippi Delta region was developed by the principal investigators at the Louisiana State University and Southern University Agricultural Centers, and University of Arkansas and Mississippi State University Cooperative Extension Services. Examples of topics covered in the trainings included the following: food-borne illness, personal hygiene and hand washing, cleaning and sanitizing, handling and serving food, food storage, transporting food safely, cleaning and inspecting fruits and vegetables, and HACCP. The proposed study began September 15, 2002.

Institutional Review Board

This study was approved by the Institutional Review Board (IRB) of the Louisiana State University Agricultural Center.

Experimental Design

The proposed study used a two-part experimental design. With this design the participants served as their own controls. The independent variable was a food safety education curriculum, and the dependent variables included the participants' food safety knowledge and behaviors. The first part of the experimental design used a pretest-posttest knowledge design which measured participants' food safety knowledge before and after a food safety education program. This part of the design was also known as the One Group Pretest-Posttest Design and involved collecting baseline data from the subjects at the beginning of the program, that is before the intervention, and again shortly after the intervention (22). The posttest was administered to the participants immediately

after the training using the safe food handler curriculum developed for the project. The second part of the experimental design used a post-plan to adopt and a post-delayed adoption of behaviors design to measure the participants' willingness to adopt and their adoption of recommended food safety practices as a result of participating in the training. The delayed data collection using a behavior survey was given to the participants 3-6 months after participating in the training.

Evaluation provides important information about the impact and benefits of any program. The pretest-posttest design, also known as the before-and-after design, has been used for many education programs and is a simple design that can provide valid results. The before-and-after design is practical for evaluating Extension Programs and allows for much stronger conclusions than using the after-only design (74).

Participant Selection

The participants of the study were personnel and volunteers of food recovery agencies in selected parishes and counties in the Lower Mississippi Delta of Louisiana, Mississippi, and Arkansas. Extension agents in each county or parish of the participating states identified existing food recovery agencies in their parishes or counties. Announcements of the trainings were sent to these agencies.

Instruments

The food safety curriculum was developed by the project faculty and then reviewed by other faculty of Louisiana State University and Southern University Agricultural Centers, Mississippi State University and University of Arkansas Cooperative Extension Services, and by the Louisiana Office of Public Health state sanitarians. The researcher reviewed the safe food handler curriculum and then prepared

the evaluation instruments. Increased knowledge and adoption of safe food handling practices was measured using a test and a survey instrument. The evaluation instruments included the following: (1) Food Safety Knowledge Pretest, (2) Food Safety Knowledge Posttest (identical to the pretest), (3) Food Safety Practices Survey, and (4) Food Safety Practices Delayed Survey (lead-in to questions were different in (4) compared to (3)—see below). The training program was designed so that its beneficial effects are continued even with frequent staff and volunteer turnover. For example, trained food recovery agency personnel and volunteers were provided safe food handler curriculum materials to use for training other personnel and volunteers in the organization. In addition, the Extension agents are available for providing additional training.

A Delphi panel consisting of experts in safe food handling validated the pre-posttest instrument. The panel consisted of Dr. Elizabeth Reames, Professor of Human Ecology; Dr. Michael Keenan, Associate Professor of Human Ecology; Dr. David Bankston, Professor of Food Science; Dr. Kenneth McMillin, Professor of Animal Sciences; Dr. Maren Hegsted, Professor of Human Ecology; Dr. Georgianna Tuuri, Assistant Professor of Human Ecology; Ms. Judy Myhand, Instructor of Human Ecology; Dr. Sally Soileau, Extension Agent of Human Ecology; and Dr. Ruth Patrick, Professor Emeritus of Human Ecology. Their suggestions were incorporated accordingly. An 80% agreement rate on the answers to questions was considered acceptable. We also used paraprofessionals to test the evaluation instruments for readability because we assumed the paraprofessionals would have about the same reading level as the food recovery

agency workers. Questions that remained were adjusted several times based on the panel's and the paraprofessionals' comments to improve readability.

The pretest measured baseline knowledge, and the posttest measured knowledge gained by the participants immediately after instruction using the food safety curriculum. The Food Safety Knowledge Pre- and Posttests were the same.

The Food Safety Practices Survey was administered immediately after the presentation of the curriculum and measured the participants' willingness to follow recommended food safety practices. The Food Safety Practices Delayed Survey determined if the participants were following (those that did not indicate "already doing") or continued to follow (those that indicated "already doing") recommended food safety practices. The Food Safety Practices Survey used the same statements as the Food Safety Practices Delayed Survey, but the Food Safety Practices Survey statements were phrased as "planning to" and the Food Safety Practices Delayed Survey statements were phrased as "currently doing." For example, the questions on the Food Safety Practices Survey asked participants if they would consider changing their behavior by asking if they, as a result of participating in the training, "plan to follow recommended food safety practices," whereas, on the Food Safety Practices Delayed Survey, the questions asked if the participant currently "follows recommended food safety practices." The Food Safety Practices Survey consisted of questions with three responses: "yes," "no," and "already doing." The Food Safety Practices Delayed Survey consisted of questions with four possible responses: "always," "most of the time," "sometimes," and "never." Scores from the surveys were tabulated.

Procedures

Participants completed the Food Safety Knowledge Pretest immediately before the safe food handler training. After taking part in the training, the participants completed the Food Safety Knowledge Posttest and the Food Safety Practices Survey. The Food Safety Practices Delayed Survey was administered to the participants 3-6 months following their participation in the training.

Statistical Analysis

Paired *t*-tests were used to analyze the results from the Food Safety Knowledge Pre- and Posttests. The data from the Food Safety Practices Survey and the Food Safety Practices Delayed Survey were analyzed qualitatively. If the Food Safety Knowledge Pre- and Posttest differences were significantly ($p < 0.05$) different from zero, and the scores for the Food Safety Knowledge Posttest were greater than for the Food Safety Knowledge Pre-Test, then the conclusion was that the instruction with the food safety curriculum was successful. A lack of a significant difference between Food Safety Knowledge Pre- and Posttests with scores below 100% indicated a lack of success. No significant difference between Food Safety Knowledge Pre- and Posttest scores 90-100% indicated an inability on our part to assess the effectiveness of participating in the safe food handler training. Responses on the Food Safety Practices Survey indicated if the workers were already performing good food safety practices or were planning to as a result of the program. On the Food Safety Practices Survey, 90-100% of participants indicating on all 10 items that they were “already doing” or “planning to do” determined success. Responses on the Food Safety Practices Delayed Survey indicated if proper food handling practices were being used. On the Food Safety Practices Delayed Survey,

success was determined by 90-100% of participants indicating on all 10 items that they “always” practice the recommended behaviors.

CHAPTER 4

RESULTS

Overall (n=190), i.e. combining the data from all three states, the absolute mean difference between Food Safety Knowledge Pre- and Posttest scores was 2.4 ± 0.2 , and this difference was significantly different ($p < 0.000$) from zero. The mean Food Safety Knowledge Posttest score was 19.0 ± 0.1 out of 20 and greater than the mean score of 16.6 ± 0.2 out of 20 for the Food Safety Knowledge Pretest. Results from the Food Safety Practices Survey overall (n=182) indicated that most participants were “already doing” proper food safety practices (5.8 ± 0.2 out of 10 statements), or that “yes” they plan to use proper food safety practices (4.0 ± 0.2 out of 10 statements). Results from the Delayed Food Safety Practices Survey are only available from Louisiana and Mississippi. Overall the participants (n=82) indicated that they “always” (8.8 ± 0.2 out of 10 statements) or “most of the time” (0.8 ± 0.1 out of 10 statements) follow proper food safety practices.

When analyzed by state, the results were similar to the overall results. The absolute mean differences between the Food Safety Knowledge Pre- and Posttest scores were significantly ($p < 0.005$) different from zero for all three states (Louisiana 2.8 ± 0.2 , Mississippi 1.7 ± 0.2 , Arkansas 2.2 ± 0.6). Louisiana (n=103, 18.7 ± 0.2 vs. 16.0 ± 0.3), Mississippi (n=58, 19.0 ± 0.2 vs. 17.3 ± 0.3), and Arkansas (n=29, 19.5 ± 0.2 vs. 17.3 ± 0.6) Food Safety Knowledge Posttest scores were greater than Food Safety Knowledge Pretest scores. The majority of the participants in Louisiana (n=95, 5.5 ± 0.4 out of 10 statements), Mississippi (n=58, 6.2 ± 0.4 out of 10 statements), and Arkansas (n=29, 6.1 ± 0.6 out of 10 statements) indicated on the Food Safety Practices Survey that they were

“already doing” or that “yes” they planned to use proper food safety practices (Louisiana 4.2 ± 0.3 , Mississippi 3.7 ± 0.4 , Arkansas 3.8 ± 0.6). Results from the Food Safety Practices Delayed Survey indicated that the majority of participants in Louisiana ($n=48$, 8.7 ± 0.2 out of 10 statements) and Mississippi ($n=34$, 9.0 ± 0.3 out of 10 statements) “always” or “most of the time” (Louisiana 1.0 ± 0.2 , Mississippi 0.6 ± 0.2) followed proper food safety practices.

Participants were asked to indicate on their tests and surveys if he/she was a volunteer or a staff member. Similar to overall results, the absolute mean differences between the Food Safety Knowledge Pre- and Posttest scores were significantly ($p<0.000$) different from zero for both volunteers (2.4 ± 0.4) and staff (2.3 ± 0.2). Volunteer ($n=49$, 18.9 ± 0.3 vs. 16.5 ± 0.5) and staff ($n=142$, 19.0 ± 0.1 vs. 16.7 ± 0.2) Food Safety Knowledge Posttest scores were greater than Food Safety Knowledge Pretest scores. The majority of the volunteers ($n=49$, 6.5 ± 0.4 out of 10 statements) and staff ($n=134$, 5.6 ± 0.3 out of 10 statements) indicated on the Food Safety Practices Survey that they were “already doing” or that “yes” they planned to use proper food safety practices (volunteer 3.4 ± 0.4 and staff 4.2 ± 0.3). Responses on the Food Safety Practices Delayed Survey indicated that the majority of the volunteers ($n=17$, 8.8 ± 0.4 out of 10 statements) and staff ($n=60$, 8.9 ± 0.2 out of 10 statements) “always” or “most of the time” (volunteer 0.8 ± 0.2 , staff 0.8 ± 0.1) followed proper food safety practices.

In addition, participants were asked to indicate whether their agency was in an urban or rural community. Similar to overall results, the absolute mean differences between the participants’ Food Safety Knowledge Pre- and Posttest scores were significantly ($p<0.000$) different from zero for both urban (2.4 ± 0.2) and rural

communities (2.3 ± 0.2). Urban ($n=113$, 19.0 ± 0.2 vs. 16.7 ± 0.3) and rural ($n=78$, 18.9 ± 0.2 vs. 16.6 ± 0.3) Food Safety Knowledge Posttest scores were greater than Food Safety Knowledge Pretest scores. The majority of the participants in urban ($n=113$, 5.4 ± 0.3 out of 10 statements) and rural communities ($n=70$, 6.4 ± 0.4 out of 10 statements) indicated on the Food Safety Practices Survey that they were “already doing” or that “yes” they planned to use proper food safety practices (urban 4.3 ± 0.3 and rural 3.4 ± 0.4). The results from the Food Safety Practices Delayed Survey showed that the majority of participants from urban ($n=30$, 8.9 ± 0.3 out of 10 statements) and rural ($n=59$, 8.7 ± 0.2 out of 10 statements) communities “always” or “most of the time” (urban 0.9 ± 0.2 , rural 0.8 ± 0.2) followed proper food safety practices. A summary of these results are shown in Table 5.

Table 6 summarizes the participants’ responses for the questions on the Food Safety Knowledge Pre- and Posttests. When each question was analyzed individually, questions 10, 14, 15, 17, and 19 showed a large qualitative improvement ($\geq 18.9\%$) from Food Safety Knowledge Pre- to Posttest. The topics for these questions included the following: HACCP, calibrating food thermometers, hand washing, cooking foods to the correct internal temperature, and cooling methods for leftovers, respectively (see Appendices B and C). Questions 4, 6, 7, 9, 11, and 20 showed little qualitative improvement ($\leq 2.1\%$) from Food Safety Knowledge Pre- to Posttests. The topics addressed in these questions were hand washing, personal hygiene, and cleaning and sanitizing. Participants missed question 19 (64.2% correct) most often on the Food Safety Knowledge Pretest. This question asked methods of cooling large quantities of food more quickly.

Table 5 Summary of evaluations of the food safety curriculum (Means \pm SEM)

	Food Safety Knowledge Pretest		Food Safety Knowledge Posttest	
Overall (n=190)	16.6 \pm 0.2		19.0 \pm 0.1*	
Louisiana (n=103)	16.0 \pm 0.3		18.7 \pm 0.2*	
Mississippi (n=58)	17.3 \pm 0.3		19.0 \pm 0.2*	
Arkansas (n=29)	17.3 \pm 0.6		19.5 \pm 0.2*	
Volunteer (n=49)	16.5 \pm 0.5		18.9 \pm 0.3*	
Staff (n=142)	16.7 \pm 0.2		19.0 \pm 0.1*	
Urban (n=113)	16.7 \pm 0.3		19.0 \pm 0.2*	
Rural (n=78)	16.6 \pm 0.3		18.9 \pm 0.2*	
Food Safety Practices Survey§				
	Already Doing	Yes	No	
Overall (n=182)	5.8 \pm 0.2	4.0 \pm 0.2	0.2 \pm 0.0	
Louisiana (n=95)	5.5 \pm 0.4	4.2 \pm 0.3	0.3 \pm 0.1	
Mississippi (n=58)	6.2 \pm 0.4	3.7 \pm 0.4	0.1 \pm 0.1	
Arkansas (n=29)	6.1 \pm 0.6	3.8 \pm 0.6	0.1 \pm 0.1	
Volunteer (n=49)	6.5 \pm 0.4	3.4 \pm 0.4	0.1 \pm 0.1	
Staff (n=134)	5.6 \pm 0.3	4.2 \pm 0.3	0.3 \pm 0.1	
Urban (n=113)	5.4 \pm 0.3	4.3 \pm 0.3	0.3 \pm 0.1	
Rural (n=70)	6.4 \pm 0.4	3.4 \pm 0.4	0.1 \pm 0.1	
Food Safety Practices Delayed Survey†				
	Always	Most of the Time	Sometimes	Never
Overall (n=82)	8.8 \pm 0.2	0.8 \pm 0.1	0.2 \pm 0.1	0.1 \pm 0.1
Louisiana (n=48)	8.7 \pm 0.2	1.0 \pm 0.2	0.3 \pm 0.1	0.1 \pm 0.0
Mississippi (n=34)	9.0 \pm 0.3	0.6 \pm 0.2	0.2 \pm 0.1	0.1 \pm 0.1
Volunteer (n=17)	8.8 \pm 0.4	0.8 \pm 0.2	0.3 \pm 0.1	0.1 \pm 0.1
Staff (n=60)	8.9 \pm 0.2	0.8 \pm 0.1	0.2 \pm 0.1	0.1 \pm 0.1
Urban (n=30)	8.9 \pm 0.3	0.9 \pm 0.2	0.2 \pm 0.1	0.1 \pm 0.0
Rural (n=59)	8.7 \pm 0.2	0.8 \pm 0.2	0.3 \pm 0.1	0.2 \pm 0.1

* Differences between Food Safety Knowledge Pre- and Posttest were significantly ($p < 0.05$) different from zero.

§ Food Safety Practices Survey was administered immediately after curricular instruction.

† Food Safety Practices Delayed Survey was administered by mail 3-6 months after curricular instruction.

Table 6 Summary of all participants’ responses to individual questions on Food Safety Knowledge Pre- and Posttest

Question	Food Safety Knowledge Pretest		Food Safety Knowledge Posttest	
	Number Correct *	% Correct °	Number Correct *	% Correct °
1	164	86.3	183	96.3
2	159	83.7	173	91.1
3	138	72.6	163	85.8
4	184	96.8	186	97.9
5	170	89.5	186	97.9
6	183	96.3	185	97.4
7	182	95.8	181	95.3
8	161	84.7	179	94.2
9	185	97.4	186	97.9
10	140	73.7	176	92.6
11	189	99.5	190	100.0
12	180	94.7	185	97.4
13	146	76.8	169	88.9
14	93	48.9	172	90.5
15	143	75.3	187	98.4
16	165	86.8	184	96.8
17	132	69.5	180	94.7
18	149	78.4	171	90.0
19	122	64.2	182	95.8
20	183	96.3	187	98.4

* Number of participants with the correct answer

° Percent of participants with the correct answer

Table 7 shows a summary of the participants’ responses for each question on the Food Safety Practices Survey. The items with the most “yes” responses ($\geq 59.3\%$) were items 6 and 7 which inquired about calibrating food thermometers and cooling foods more quickly (see Appendix D). Participants responded “no” most often ($\geq 4.9\%$) to items 6 and 10 regarding calibrating food thermometers and storing raw meat and ready-to-eat foods in the refrigerator. The Food Safety Practices Survey showed that participants were already washing fruits and vegetables thoroughly, cleaning and sanitizing cooking utensils, and washing their hands before preparing food and after

handling raw meat or poultry by most often ($\geq 67.6\%$) responding “already doing” to items 3, 4, and 5 respectively.

Table 7 Summary of all participants’ responses to individual questions on Food Safety Practices Survey

Food Safety Practices Survey						
Item	Yes		No		Already Doing	
	Number *	% °	Number *	% °	Number *	% °
1	61	33.5	1	0.5	120	65.9
2	70	38.5	3	1.6	109	59.9
3	55	30.2	1	0.5	128	70.3
4	58	31.9	1	0.5	123	67.6
5	39	21.4	0	0.0	143	78.6
6	132	72.5	10	5.5	43	23.6
7	108	59.3	5	2.7	69	37.9
8	79	43.4	2	1.1	101	55.5
9	56	30.8	7	3.8	119	65.4
10	61	33.5	9	4.9	112	61.5

* Number of responses

° Percent of responses

Table 8 shows a summary of all participants’ responses to individual questions on the Food Safety Practices Delayed Survey. Proper cleaning and sanitizing, reheating leftovers thoroughly, and thorough hand washing were the food safety practices participants claimed they “always” followed. This was reflected in the most ($\geq 96.3\%$) “always” responses to items 1, 2, 4, and 5 (see Appendix E) on the Food Safety Practices Delayed Survey. The results also showed that participants use a calibrated food thermometer to check food temperatures and cover and correctly label prepared food before storing “most of the time” ($\geq 14.6\%$) by their responses to items 6 and 8. Results of the Food Safety Practices Delayed Survey showed that participants “sometimes” use a calibrated food thermometer to check food temperatures and divide larger quantities of food into smaller containers to cool more quickly by responding “sometimes” most often ($\geq 9.8\%$) to items 6 and 7. Participants responded “never” (6.1%) most often to item 10

claiming they “never” store raw meat in the refrigerator below ready-to-eat or cooked foods.

Table 8 Summary of all participants’ responses to individual questions on Food Safety Practices Delayed Survey

Food Safety Practices Delayed Survey								
Item	Always		Most of the time		Sometimes		Never	
	Number *	% °	Number *	% °	Number *	% °	Number *	% °
1	81	98.8	1	1.2	0	0.0	0	0.0
2	79	96.3	3	3.7	0	0.0	1	1.2
3	74	90.2	7	8.5	1	1.2	0	0.0
4	80	97.6	2	2.4	0	0.0	0	0.0
5	81	98.8	1	1.2	0	0.0	0	0.0
6	49	59.8	23	28.0	8	9.8	2	2.4
7	64	78.0	9	11.0	8	9.8	1	1.2
8	68	82.9	12	14.6	2	2.4	0	0.0
9	75	91.5	6	7.3	0	0.0	1	1.2
10	73	89.0	3	3.7	1	1.2	5	6.1

* Number of responses

° Percent of responses

CHAPTER 5

DISCUSSION

The goal of the project was to prevent food-borne illness in the food-insecure population in the Lower Mississippi Delta. The objectives of the project were to develop a food safety curriculum, to administer it to food handlers that serve the vulnerable population in the Lower Mississippi Delta who utilize food recovery programs, and to determine the effectiveness of the curriculum.

Overall the results showed that the curriculum was used successfully in training the food handlers. Participants showed significant improvement from the Food Safety Knowledge Pretest to the Food Safety Knowledge Posttest, and the Food Safety Practices Delayed Survey results showed that the participants were still using proper food safety practices 3-6 months following the food safety training. Verbal feedback from all food safety trainings was positive. The participants seemed to enjoy the presentation of the curriculum, visual aids, hands-on activities, and games. Participants especially liked the Glo-Germ activity emphasizing proper hand washing and the Tic-Tac-Toe game involving questions from the food safety lessons presented to the audiences.

Food Safety Knowledge Pre - and Posttest

Results from the evaluation of the effectiveness (Food Safety Knowledge Pre- and Posttest) of the food safety curriculum demonstrated that the curriculum was used successfully to improve food safety knowledge for the participants overall (19.0 ± 0.1 vs. 16.6 ± 0.2), and for participants in each of the three participating states (Louisiana 18.7 ± 0.2 vs. 16.0 ± 0.3 , Mississippi 19.0 ± 0.2 vs. 17.3 ± 0.3 , and Arkansas 19.5 ± 0.2 vs. 17.3 ± 0.6). Participants in urban (19.0 ± 0.2 vs. 16.7 ± 0.3) and rural (18.9 ± 0.2 vs. $16.6 \pm$

0.3) communities, as well as both volunteers (18.9 ± 0.3 vs. 16.5 ± 0.5) and staff (19.0 ± 0.1 vs. 16.7 ± 0.2), performed significantly better on the Food Safety Knowledge Posttest compared to the Pretest. This improvement in food safety knowledge is similar to results from several previous studies (20, 75, 76, 77, 78).

When each question was analyzed individually the results demonstrated that participants showed the greatest qualitative improvement (%) from Food Safety Knowledge Pre- to Posttests on questions concerning HACCP (18.9%), calibrating food thermometers (41.6%), cooking foods to the correct internal temperature (25.3%), and cooling methods for leftovers (31.6%). This indicates that participants had a lack of pre-knowledge in these areas, and after the food safety curricular instruction the participants understood the topics and were able to demonstrate this by correctly answering questions concerning those topics on the Food Safety Knowledge Posttest. Participants' scores were already high; therefore, less improvement was noted on questions concerning hand washing (1.1%), personal hygiene (1.1%), and cleaning and sanitizing to prevent cross-contamination (0.5%). This suggests that participants were already knowledgeable in these areas and answered these questions correctly on both the Food Safety Knowledge Pre- and Posttests. The question most missed by participants on the Food Safety Knowledge Posttest (85.8% correct) asked participants which food--a slice of toast, macaroni salad, or gumbo--was the least likely to cause illness from microorganism growth. This question may have been misleading or perhaps this topic was not adequately emphasized in the curriculum.

Food Safety Practices Survey

Results from the Food Safety Practices Survey administered immediately after the food safety curricular instruction, indicated that the majority of food recovery agency personnel and volunteers were already using (5.8 ± 0.2 out of 10 statements) or plan to use (4.0 ± 0.2 out of 10 statements) proper food safety practices in their agency or at home. The fact that responses to several statements on the Food Safety Practices Survey indicated that overall participants were “yes” planning to use proper food safety practices (4.0 ± 0.2) presumably demonstrated that the participants were not “already doing” these practices, and because of the food safety curricular instruction they would perform these safe food handling practices in the future. The results from the Food Safety Practices Survey were similar to overall results when participants were analyzed by state (Louisiana: “already doing” 5.5 ± 0.4 , “yes” 4.2 ± 0.3 ; Mississippi: “already doing” 6.2 ± 0.4 , “yes” 3.7 ± 0.4 ; or Arkansas: “already doing” 6.1 ± 0.6 , “yes” 3.8 ± 0.6), position (volunteer: “already doing” 6.5 ± 0.4 , “yes” 3.4 ± 0.4 or staff: “already doing” 5.6 ± 0.3 , “yes” 4.2 ± 0.3), and agency location (urban: “already doing” 5.4 ± 0.3 , “yes” 4.3 ± 0.3 or rural: “already doing” 6.4 ± 0.4 , “yes” 3.4 ± 0.4).

When each Food Safety Practices Survey question was analyzed separately the results showed that participants were “already” properly washing fruits and vegetables (70.3%), cleaning and sanitizing cooking utensils after each use (67.6%), and washing their hands before preparing food and after handling raw meat and poultry (78.6%). These are common safe food handling practices personnel and volunteers of food recovery agencies were already performing prior to the food safety training. These topics were included in the curriculum and thoroughly emphasized during the instruction. In

contrast, a study by Altekruze and colleagues reported that participants who responded to a telephone survey were not adequately washing their hands or taking precautions to prevent cross-contamination (79). Another study by Altekruze and colleagues reported that respondents did not properly clean cutting boards after contact with raw meat or chicken (80). Participants responded “yes” to items regarding using calibrated food thermometers to check food temperatures regularly (72.5%) and dividing large quantities of hot food into smaller containers to cool more quickly (59.3%). These results suggest that participants were not performing these particular food safety practices and would begin to do so as a result of the training. However, the greatest number of participants responding “no” was most often to the same item on the use of a food thermometer (5.5%). This means some participants, although a relatively small number of respondents, were not willing to check food temperatures with a calibrated thermometer. A study by the USDA’s Food Safety and Inspection Service (FSIS) reported that food thermometer use has increased since 1998, but most consumers are not regularly using a food thermometer (78). The other item to which some participants responded “no” was to the item suggesting storing raw meat in the refrigerator below cooked or ready-to-eat foods (4.9%). Some participants may have been confused by this item or it may not have been clearly communicated during the food safety training. These results are similar to those reported in the USDA’s FSIS HACCP evaluation report released in September of 2002 (78).

Without actually going into the facility and observing the workers’ food handling behaviors, it is hard to determine if, as a result of the food safety training, the participants will adopt safe food handling behaviors. This is a limitation to our study as we used self-

reported data from the Food safety Practices Surveys to evaluate food handlers' behaviors. A study by Meer and associates (75) showed that food safety knowledge scores had a small, positive effect on food safety practices scores in Expanded Food and Nutrition Education Program participants, but the participants' food safety practices were not observed by the researchers. In a review of food safety studies, Redmond and colleagues (81) showed that food safety knowledge, attitudes, intentions, and self-reported practices did not correspond to observed behaviors, suggesting that observational studies provide a more accurate indication of the food safety practices actually used in food preparation (81).

A study by Clayton and associates (82) claimed that food safety training does not necessarily guarantee that the workers carry out the safe food handling behaviors. The study suggested that barriers preventing the workers from always practicing safe food handling included lack of time, lack of staff, and a lack of resources. The results of the study were based on the food handlers' self-reported practices, like on the Food Safety Practices Survey in our study (82). A report by the USDA's FSIS showed that consumers were more knowledgeable about food safety, but this knowledge was not always reflected in their food handling behaviors when they were observed (78). Another study by McIntosh and colleagues suggested that knowledge of specific food-borne pathogens and food safety practices had no effect on the participants' willingness to change their behavior (83). Henroid and associates (84) evaluated school foodservice employees' food handling practices and food safety knowledge and attitudes. The results of their study showed that the food safety knowledge was high, but when food handling behaviors were observed, the safe food handling practices were not being carried out.

This study involved a HACCP-based analysis and did check temperatures of the food, refrigerators and freezers, and dish machines (84).

In contrast, some studies demonstrate increased food safety practices as a result of food safety education when food handlers are observed. Studies have reported that food safety education helped to increase sanitary conditions in restaurants (19, 77, 85). These studies suggested that food safety education did lead to increased adoption of safe food handling practices as evidenced in an adult care facility audit (77) and restaurant inspection scores (19, 85).

On the initial Food Safety Practices Surveys the mean response for “already doing” proper food safety practices was 5.8 ± 0.2 out of 10 statements. The Food Safety Knowledge Pretest scores were also relatively high (overall 16.6 ± 0.2 out of 20 questions). These results demonstrated an appreciable level of pre-knowledge. These pre-knowledge results may mean that the vulnerable population in the Lower Mississippi Delta region of the U.S. may not be at too great of a risk for food-borne illness from food obtained at food recovery agencies. However, the actual foods served to this population were not sampled for holding temperatures, subjected to sampling for microbial analyses, canned goods inspected, etc., to more definitively determine the safety of food served to this vulnerable population. In addition, any one of the proper food safety practices that were not being performed at the time that the participants were initially surveyed could theoretically put vulnerable individuals at risk for developing a food-borne illness.

The principal investigators for the project proposed in an earlier version of the proposal to perform temperature checks on recovered foods and do follow-up observations of the food recovery agencies. The investigators were aware that

knowledge and indication on surveys were no guarantee of proper behavior practices. However, the funding agency, USDA-CSREES, determined that education and simple evaluation, such as tests and surveys, were adequate and eliminated funding on temperature checks and follow-up observations of proper food safety practices.

Food Safety Practices Delayed Survey

The results of the Food Safety Practices Delayed Survey (only Louisiana and Mississippi data available) administered 3-6 months following the training using the food safety curriculum demonstrated a qualitative indication of improvement in food safety practices. A majority of the participants indicated a response of “always” (8.8 ± 0.2 out of 10 statements) or “most of the time” (0.8 ± 0.1 out of 10 statements) using proper food safety practices on the Delayed Food Safety Practices Survey as compared to the number of participants that indicated that they were “already doing” proper food safety practices (5.8 ± 0.2 out of 10 statements) on the Food Safety Practices Survey. These results indicated the participants had retained the food safety knowledge for the 3-6 month period and were continuing to carry out safe food handling behaviors at the time of the survey. When analyzed by state, both Louisiana (8.7 ± 0.2) and Mississippi (9.0 ± 0.3) had results similar to the overall results with a majority of the participants “always” following proper food safety practices. These results were similar for both volunteers (8.8 ± 0.4) and staff (8.9 ± 0.2) as well as participants in both urban (8.9 ± 0.3) and rural (8.7 ± 0.2) communities. A study by Lynch and colleagues showed similar results in that the time lapsed since safe food handler training did not significantly affect the level of food safety knowledge among participants (86).

When each Food Safety Practices Delayed Survey question was analyzed individually participants reported “always” cleaning and sanitizing cutting surfaces (98.8%) and cooking utensils (97.6%) after cutting up raw meat or when there is a chance they may have become contaminated, reheating leftovers thoroughly before serving (96.3%), and washing their hands thoroughly before preparing food and after handling raw meat or poultry (98.8%). These are essential safe food handling practices and were thoroughly emphasized throughout the food safety training. In contrast, two studies by Altekruze and colleagues (79, 80) showed that these safe food handling practices are not always being followed. The USDA’s FSIS HACCP Evaluation report showed that participants admitted that they do not always wash their hands, for example, before preparing a sandwich or snack (78). The Food Safety Practices Delayed Survey results demonstrated that “most of the time” some of the participants use calibrated thermometers to check food temperatures (28.0%) and cover and correctly label prepared food before storing (14.6%). Some of the participants claimed they “sometimes” use calibrated thermometers (9.8%) and divide large quantities of hot foods into smaller containers to cool more quickly (9.8%). Participants may have responded that they “most of the time” and “sometimes” follow these particular food safety practices because of certain known barriers to food safety reported in a study by Clayton and associates (82). These barriers include lack of time, lack of staff, and lack of resources (82). Also, it has been reported that most consumers do not always use a calibrated thermometer in the home to check food temperatures (78). The Food Safety Practices Delayed Survey results showed that 6.1% of participants “never” store raw meat in the refrigerator below cooked or ready-to-eat foods. Participants may have been confused by the way this item

was worded or this safe food handling practice may not have been emphasized in the curriculum. However, these results are similar to those found in the USDA's FSIS HACCP evaluation report that showed consumers are not conscious about keeping raw meat and poultry separate from other foods in their refrigerators (78).

Conclusions

The results of this study support the hypothesis that the development and delivery of a food safety education program for participating food recovery agency personnel and volunteers will increase food safety knowledge and indication of adoption of safe food handling behaviors. This will presumably decrease the risk and incidence of food-borne illness in those receiving assistance. The overall goal of the project was to develop a strategy for preventing food-borne illness by promoting food safety practices in personnel and volunteers providing food to a vulnerable population in the Lower Mississippi Delta who utilize food recovery programs. The results of the study suggest this goal was achieved. The improvement, statistically (Food Safety Knowledge Pre- and Posttest) and qualitatively (Food Safety Practices Survey and Delayed Survey) of the knowledge and the willingness on the part of food handling personnel and volunteers of food recovery agencies to change (Food Safety Practices Surveys) food handling practices, support the continued use of the food safety curriculum in the Lower Mississippi Delta region, and possibly in other regions of the U.S.

Future Directions

Proper food safety practices for food handlers are important, especially when the food is served to the food-insecure population of the Lower Mississippi Delta region. Food safety education has been shown to be effective in increasing knowledge of

participants in this study and in previous studies (20, 75, 76, 77). Food safety training has also been shown to be effective in the adoption of safe food handling behaviors by food service workers (19, 77, 85); however, these studies did not observe the actual food safety practices of the food handlers. The results were based on participants' self-reported practices. It has been reported that when food handling behaviors are observed, food safety knowledge does not always correspond with proper food safety practices (78, 82, 84). It is important to further explore if the food safety training actually leads to improvement in safe food handling behaviors by observing the food handlers during food preparation. In addition, the adoption of safe food handling behaviors may not increase the safety of the food served to this vulnerable population. Without microbial analyses and time/temperature checks of the food, etc., it is impossible to determine if the food safety curriculum and delivery of the program made the food served by the food recovery agencies safer for those receiving assistance. Perhaps further exploration and testing the safety of the food is needed.

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**APPENDIX A
CONSENT FORM**

Consent Form
Preventing Foodborne Illness in a Vulnerable Population in the Lower Mississippi Delta
Louisiana State University AgCenter
Mississippi State University Cooperative Extension Service
University of Arkansas Cooperative Extension Service
Southern University AgCenter

1. **Purpose:** To provide safe food handler training to food recovery agency staff and volunteers, which may help to prevent foodborne illness
2. **Number of participants:** Food recovery agency staff and volunteers from several parishes and counties in Louisiana, Arkansas and Mississippi will be invited to participate in the safe food handler training.
3. **Time:** The safe food handler training session will be approximately 3 hours.
4. **Procedures:** Safe food handler training will be conducted for food recovery agency staff and volunteers. Surveys will be given to participants before and after training to determine the effectiveness of the curriculum materials and training.
5. **Participant's rights:** Your participation in the project is voluntary.
6. **Benefits:** Learning more about food safety and safe food handling practices can help prevent foodborne illness.
7. **Risks:** There is very minimal risk to you as your survey results will only be given to you. Publication of project results will only include average test scores and collective survey results, with no reporting of individual data.
8. **Privacy:** Your survey results will be given to you only. All results will be reported anonymously without using the actual names of the individual participants nor food recovery organizations; only the number of organizations per state will be reported.
9. **Right to refuse or withdraw:** I understand that my participation is voluntary and I may refuse to participate or may discontinue my participation in the research AT ANY TIME.
10. **Offer to answer questions:** This study has been explained to my satisfaction by _____ and my questions were answered. If I have any other questions about this study, I may call David G. Morrison, the Assistant Director of the Louisiana Agricultural Experiment Station and Administrator for the Institutional Review Board for the Louisiana Agricultural Center, at 225-578-8236; Tracy S. Arwood, the Regulatory Compliance Officer for Mississippi State University, at 662-325-3294; or Bobbie Biggs, the Research Compliance Program Coordinator for the University of

Arkansas, at 479-575-6608.

11. **Acknowledgment and consent for participation:** I agree that I have read and understand this Consent to Participate in this Research Study (or it has been read to me); that I understand the information contained in it, about which I have asked if unsure; that I have been given an opportunity to ask whatever questions I had about the study; that all my questions about the study have been answered in a satisfactory manner; and that I understand the nature and purpose of the study, its benefits and risks .

11. Project Directors: Elizabeth Reames - 225-578-3929
Melissa Mixon – 662-325-3080
Easter Tucker – 501-671-2099

Participant

Signature of Participant

Date

APPENDIX B
FOOD SAFETY KNOWLEDGE PRETEST

Name_____

Parish or County_____

Circle: Volunteer or Staff

For each question below, circle the answer that you think is best.

- 1. Which is the greatest food safety problem?**
 - A. pesticides**
 - B. hair**
 - C. microorganisms**

- 2. Cross-contamination is most likely to occur when you**
 - A. touch raw meat and then touch cooked or ready-to-eat food.**
 - B. check the refrigerator temperature regularly.**
 - C. hold food at temperatures below 140°F.**

- 3. Which of these foods is LEAST likely to cause illness from microorganism growth?**
 - A. slice of toast**
 - B. macaroni salad**
 - C. gumbo**

- 4. Hands should be washed after which of these activities?**
 - A. touching your hair**
 - B. using a handkerchief**
 - C. both A and B**

- 5. When putting on disposable gloves to make hamburger patties you should**
 - A. wash your hands and then put on gloves.**
 - B. put on gloves and then wash your gloved hands.**
 - C. put on gloves without washing your hands.**

- 6. Which personal behavior can contaminate food?**
A. touching a pimple or sore
B. coughing or sneezing on food
C. both A and B
- 7. After washing your hands, dry them with**
A. your apron.
B. a single-use paper towel
C. a reusable cloth towel.
- 8. Which of these is a bad food storage practice?**
A. rotating food to use the oldest food first
B. covering and labeling food before storage
C. storing raw meat above ready-to-eat food
- 9. After trimming raw chicken on a cutting surface,**
A. rinse the surface with water.
B. dry the surface with a paper towel
C. clean and sanitize the cutting surface.
- 10. The purpose of the HACCP system is to**
A. identify and control possible food safety hazards.
B. keep the kitchen pest-free.
C. identify faulty food preparation equipment.
- 11. After going to the restroom, you should**
A. wash your hands.
B. comb your hair.
C. have a snack.
- 12. Which of these always needs to be both cleaned and
sanitized?**
A. walls
B. any surface that comes into contact with food
C. ceilings

- 13. Good personal hygiene practices include all of the following EXCEPT**
- A. proper hand washing.**
 - B. daily bathing.**
 - C. getting regular dental check-ups.**
- 14. A recommended method of calibrating food thermometers is the**
- A. ice-point method.**
 - B. vinegar method.**
 - C. room-temperature method.**
- 15. When washing your hands, you should rub your hands together with soap for at least**
- A. 20 seconds.**
 - B. 5 seconds.**
 - C. 10 seconds.**
- 16. When washing dishes, how should they be dried?**
- A. with a reusable cloth towel**
 - B. air-dried**
 - C. with your apron**
- 17. When cooking a hamburger, what is the correct way to determine if the meat is cooked thoroughly?**
- A. cut into the middle and see if the meat is pink**
 - B. smell the meat**
 - C. use a food thermometer**
- 18. In the refrigerator, cooked foods should be stored where?**
- A. above raw foods**
 - B. below raw foods**
 - C. it does not matter**

- 19. To cool a hot pot of gumbo quickly**
- A. pour the gumbo into a deep, plastic container.**
 - B. divide the gumbo into shallow, metal containers.**
 - C. leave the gumbo in the cooking pot.**

- 20. What is a commonly heard statement about food safety?**
- A. “Use it or lose it!”**
 - B. “Make it or break it!”**
 - C. “When in doubt, throw it out!”**

APPENDIX C
FOOD SAFETY KNOWLEDGE POSTTEST

Name _____

For each question below, circle the answer that you think is best.

- 1. Which is the greatest food safety problem?**
 - A. pesticides**
 - B. hair**
 - C. microorganisms**

- 2. Cross-contamination is most likely to occur when you**
 - A. touch raw meat and then touch cooked or ready-to-eat food.**
 - B. check the refrigerator temperature regularly.**
 - C. hold food at temperatures below 140°F.**

- 3. Which of these foods is LEAST likely to cause illness from microorganism growth?**
 - A. slice of toast**
 - B. macaroni salad**
 - C. gumbo**

- 4. Hands should be washed after which of these activities?**
 - A. touching your hair**
 - B. using a handkerchief**
 - C. both of the above**

- 5. When putting on disposable gloves to make hamburger patties you should**
 - A. wash your hands and then put on gloves.**
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A. touching a pimple or sore
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C. both of the above
- 7. After washing your hands, dry them with**
A. your apron.
B. a single-use paper towel
C. a reusable cloth towel.
- 8. Which of these is a bad food storage practice?**
A. rotating food to use the oldest food first
B. covering and labeling food before storage
C. storing raw meat above ready-to-eat food
- 9. After trimming raw chicken on a cutting surface,**
A. rinse the surface with water.
B. dry the surface with a paper towel
C. clean and sanitize the cutting surface.
- 10. The purpose of the HACCP system is to**
A. identify and control possible food safety hazards.
B. keep the kitchen pest-free.
C. identify faulty food preparation equipment.
- 11. After going to the restroom, you should**
A. wash your hands.
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- 12. Which of these always needs to be both cleaned and
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A. walls
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- A. proper hand washing.**
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- A. cut into the middle and see if the meat is pink**
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- A. above raw foods**
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- 19. To cool a hot pot of gumbo quickly**
- A. pour the gumbo into a deep, plastic container.**
 - B. pour the gumbo into shallow, metal containers.**
 - C. leave the gumbo in the cooking pot.**

- 20. What is a commonly heard statement about food safety?**
- A. “Use it or lose it!”**
 - B. “Make it or break it!”**
 - C. “When in doubt, throw it out!”**

APPENDIX D
FOOD SAFETY PRACTICES SURVEY

Name _____

Circle 1 of the 3 answer choices.

After attending the food safety training today, I plan to follow these recommended food safety practices (or habits)...

1. clean and sanitize cutting surfaces after cutting up raw meat.
YES NO ALREADY DOING

2. reheat leftovers thoroughly before serving.
YES NO ALREADY DOING

3. wash fruits and vegetables thoroughly under running water to remove dirt and other contaminants.
YES NO ALREADY DOING

4. clean and sanitize cooking utensils after each use or when there is a chance that they have been contaminated.
YES NO ALREADY DOING

5. wash my hands before I prepare food and after handling raw meat or poultry.
YES NO ALREADY DOING

6. use a calibrated food thermometer when checking food temperatures.
YES NO ALREADY DOING

7. divide large quantities of food into smaller containers to cool the food more quickly.
YES NO ALREADY DOING

8. cover and correctly label prepared food before storing.
YES NO ALREADY DOING

9. use the oldest food products first.
YES NO ALREADY DOING

10. store raw meat in the refrigerator below ready-to-eat or cooked foods.
YES NO ALREADY DOING

APPENDIX E
FOOD SAFETY PRACTICES DELAYED SURVEY

Name _____

Circle 1 of the 4 answer choices.

I follow these recommended food safety practices (or habits)...

- 1. clean and sanitize cutting surfaces after cutting up raw meat.**
Always Most of the Time Sometimes Never
- 2. reheat leftovers thoroughly before serving.**
Always Most of the Time Sometimes Never
- 3. wash fruits and vegetables thoroughly under running water to remove dirt and other contaminants.**
Always Most of the Time Sometimes Never
- 4. clean and sanitize cooking utensils after each use or when there is a chance that they have been contaminated.**
Always Most of the Time Sometimes Never
- 5. wash my hands before I prepare food and after handling raw meat or poultry.**
Always Most of the Time Sometimes Never
- 6. use a calibrated food thermometer when checking food temperatures.**
Always Most of the Time Sometimes Never
- 7. divide large quantities of food into smaller containers to cool the food more quickly.**
Always Most of the Time Sometimes Never
- 8. cover and correctly label prepared food before storing.**
Always Most of the Time Sometimes Never
- 9. use the oldest food products first.**
Always Most of the Time Sometimes Never
- 10. store raw meat in the refrigerator below ready-to-eat or cooked foods.**
Always Most of the Time Sometimes Never

APPENDIX F
FOOD SAFETY CURRICULUM OUTLINE



Serving Food Safely: A food safety guide for food handlers working with food recovery agencies

Developed as a collaborative project with LSU AgCenter, Southern University AgCenter, University of Arkansas Cooperative Extension Service and Mississippi State University Cooperative Extension Service

Lesson 1: What Causes Food-borne Illness?

Food-borne illness is caused by harmful substances that make food unsafe to eat. The harmful substances are called food safety hazards.

3 Types of Food Safety Hazards:

1. biological hazards
2. physical hazards
3. chemical hazards

Activity: Viewing Microorganisms

Lesson 2: Preventing Food-borne Illness

Follow three rules to prevent food-borne illness:

1. Control time and temperature abuse.
2. Practice good personal hygiene.
3. Prevent cross contamination.

Activity: Bacteria Multiplication

Lesson 3: Keeping Food Out of the Temperature Danger Zone

The temperature danger zone is 41 degrees F to 140 degrees F. Bacteria grow and multiply quickly in the temperature danger zone. Use a calibrated thermometer to check food temperatures regularly.

Activity: Taking temperature of food or ice

Lesson 4: Personal Hygiene and Handwashing Procedures

Food handlers can contaminate food by failing to wash hands properly when necessary, coughing or sneezing on food, or handling food after touching sores or cuts.

Activity: Glo-Germ

Lesson 5: Cleaning and Sanitizing

Cleaning and sanitizing are not the same. Cleaning is removing food or other types of soil from a surface, such as a plate or counter. Sanitizing is reducing the number of microorganisms to a safe level.

Activity: What are you working with?

Lesson 6: Handling and Serving Food Safely

Practice good personal hygiene. Control time and temperature. Prevent cross contamination. Cook food to the required internal temperature. Use the two-stage cooling method: cool cooked food from 140 degrees F to 70 degrees F within 2 hours, and then from 70 degrees F to 41 degrees F within an additional 4 hours, for a total cooling time of 6 hours or less.

Activity: Tic- Tac- Toe

Lesson 7: Food Storage

Use products closest to their expiration date first. Store perishable foods at the correct temperature. Store raw meat, poultry, and fish separately from cooked and prepared food.

Activity: Identifying White Powders

Lesson 8: Transporting Food Safely

Transport food at recommended temperatures. Protect food during pick-up and delivery. Practice good personal hygiene.

Activity: "Transporting Food Safely" video produced by the LSU AgCenter

Lesson 9: HACCP for Control of Food Safety

HACCP food system identifies food safety hazards at specific points in a food's flow to prevent, eliminate, or reduce them to safe levels.

Activity: Driving Situation

Lesson 10: Cleaning and Inspecting Fresh Fruits and Vegetables

Fresh fruits and vegetables may carry pathogens (disease-causing organisms) or contain insects and other materials.

Activity: Absorption Test

VITA

Sara Katherine (Katie) Waggoner was born on February 23, 1980, in Monroe, Louisiana. She received her bachelor's degree in dietetics in May 2002 from Texas Christian University in Fort Worth, Texas. In the fall of 2002, Katie enrolled in the Human Nutrition and Food division of Human Ecology at Louisiana State University to pursue a master's degree. During her studies, she worked as a graduate assistant in the divisions of Family, Child, and Consumer Sciences and Human Nutrition and Food. She is a member of Gamma Sigma Delta Agricultural honor society, American Dietetic Association, Louisiana Dietetic Association, and the Baton Rouge Dietetic Association. Katie intends to graduate in May 2004.