

CHAPTER I

INTRODUCTION

Food safety has become a topic of increasing concern in the United States (U. S.). In 1997, a national food safety initiative, Food Safety: From Farm to Table, was established to expand food safety programs and to increase consumer protection (1). The Centers for Disease Control and Prevention (CDC) estimate that 76 million people experience a foodborne illness each year resulting in 325,000 hospitalizations and 5,000 deaths (2). Foodborne illness results in a substantial estimated economic cost of \$6.5 to \$34.9 billion dollars in the U.S. annually (3). Despite highly publicized outbreaks of *Escherichia coli* O157:H7 in undercooked ground beef (4), *Salmonella enteritidis* in raw eggs (5), and *Listeria monocytogenes* in ready-to-eat foods (6) many consumers fail to recognize the frequency and negative outcomes associated with foodborne illness. It is estimated that at least 20% of all foodborne disease outbreaks are a result of unsafe food handling practices in the home (7). However, some experts believe that the occurrence of foodborne illness in homes is much higher since many sporadic cases are often not reported (8). Practices such as consuming contaminated raw foods, inadequate cooking, improper cooling, lapses of 12 or more hours between preparing and eating food, and poor personal hygiene among food handlers were most likely to contribute to outbreaks of foodborne illness in the home (9).

In the last two decades, the average family size has decreased and the number of single parents and families with both parents working outside the home has increased. These changes in consumer lifestyles have resulted in a decrease in home food preparation and an increased use of commercially prepared and convenience foods (10). As a result of these changes, many consumers lack knowledge and understanding of safe food handling practices (11). Research indicates that many U.S. consumers do not have adequate food safety knowledge and do not use safe food handling practices to prevent foodborne illness (7,11-25).

Foodborne illness is a major concern for the increasing older adult population. Today, adults 65 years or older account for 12.7% of the U.S. population (26). By 2050, the U.S. Census Bureau estimates that 1 in 5 Americans will reach age 65 (27). In Virginia, 19.6% of the population are age 55 or older (26). Approximately 30% of older adults, 55 years or older, live in poverty because they rely on Social Security benefits and Medicare to meet their financial and

health care needs (28). Unfortunately, many older adults have chronic diseases that can create substantial health care costs. In some cases, Medicare does not cover health care costs creating a financial burden for many older adults (29). Factors such as decreased immune function, reduced gastric secretions, malnutrition, poverty, and low literacy skills may contribute to older adults being more susceptible to foodborne illness (30-33). Furthermore, many older adults do not recognize themselves as being at risk for foodborne illness (18).

Currently, few studies have examined food safety knowledge and practices of older adults with lower socioeconomic status. Most studies that examined food safety knowledge and practices were conducted among the general population (11-14,16-21,23,24). Respondents tended to have higher education levels and be under the age of 65 years (11,12,24). Although, these studies indicate that safe food handling knowledge and practices of older adults may be better than the general population; practices may still be inadequate to prevent foodborne illness in this susceptible population (12). Also, the relationship between demographic characteristics and food safety knowledge and practices is not clearly understood. Few studies have reported on the relationship between income and food safety knowledge and practices (20,24,25). Some studies have linked lower education levels to decreased food safety knowledge (12,24). However, most studies that examined food safety knowledge and practices were mail and telephone surveys. Mail surveys may create a response bias, since literacy skills are often required in order to fill out and return the surveys (34). Both mail and telephone surveys may not allow for an establishment of rapport among interviewers and respondents. Also, individuals with lower educational levels and incomes may be more inclined to give socially acceptable answers to a person with whom they have not established rapport. Many consumers are knowledgeable of food safety concepts, but simply failed to adhere to them (7,11,12,16,20). In general, these findings indicate that the relationship between having knowledge of food safety principles and practicing safe food handling are ambiguous. Furthermore, more research is also needed to determine food safety knowledge and practices among different sub-groups of the population, especially the older adult population.

This study focuses on food safety knowledge and behaviors among older adult participants enrolled in the Food Stamp Nutrition Education Program (FSNEP), which is funded by the Food and Consumer Service, United States Department of Agriculture (USDA). In the Commonwealth of Virginia, FSNEP is titled The Smart Choices Nutrition Education Program

(SCNEP) and is implemented through Virginia Cooperative Extension. In 1999, 6,517 households were enrolled in FSNEP, 3,193 (49%) of households were receiving food stamps, and 5,604 (86%) of households had an income less than 150% of the poverty level (35). Since no studies have looked specifically at this population, assessing food safety knowledge and practices is imperative in developing successful interventions for promoting adequate food safety behaviors. Based on previous studies, one might anticipate that older adults with lower socioeconomic status would have higher food safety knowledge and practices than the general public. However, these findings are contrary to observations and reports of FSNEP program assistants, which indicate that food safety practices of older adult program participants violate many food safety recommendations (personal communication, Ruby H. Cox, PhD, RD, 1999).

OBJECTIVES OF THE STUDY

1. To determine food safety knowledge and practices of older adult population of FSNEP.
2. To examine changes in food safety knowledge and practices of FSNEP participants after a food safety lesson from the *Healthy Futures* curriculum (35) currently used in FSNEP.
3. To examine changes in knowledge and practices resulting from using an instructional food safety video titled *From Store to Fork: Safe Food Guidelines For Older Adults* (36) in conjunction with the current FSNEP food safety lesson.
4. To determine if socioeconomic variables such as age, gender, ethnicity, income, and education are correlated with food safety knowledge and behaviors.
5. To compare observations of food safety practices with self-reported practices of FSNEP participants.

DEFINITION OF TERMS

FSNEP (Food Stamp Nutrition Education Program): A nutrition education program funded with food stamp administrative monies from the Food and Nutrition Service, USDA. FSNEP educates food stamp households on basic nutrition concepts and how to manage food stamps and other food resources to achieve a healthy diet.

SCNEP (Smart Choices Nutrition Education Program): Specific title given to FSNEP in Virginia.

FSNEP Program Assistant: A paraprofessional trained to provide nutrition education to FSNEP clients. FSNEP Program Assistants are indigenous to the client population.

Older, low-income FSNEP client: An individual 45 years or older with an income of 150% or less of the federal poverty guidelines and newly enrolled in FSNEP.

CHAPTER II

REVIEW OF LITERATURE

INCIDENCE OF FOOBORNE ILLNESS

In the last decade foodborne illness has become a primary public health issue in the U.S. In 1998, there were 3,793 cases of cryptosporidiosis, 3,161 cases of *Escherichia coli* O157:H7, 43,694 cases of salmonellosis, and 23,626 cases of shigellosis reported in the United States (38). Between 1993 and 1997, 2,751 outbreaks (86,058 cases) of foodborne illness occurred in the U.S. (39). Only, 32% of the outbreaks were of known etiology. Seventy-five percent of outbreaks and 86% of cases from known sources were caused by bacterial pathogens. Chemical agents accounted for 17% of the outbreaks, while viruses and parasites accounted for 6% and 2%, respectively (39). In Virginia, there were 700 cases of campylobacteriosis, 1,135 cases of salmonellosis, 200 cases of shigellosis, 123 cases linked to Norwalk-like viruses, and 69 cases of *Escherichia coli* O157:H7 reported in 1998 (40).

Although these data provide insight into the magnitude of foodborne illness, the actual incidence of foodborne illness is estimated to be much higher. Quantifying the number of foodborne illnesses is complicated by many factors such as underreporting. Many foodborne illnesses go unreported because not all pathogens associated with foodborne transmission are required to be reported at local and national levels. In addition, many sporadic and mild cases of foodborne illness are not reported because treatment is usually not sought. Another issue in determining the incidence of foodborne illness is the difficulty in tracing sources of outbreaks and many foodborne illnesses are caused by unidentified pathogens.

The incidence of foodborne illness has a significant impact on the U.S. economy. Buzby and Roberts (3) estimated the economic cost of seven foodborne pathogens, *Campylobacter jejuni*, *Clostridium perfringens*, *Escherichia coli* O157:H7, *Listeria monocytogenes*, *Salmonella* spp., *Staphylococcus aureus*, and *Toxoplasma gondii* to be \$6.5 to \$34.9 billion dollars annually.

FACTORS CONTRIBUTING TO FOODBORNE ILLNESS

There are many contributing factors that can lead to foodborne illness. In a 1993-1997 review of 2,751 foodborne outbreaks, Olsen et al. (39) reported that improper holding temperatures and inadequate cooking were the two most common food preparation practices that

contributed to foodborne illness. Three-hundred and twelve outbreaks were a result of holding foods at an improper temperature, 168 outbreaks occurred due to inadequate cooking, and 134 outbreaks were due to poor personal hygiene. Olsen et al. (39) also reported that 585 of the 2,751 foodborne outbreaks occurred in private residences, most of which were attributable to bacterial pathogens. Bryan et al. (9) reviewed 345 confirmed foodborne outbreaks in U.S. homes and found that consuming contaminated raw foods, inadequate cooking, obtaining foods from unsafe sources, improper cooling, and lapses of 12 or more hours between preparing and eating foods were the most important factors that contributed to foodborne illness. Forty-two percent of the outbreaks were attributed to raw food and 31% were due to inadequate cooking. In addition, 28.7% were attributed to food from unsafe sources and improper cooling, while lapses of 12 or more hours between preparing and eating food resulted in 12.8% of the outbreaks (9).

CONSUMER FOOD SAFETY PRACTICES

Research indicates that many U.S. consumers do not have adequate food safety knowledge and practices to prevent foodborne illness (7,11-25). Furthermore, many consumers who have adequate food safety knowledge fail to put those principles into practice (7,11,12,16,20). In 1974, the USDA Economic Research Service conducted personal interviews with 2,503 homemakers assessing food safety knowledge, attitudes, and practices (20). Sixty-three percent (1,577) of households examined engaged in high-risk food handling practices. Households classified as high-risk committed one or more of the following unsafe food handling practices: undercooking hamburgers, leaving susceptible food at room temperature for more than two hours, keeping meat and poultry leftovers in a refrigerator above 45° F, stuffing turkey a day before roasting, storing leftover stuffing in a turkey, and partially cooking a turkey and then completing the cooking later. These high-risk food handling practices were common among households with higher education levels, higher incomes and among homemakers 49 years old or younger.

In the USDA study, 88% of homemakers were very or somewhat concerned with leaving uncooked meat and poultry at room temperature for 2 to 3 hours, while only 53% were concerned with leaving cooked meat at room temperature. Furthermore, 66% incorrectly thought cooked food should be cooled to room temperature before refrigerating. This lack of knowledge of proper storage of cooked meat was evident in the food handling practices reported. Of 1,577

households classified as high-risk, 66% left cooked meat or salad sandwiches at room temperature for more than two hours. Older homemakers and homemakers with lower educational levels were more likely to leave cooked beef roast, pork roast, and chicken at room temperature than homemakers from other socioeconomic groups. In addition to improper storage of cooked food, approximately 1 in 5 homemakers interviewed believed refrigeration of food completely stops growth of harmful bacteria and freezing kills bacteria that cause foodborne illness. However, 32% of household refrigerators were 45°F or above. Increased temperatures were found in households with lower education levels and incomes. Seventy-five percent of households with a high school education or less had refrigerator temperatures above 45°F. Homemakers with decreased education levels and lower incomes were more inclined to say they would taste the contents of a canned good to determine if the food was safe. A majority of participants adequately cooked hamburgers. Of 2,378 households that prepared hamburgers only 95 (4%) reported eating undercooked hamburgers. However, 1,101 (44%) homemakers were unable to correctly associate *Salmonella* with raw poultry and eggs. Thirty-six percent were unable to associated botulism with canned goods, 35% could not identify trichinosis with undercooked pork, and 32% could not associate *Staphylococcus* with infected cuts on hands. Knowledge of food safety and behavior coincided in only 9% of households interviewed. Half of all households were unaware of food safety principles and engaged in high-risk food handling practices.

Yang et al. (24) surveyed 19,356 adults in a multi-state survey and found approximately 2,686 of the respondents reported not washing their hands with soap after handling raw meat or poultry. Only 3% of the respondents washed and sanitized a cutting board with soap and bleach after cutting raw meat or poultry. Half of the respondents reported eating undercooked eggs and 328 ate undercooked hamburgers. The authors theorized that consumption of undercooked food by respondents may be attributed to cultural norms and/or a lack of understanding of the risk associated with consuming undercooked food. Highest food safety practices were found among respondents with lower education levels, lower incomes, and among respondents 55 years or older. Respondents with a high school education or less were significantly ($p < 0.05$) more likely to wash hands and cutting surfaces with soap and bleach after handling raw meat and poultry and significantly less likely to eat undercooked hamburgers than respondents with a college education. Respondents with annual incomes less than \$15,000 were also significantly ($p < 0.05$)

more likely to wash hands and cutting surfaces with bleach or soap and less likely to eat undercooked hamburgers. Consumers with higher incomes and education levels may lack food safety knowledge and practices because they may not prepare their own food as often as consumers of lower socioeconomic status (12). In the Yang et al. (24) study only 13% of the 5,168 respondents 60 years or older, did not wash their hands and cutting surfaces with soap and bleach after contact with raw meat and poultry. Also, 13% and 49% of the 5,168 respondents 60 years or older reported eating undercooked hamburgers and raw eggs, respectively. These results indicate that consumers, including older adults, with lower incomes and lower educational levels may have higher food safety practices. However, only 5,168 (26.7%) of the total survey respondents were 60 years or older, 2,807 (14.5%) had less than a high school education, and 2,497 (12.9%) earned less than \$15,000 a year.

A 1993 national survey, of 1,415 adults conducted by the U.S. Food and Drug Administration (FDA) found approximately one-third of the respondents reported unsafe food handling practices (12). The majority of respondents knew that hand washing (86%) and preventing cross-contamination (80%) were important in reducing the risk of foodborne illness. However, only 934 (66%) reported washing their hands and 948 (67%) washed cutting boards after contact with raw meat and poultry. Furthermore, approximately one-half (53.7%) of respondents could associate *Salmonella* with specific foods. The FDA survey conducted by Altekruze et al. (12) found lower food safety knowledge among respondents with less than a high school education, which is in contrast to the findings of Yang et al. (24). Of the 283 FDA survey respondents with less than a high school education, only 99 (35.1 %) could associate specific foods with *Salmonella*. In addition, only 136 (48%) thought cooking meat well done decreased the risk of foodborne illness. However, respondents with less than a high school education were significantly ($p \leq 0.05$) more likely to serve hamburgers medium or well done. Reasons for these results are unclear, but the authors hypothesized that respondents may inadequately cook hamburgers because of taste preferences. Although, respondents with a high school education, were significantly ($p \leq 0.05$) more likely to know hand washing decreases the risk of foodborne illness, respondents with less than a high school education were just as likely to wash their hands (66%) after handling raw meat or poultry. These findings may be attributed to a greater amount of food preparation experience among respondents with lower education levels. Safe food handling practices also increased with age, which was similar to the findings of Yang et al. (24).

Respondents 65 years or older, were significantly ($p < 0.05$) more likely to wash their hands and cutting boards after handling raw poultry. However, individuals 65 years and older comprised the smallest age group (13.3%) of the survey respondents. The FDA survey also examined the relationship between experiencing a foodborne illness and food safety knowledge and practices. In the same FDA survey, Fein et al. (18) reported that 387 of the respondents or a family member had experienced a foodborne illness. Of those experiencing a foodborne illness, 163 (42%) were knowledgeable of food safety practices. However, inadequate food handling practices were found among 182 (47%) of the respondents.

Williamson et al. (11) surveyed 869 consumers and found that 635 (73%) of the respondents associated *Salmonella* with poultry and eggs. However, many failed to engage in safe food handling practices of these products. Correlation analysis of food safety knowledge and practices indicated that only half of the respondents who associated *Salmonella* with poultry and eggs correctly refrigerated cooked chicken. In addition, 146 (23%) of the respondents let cooked chicken reach room temperature before refrigerating, and only 279 (44%) of respondents reported washing their cutting board and knife after cutting raw chicken. Respondents of this survey were more likely to know the association of *Salmonella* with poultry and eggs than the respondents of the FDA survey (12). This finding may be attributed to differences in study designs. The authors found that as education levels increased to associate degrees, knowledge of food safety increased. Although, participants were evenly distributed across educational levels, the specific breakdown of educational levels was not reported in this survey. Higher food safety knowledge was observed among participants 65 years or older. However, only 209 (24%) of the survey respondents were 65 years or older.

In 1996, the American Meat Institute (AMI) conducted a study of 1,000 U.S. households (14). AMI estimates that only 65% of Americans know how to properly refrigerate cooked chicken. However, 29% allowed cooked chicken to reach room temperature before refrigerating. These results were similar to the findings of Williamson et al. (11). Sixty-eight percent incorrectly stored leftover stew in the cook pot or in a deep container. While only 54% knew to wash a cutting board with soap and water after cutting fresh meat.

The American Dietetic Association (ADA) and the ConAgra Foundation (13) conducted a national telephone survey of 1,000 households and found that approximately 90 percent of consumers believe their food handling practices were adequate. However, only 45% knew that

improper handwashing could lead to foodborne illness. In addition, 44% failed to properly wash their hands before preparing food. Eighty-percent reportedly washed their hands with soap and water after handling raw meat. However, of those who considered their food handling practices as adequate, nearly 10% failed to follow proper handwashing techniques. A majority (78%) of survey respondents knew the potential for cross-contamination from cutting boards used to cut raw meats and vegetables. However, 11% reportedly admitted to rinsing or wiping the cutting board after cutting raw meat, and only 17% sanitized the cutting board with a bleach solution. Seventy-four percent knew that eating meats and chicken not cooked to proper temperatures may cause food poisoning. However, only 12% used a meat thermometer to check the doneness of meats. Forty-six percent believed that eating food stored in a refrigerator with a temperature higher than 40°F is likely to cause food poisoning. However, 56% did not have a refrigerator thermometer. Although, 60% reported never leaving perishable food out of the refrigerator for more than two hours, nearly 30% of those who considered their food practices to be adequate did not refrigerate food immediately.

The Food Marketing Institute (19) conducted a national telephone survey of nutrition and food safety behaviors of 1,004 households in the U.S. Seventy-five percent of respondents believed that food safety was an important factor when food shopping and 79% of respondents reported being completely or mostly confident in the safety of food in the supermarket. Forty-one percent believed that it was very or fairly common for people to become sick from food prepared in the home. Twenty-seven percent of respondents believed that mishandling of food was the most common cause of food poisoning, followed by spoiled and expired foods (20%), improperly cooked food (16%) and germs and bacteria (14%). When asked about the most important things they do in the kitchen to ensure safety of the food prepared, 69% stated they washed hands and surfaces, 36% washed vegetables, 21% cooked food properly, 14% refrigerated food promptly, 10% used antibacterial soap, and 6% used fresh/non-expired foods.

In addition to national food safety surveys, several state surveys have been conducted. Woodburn and VanDeRiet (23) studied 100 Oregon households assessing food preparers knowledge of safe food handling practices and found 57% of participants to be knowledgeable of proper storage of refrigerated foods (22). However, 29% left sliced roast beef and 16% left cooked roast beef at room temperature for extended periods of time. In addition, half of the participants cooled cooked food to room temperature before refrigerating. This finding is similar

to the USDA Economic Research Service Study (20), which reported that 66% of homemakers cooled cooked food to room temperature before refrigerating. Woodburn and VanDeRiet (23) reported that 86% of respondents washed work surfaces between handling raw and cooked chicken. However, only 60% washed the work surface between handling raw and cooked turkey. Participants over the age 30 years were significantly ($p \leq 0.05$) more likely to be guilty of cross-contamination after handling raw turkey, and leave cooked turkey and potato salad unrefrigerated for more than six hours. No significant differences ($p \leq 0.05$) between income groups or education levels were observed in this study. A majority of survey respondents knew ground beef, pork chops, and poultry should be cooked thoroughly.

In a survey of 426 Nebraskan heads of households, more than half of the respondents inappropriately stored, cooked, and cooled foods (7). In general, the results of this study were consistent with those of other studies in which consumers were knowledgeable of selected food safety concepts, but engaged in poor food handling practices. Forty percent of respondents knew how to properly cook food, whereas 63 of 166 (38%) of the respondents failed to cook food to the proper temperature. Thirty-six respondents, knowledgeable in safe handling of leftovers, stored large containers of food in the refrigerator. In addition, 71 of 228 (31%) respondents, knowledgeable in safe food preparation practices, allowed 12 hours or more to lapse between preparing and eating foods. In comparison to the findings of Altekruze et al. (12) and Williamson et al. (11), this survey also found significantly ($p \leq 0.05$) lower overall food safety knowledge scores for respondents with less than a high school education. When food safety knowledge scores were compared for individual food safety practices, respondents with less than a high school education had significantly ($p \leq 0.05$) lower knowledge scores for improper cooling of foods in large containers. Conversely, respondents 55 years or older had higher knowledge of preventing cross-contamination of foods. Although this study links lower education levels with decreased food safety knowledge, most of the survey participants (92.6 %) had a high school education. In addition, only 154 (36.2%) of the respondents were 55 years or older.

Bruhn and Schutz (15) conducted a mail survey of 605 Californians and found that a majority of survey respondents were knowledgeable of proper food safety principles when food shopping (15). Sixty-eight percent of survey respondents indicated that they would purchase frozen food that was solid, 80% examined packages to see if they were opened or damaged, and 67% defrosted frozen food in the refrigerator. However, 46% reportedly defrosted frozen food

on a counter top and 10% reportedly defrosted food in warm water. Eighty percent of survey respondents recognized that leftovers should not be kept at room temperature for several hours. However, half of the respondents incorrectly thought cooked food should be cooled to room temperature before refrigerating or freezing. In addition, 50% of survey respondents would refrigerate leftovers in large containers or in the same container used to prepare food. Eighty percent never used the same plate for raw and cooked meat and two-thirds cleaned food preparation areas with soap and water. Half of the respondents indicated they do not use luncheon meat, pasta, or sauce after the “use-by” date. However, 13% ignored the “use-by” date and used a product if it smelled unspoiled. In addition, 46% of respondents sometimes or always tasted to see if leftovers were safe. In contrast to the USDA Economic Research Study (20), a majority of respondents in this survey (70%) recognized that freezing does not kill all bacteria.

A 1995-1996 telephone survey of food handling practices of 834 consumers in Kansas found 75 (9%) of survey participants ate undercooked hamburger (25). Respondents 60 years or older were significantly ($p<0.05$) less likely to eat undercooked hamburger than those less than 30 years old. Also, respondents with incomes less than \$15,000 were significantly ($p<0.05$) less likely to consume undercooked hamburger than respondents with incomes \$35,000 to 49,999. Respondents with a small child (1 to 4 years of age) were significantly ($p<0.05$) less likely to eat undercooked hamburger. The survey showed that more than half (55.6%) of survey respondents ate undercooked eggs. Individuals with a high school education or higher and an older child 13 to 17 years old at home were significantly ($p<0.05$) more likely to eat undercooked eggs. In contrast to the findings of Yang et al. (24), respondents of this survey, 60 years or older, were significantly ($p<0.10$) less likely than young adults, 18 to 29 years, to report eating undercooked eggs. Also, respondents with lower incomes ($< \$15,000$) were significantly ($p<0.05$) more likely to drink unpasteurized milk.

Similar studies assessing food-handling practices have been conducted in Australia, Italy, and the United Kingdom. A telephone survey of 1,203 Australian households found many Australians lack adequate food safety practices (41). Forty-percent of respondents thawed red meat at room temperature, 20 % used undercooked ground meat, and 84.5% allowed cooked foods to cool to room temperature before refrigerating. Fifty-three percent took less than 30 minutes in transporting meat home from the grocery store. Most of the respondents (67.2%) reheated leftovers in a microwave, and 69% thought it was important not to reheat food more

than once. A majority of the participants (67.7%) did not know the proper refrigerator temperature setting. Only 26.3% of respondents knew their refrigerator should be set at 1°C to 5°C. Of the 316 respondents who knew proper refrigeration temperatures, only 15.5% had their refrigerators set properly. Eight-eight percent reportedly cleaned kitchen surfaces and sinks adequately to prevent foodborne illness, 8.4% washed only with a sponge/warm water, and 3.2% wiped with a damp cloth. Thirty percent of respondents reportedly cleaned kitchen sink and bench tops daily and 82% washed hands with soap and detergent before and after handling food. However, when asked about handling raw, meat, poultry, and fish, 529 of respondents (44%) failed to follow recommended handwashing procedures. Although, 553 (46%) washed utensils between use with detergent and water, 78.7% were unaware of the potential for cross-contamination from using a plate that held raw steak to serve cooked steak. These results indicate that many Australians do not fully understand safe food handling principles.

Sammarco et al. (42) surveyed 183 parents of primary school students in Campobasso, Italy. Survey respondents were guilty of cross-contamination, improper thawing, inadequate storing, and re-heating of cooked foods. In contrast to the findings of Jay et al. (41), 98.4% of respondents washed their hands before preparing food, and 99% cleaned up work areas after preparing food. However, 73.2% reported thawing large pieces of raw food at room temperature and 89.1% reported not re-heating leftovers. The survey also found 75% of respondents were unaware that storing raw meat and poultry in the upper shelves of refrigerators could cross-contaminate other food.

A survey of 1,093 homes in the United Kingdom, found 90% of respondents returned home from grocery shopping in less than 20 minutes and 84% reported unpacking and storing food items very quickly after returning home (43). Thirty-four percent stored raw meat on the bottom shelf of the refrigerator. Sixty-four percent of shoppers indicated they would throw away products after the “use-by” date. Nearly 60% of shoppers questioned said they would defrost a frozen chicken outside the refrigerator, and 84% of shoppers did not know the correct temperature for storing chilled food. Less than half of the respondents reported adjusting their refrigerators during the year. Approximately half of the respondents used work surfaces and cutting boards for cooked foods previously used to cut raw meat.

In addition to surveys that assessed food safety knowledge and practices, some food safety studies observed actual food handling practices. Jay et al. (44) conducted a video study of

Australian food handling practices. In this study, 40 kitchens in Melbourne, Australia were videoed for 1 to 2 weeks using time-lapse video monitoring. Participants completed a food safety questionnaire prior to the video surveillance. Most participants did not adequately handwash or clean kitchen surfaces. Forty-seven percent of participants failed to wash their hands after handling raw meats and 44% washed hands without soap. Almost half of the participants failed to use a detergent or cleaner for cleaning kitchen surfaces. Temperature abuse of leftovers and ready-to-eat food, and the presence of pets in the kitchen were other poor food safety practices observed. The study found discrepancies between stated and observed food handling practices of participants. Twenty-two percent of household observed claimed to handwash for a longer period of time than was actually observed. In addition, 19% of households that claimed to have soap available in the kitchen did not have it available, and 69% did not clean kitchen surfaces as claimed. During the 60 weeks of video taping of the 40 households, cross-contamination of food was observed 29 times, direct contamination was observed 19 times, time temperature abuse occurred 13 times, and pet handling during food preparation was observed 10 times.

A similar video study observing food handling practices in the home was conducted in Utah (45). One hundred households were observed preparing a meal from raw beef, chicken, or fish, and a vegetable salad. The study found 60% of the participants failed to wash their hands before food preparation, and 33% did not wash their hands after handling raw meat. Cross-contamination of raw and ready-to-eat foods was also observed in a majority of homes. Eighty percent of participants did not use a separate area of the kitchen for handling raw and ready-to-eat foods. In addition, 40% of the households observed had refrigerator temperatures above 45°F. Furthermore, 42% of the participants undercooked chicken, 35% undercooked ground beef, and 12% undercooked fish. Only two participants used a meat thermometer to check for doneness of meat.

Audits International conducted a study in the U.S. and Canada that observed in home food handling practices. (17). Meal preparation practices of 106 households were observed and evaluated by trained auditors. Auditors used an objective critical control point approach for evaluation. Ninety-nine percent of the households observed failed to meet minimal criteria for acceptable performance. To be classified as acceptable, zero critical violations and four major violations could be observed. A critical violation was defined as an inappropriate food safety practice that could potentially lead to a foodborne illness. In 102 of the households, at least one

critical violation was observed. Seventy-six percent of households were guilty of cross-contamination, 57% neglected handwashing, 28% improperly stored chemicals, 24% failed to cook food to the recommended temperature, 23% of households had refrigerators set above 41°F, and 11% held hot ingredients in the temperature danger zone below 140°F. These observed critical violations indicate that food handlers are at risk for contracting a foodborne illness. The three most common major violations observed were misusing a common cloth, sponge, or towel (92%), using a thermometer insufficiently (92%), and using products past the manufacture “use-by” date (89%). Also, 71% food handlers were observed eating during meal preparation, 63% held refrigerated ingredients at temperatures too high, 42% stored products uncovered, and 31% failed to use a proper thawing technique when thawing frozen food.

In 1999, Audits international repeated the study in 82 North American cities (16). In addition to observation of meal preparation practices, the study attempted to investigate reasons for the poor food handling practices observed. For a basis of comparison, the 1997 food safety survey results were modified to reflect changes made in the classification of critical and major violations in the 1999 study. The adjusted results for the 1997 food safety study increased the percentage of households deemed acceptable from 1% to 4%. Of 121 households surveyed in 1999, 26% met minimal criteria for acceptable performance and at least one critical violation was observed in 69% of the households. The most frequent critical violations observed were cross-contamination (31%), improper cooling of leftovers (29%), failure to wash hands (29%), improper food preparation techniques (21%), improper chemical storage (20%), and inadequate cooking temperatures (19%). Major violations included failure to regularly measure temperatures of held or prepared food (79%), improper food handling practices (55%), common cloth, sponge, or towel misused (49%), products present past the "use-by" date (46%), and refrigerated ingredients held at temperatures above 45°F (23%). When the auditors attempted to identify reasons for food safety violations observed, they found that the most common violations were due to a lack of knowledge (62%) as opposed to a lack of motivation of participants to follow safe food handling guidelines (38%). Participants were also asked to answer 4 to 6 questions on six areas of high concern for food safety. The six areas of concern included cross-contamination, improper cooling of leftovers, handwashing, internal cooking temperatures, refrigerated ingredients, and improper storage of chemicals and cleaning supplies. Forty-five (37%) answered all questions correctly, of those 77% met safe food handling criteria during

observations. Of 55% who answered all questions about cross-contamination correctly, 69% met criteria during food preparation. Twenty-three percent were knowledgeable about improper cooking of leftovers and 71% of these met criteria during observation. In addition, 79% were knowledgeable of handwashing and 71% engaged in handwashing during food preparation. Only 7% of participants were knowledgeable of internal cooking temperatures. However, 81% met criteria during observation. Households with children and a head of kitchen under the age of 50 years were more likely to engage in safe food handling practices. Of the 32 households with children and a head of kitchen under the age of 50 years, only 9 were deemed acceptable and only 1 of 13 households without children and a head of kitchen under 50 years was considered acceptable.

In South Wales United Kingdom, 108 subjects food handling practices were observed and evaluated using a Hazard Analysis Critical Control Point (HACCP) based audit (46). Each participant was asked to prepare one of four recipes designed to assess food safety behavior. A Food Operation Risk Demerit Rating (FOR) was developed and demerits were assigned when a food-handling mistake was observed. The study found 45% of subjects transported chilled food at temperatures above 8°C, 50 % of subjects stored chilled foods in a refrigerator that operated above 5°C, 66% of subjects did not wash their hands before food preparation, and 58% did not wash hands after handling raw meat or poultry. Furthermore, 41% failed to wash vegetable ingredients, 60% used the same cutting board for all operations, 25% did not clean cutting boards adequately, 15% failed to cook food to proper internal temperatures, 58% held cooked food items at room temperature for more than 90 minutes, 11% re-heating leftovers inadequately, and 6% reheated products more than once. Worsfold and Griffith (46) reported that 58% of participants had a FOR Ratings below 20% and 5 subjects scored zero. Ten percent of those observed had a FOR Rating score of 40%. The authors concluded that a FOR Rating above 20% increases the potential for foodborne illness. The FOR scores showed no differences based upon age or socioeconomic status.

OCCURANCE AND SUSCEPTIBILITY OF OLDER ADULTS TO FOODBORNE ILLNESS

Foodborne illness is a major concern for the increasing elderly population. By the year 2050, the elderly population is expected to double in size to 80 million (47). During the aging

process, decreases in humoral and cellular immune function may occur as well as a reduction in gastric acid secretion and intestinal motility. Many older adults may be malnourished which can contribute to decreased immune function (32). All these factors contribute to older adults being more susceptible to contracting a foodborne illness. Furthermore, many older adults do not recognize themselves as being at risk for foodborne illness (18).

In 1998, there were 209 cases of cryptosporidiosis, 366 cases of *Escherichia coli* O157:H7, 3,954 cases of salmonellosis, and 436 cases of shigellosis in the U.S. among individuals age 65 or older (39). In Virginia, 206 cases of salmonellosis, 190 cases of campylobacteriosis and 24 cases of shigellosis were reported for individuals age 50 and older (40). *Campylobacter jejuni*, *Clostridium perfringens*, *Escherichia coli* O157:H7, *Salmonella* spp., and *Staphylococcus aureus* cause more deaths in the elderly than the general population (32). Levine et al. (48) reviewed 115 confirmed foodborne outbreaks in nursing homes from 1975 to 1987 and reported that *Salmonella* spp. accounted for 1,004 (20.3%) of the reported cases and 36 of 51 total deaths associated with foodborne illness. While foodborne illness has been a concern for a number of years in nursing homes, only 4.2% of people 65 or older lived in a nursing home in 1996 (48). Unlike those in nursing homes, this segment of the elderly population shop for and prepare their own foods.

In 1997, simultaneous outbreaks of *Escherichia coli* O157:H7 occurred in Michigan and Virginia where approximately 64 people became ill from consuming contaminated alfalfa sprouts (49). In the Michigan outbreak, the ages of those infected ranged from 2 to 79 years with a median age of 35 years, whereas in Virginia, the age ranged from 6 to 67 years with a median age of 31 years. In 1998, a multi-state outbreak of listeriosis, associated with the consumption of undercooked hot dogs and other meat products manufactured by a large meat processing plant, resulted in three deaths among the elderly (6). Of the 32 people infected, the majority were older adults with a median age of 69 years. These and many other outbreaks associated with older adults illustrate the need to increase knowledge and awareness about foodborne illness to this segment of the population.

FOOD HANDLING PRACTICES OF ELDERLY

Although some studies have indicated that safe food handling practices among older adults may be higher, many practices are still inadequate to prevent foodborne illness (12).

Currently, there have been few studies examining food safety knowledge and practices of the older adult population. Johnson et al. (50) conducted a study of 809 elderly people in the United Kingdom and found many elderly adults may have inadequate food handling practices. In the study, a total of 645 refrigerators were measured and 451 were found to be too warm, ranging from 6 to 13°C. In a follow-up interview of 203 initial participants, 138 participants reportedly understood "use-by" dates and 79% knew the correct definition of "sell-by" dates. However, 69% of participants reported having difficulty reading food labels because of poor eyesight or because the print was too small or cramped. Thirty-seven percent of participants reported being concerned with contracting a foodborne illness. Although, this study indicates that older adults may lack knowledge of key food safety principles more research is needed among this population.

IMPACT OF FOOD SAFETY EDUCATION

Education of consumers on food safety is a key component in preventing foodborne illness. Nies and Gentry-Van Laanen (51) surveyed 100 participants of Texas Agricultural Extension Service (TAEX) food safety programs and found significant improvements in food safety practices. Significantly ($p < 0.01$) higher rates of thawing frozen foods in the refrigerator, using appliance thermometers, keeping food preparation areas clean, and not leaving perishable foods at room temperature for more than two hours were reported. Also, washing hands with soap and water before handling food, after handling raw meat, and before handling cooked foods significantly ($p < 0.01$) improved. Similar to the findings of Williamson et al. (11), the study found that, as educational levels increased to technical school or some college, the percentage of respondents washing their hands more than 90% of the time before handling cooked foods increased. However, as educational levels reached advanced degrees, respondents were significantly ($p < 0.01$) less likely to wash hands. In addition, those with a college education were significantly ($p < 0.01$) more likely to use the same platter for raw and cooked meat before and after the program, than those with a high school education or less. Respondents with lower levels of education were significantly ($p < 0.05$) more likely to attend a higher number of food safety programs than those with higher levels of education. Forty-five percent with less than a high school education attended four or more food safety programs in the past three years. Only 10% of college graduates attended four or more in past three years. This study illustrates the

benefits of food safety education on changing food safety behaviors. However, one major limitation of this study was the data for pre and post food safety behaviors were collected after the educational program was completed.

Currently few published studies exist documenting the benefits of food safety educational programs in improving food safety knowledge and practices of consumers. Furthermore, studies evaluating the effectiveness of food safety education of older adults are lacking. More studies documenting the benefits of food safety education among the general population and other sub-population are needed.

SUMMARY

Most U.S. consumers do not have adequate knowledge of basic food safety principles (7,11-25). Also, many consumers who have adequate food safety knowledge fail to put those principles into practice (7,11,12,16,20). In addition, little is known about the food safety knowledge and practices of different sub-populations, such as the older adults who may be more susceptible to contracting a foodborne illness. Some studies indicate that older adults may have higher food safety practices than the general public. However, food safety practices of older adults may be inadequate to prevent foodborne illness. Furthermore, few studies have been conducted to document and evaluate the effectiveness of food safety educational programs in improving food safety practices of consumers. Studies examining benefits of food safety education for older adults are apparently lacking. Thus, there is a need to investigate the food handling practices of older, low-income adults and to determine the effectiveness of food safety education on changing food safety knowledge and practices of this population group.

CHAPTER III

RESEARCH METHODOLOGY

TARGET POPULATION

The target population for this study were older adult participants of the Food Stamp Nutrition Education Program (FSNEP). To be eligible for the study, FSNEP participants were required to be newly enrolled in the program, 45 years of age or older, considered functionally independent, have a clear understanding of the English language, and have an income of 150% of federal poverty guidelines or below (52).

DESIGN OF THE STUDY

This study consisted of two intervention groups. The first group received a food safety lesson using the *Healthy Futures* curriculum (35) currently used in FSNEP. The second group used an instructional video titled *From Store to Fork: Safe Food Guidelines For Older Adults* (36) in conjunction with the *Healthy Futures* curriculum. The video was used at the end of the food safety lesson to reinforce information taught to participants. FSNEP lessons were generally taught to participants in their home. However, some older adults were taught at congregate meal sites. Program participants were randomly assigned to an intervention group and assigned an identification number. Information was collected by FSNEP Program Assistants on the following exogenous variables: age, sex, race, income, place of residence, and number of household members. This information was recorded on the participant's Family Record (see Appendix A) (53). Additional information not available on the Family Record regarding education level, selected chronic diseases, meal preparation, and experience with foodborne illness was also collected from participants (see Appendix A). FSNEP Program Assistants made observations of participant's food safety practices in the home before and after the food safety lesson (see Appendix B). If participants were taught at congregate meal sites, observations were not made. Outcome variables were measured using questionnaires assessing the participant's food safety knowledge and practices (see Appendix C). Pre-test questionnaires were administered during the lessons prior to the food safety lesson to measure food safety knowledge and practices. The Food Safety Knowledge Questionnaire was administered at post-test at the next meeting with participants following completion of the food safety lesson to

determine changes in food safety knowledge. At this time, participants in the group viewing the instructional video were asked to evaluate the video (see Appendix D). The Food Safety Practices Questionnaire was administered at post-test to participants when the Family Record was completed upon exit from the program to determine if changes in food safety practices occurred. Responses to question number six from the Food Practice Checklist and to question number seven from the Additional Food Behavior Checklist sections on the Family Record were also analyzed as part of the food safety practices pre- and post-test (see Appendix A).

Comparisons of pre- and post-test scores for both food safety knowledge and practices were made among participants and served as reflexive controls. FSNEP Program Assistants were provided with a schedule and trained to administer all questionnaires and to teach the food safety lesson (see Appendix E). Study materials were mailed to 47 FSNEP units in October 1999. The study was approved by and followed the guidelines established by the Institutional Review Board of Research Involving Human Subjects at Virginia Polytechnic Institute and State University and by the Department of Human Nutrition, Foods and Exercise (54). Each participant was asked to sign an informed consent form and all information collected was kept strictly confidential (Appendix F).

PILOT TESTING OF SURVEYS

Prior to administering the study statewide, the questionnaires were pilot tested with 19 FSNEP participants in Lynchburg, Virginia, who met the study criteria. The pilot test was used to determine if the questionnaires were appropriate for the target audience. Attempts were made to analyze the questionnaires for reliability in assessing food safety knowledge and practices. However, reliability of surveys could not be determined because multi-factorial analysis indicated the surveys were multi-dimensional. Therefore, tests for reliability were not conducted. None of the participants of the pilot group were included in the main survey.

STATISTICAL ANALYSIS/ANALYTICAL PLAN

Data were analyzed using the Statistical Package for the Social Sciences (SPSS for Windows, version 9.0, SPSS Inc., Chicago, Ill.). Results are described using percentages, means, and standard deviations where appropriate. Pearson correlations, Spearman's rank correlations, and independent sample t-test were conducted to determine relationships between

demographic characteristics and pre-test scores and change scores (pre-test scores minus post-test scores). Analysis to determine if the two treatment groups differed on demographic variables and pretest scores at baseline was conducted using Chi-square statistics and independent samples t –tests. Paired t-tests were used to determine significant differences of means ($p < 0.05$) of pre- and post-test scores for each treatment group. To determine significant differences ($p < 0.05$) between the two treatment groups comparisons of mean post-test and change scores were made using paired t-tests. Cross tabulations and Chi-square statistics were used to determine difference between the two treatment groups for each individual item on the knowledge questionnaire. Independent samples t-tests were used to determine significant differences between the two treatment groups for each individual item on the food safety practices questionnaire. Pearson correlation of scores on the food safety observation checklist and the food safety practices questionnaire was used to validate the food safety practices questionnaires.