This is to certify that the

thesis entitled

Safe Food Handling:
Knowledge of Third-grade Teachers and
School Foodservice Personnel in Michigan Schools

presented by

Wen-yu Chin

has been accepted towards fulfillment
of the requirements for

Master of Science degree in Institution Admin.

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Date Dec. 22, 1992

SAFE FOOD HANDLING: KNOWLEDGE OF THIRD-GRADE TEACHERS AND SCHOOL FOODSERVICE PERSONNEL IN MICHIGAN SCHOOLS

By

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A THESIS

Submitted to
Michigan State University
in Partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Food Science and Human Nutrition

1992

ABSTRACT

SAFE FOOD HANDLING: KNOWLEDGE OF THIRD-GRADE TEACHERS AND SCHOOL FOODSERVICE PERSONNEL IN MICHIGAN SCHOOLS

By

Wen-yu Chin

Michigan third-grade teachers (n= 439/997 or 43.9% response rate) and school foodservice personnel (n= 597/1400 or 42.6% response rate) were surveyed by mail to determine their knowledge of safe food handling. Teachers correctly answered 55% of eight knowledge questions. Teachers over 40 years of age had a higher mean knowledge score on safe food handling than teachers under 40 years of age ($p \leq 0.05$). School foodservice personnel correctly answered 76% of the knowledge questions. Managers/supervisors of school foodservice operations had a higher mean knowledge score on safe food handling than school foodservice personnel with other job titles such as cooks and cook assistants ($p \leq 0.05$). Separate training programs about safe food handling for both teachers and school foodservice personnel should focus on safe temperatures for operating refrigerators and methods of identifying unsafe food.

To my parents

for their love and support.

ACKNOWLEDGEMENTS

I would like to express my appreciation to the members of my guidance committee, Dr. Carol Sawyer, Dr. Sandra Andrews, Dr. June Youatt, and Dr. James Pastka, for the encouragement and education. A special thank goes to Dr. Sawyer for her professional guidance throughout the graduate program.

A special note of gratitude is given to Dr. Murphy for her assistance in survey research. I would also like to thank Dr. Gill for answering the questions about data analysis.

Angela Fraser, Kuo-Tung Li and Ya-Lan Tan also deserve a special mention for the assistance and friendships. Thank you for sharing your ideas and skills in all aspects of this project. Thanks also to Ya-Li Huang and Ya-Hsien Chen for the special friendships.

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1.0 INTRODUCTION

Foodborne disease, caused mostly by foodborne pathogens, is a critical health problem in the United States (Bean and Griffin, 1990; Swintek, 1991; Titus and Talbot, 1991). Among the threats posed by potentially unsafe foods, microbiological issues are the primary areas that have been emphasized (Wolf, 1992). The Centers for Disease Control (CDC) stated that foodborne disease remains one of the most common and important causes of disease and death in the United States (USDA, 1989a). The CDC estimated that between 6.5 and 81 millions cases and 9,000 deaths related to foodborne disease occur annually in the U.S. (Amler and Dull, 1987; Archer and Kvenberg; 1985, USDA, 1989a; Synder, 1992).

One cause of foodborne disease is unsafe food handling practices (USDA, 1989b; Synder, 1992). According to CDC data, the most frequently reported food-preparation practices that contributed to foodborne disease betwen 1983 to 1987 were improper storage or holding temperature of food, followed by poor personal hygiene of food handlers (Bean *et al.*, 1990). Other studies have indicated that U.S. consumers are not always knowledgeable about food handling and preparation, especially concerning cold holding

temperature, storage of leftovers, and methods of thawing frozen foods (Beard, 1991; Gravani, 1992).

Not everyone faces the same risk from eating food contaminated with pathogenic microorganisms or their toxins. Individuals who are particularly vulnerable to foodborne disease include senior citizens, pregnant women, young children, and people suffering from chronic diseases (Wolf, 1992; Snyder, 1992).

Children may be particularly at risk for foodborne disease (Neill, 1989; Potter, 1989; Foster, 1987). Although many studies have shown that schools can play an important role in health promotion, little information is available on the safe food handling knowledge of school employees such as teachers and school foodservice personnel (Nader *et al.*, 1986; Kirks and Hughes, 1986). Thus, the purpose of this study was to determine the safe food handling knowledge of third-grade teachers and school foodservice personnel in Michigan schools.

This study is part of a larger safe food handling project. To decrease the potential occurrence of foodborne disease in Michigan children and their families, a needs assessment in the area of safe food handling was designed by researchers at Michigan State University. Third-grade children were chosen because they, most likely, had not yet received any formal instruction on safe food handling. Questionnaires were mailed to third-grade children and adult

populations who may influence them in the area of safe food handling. The adult populations included third-grade teachers, school foodservice personnel, household members of the children, and health information providers.

The outcome of this project has been the development of a curriculum for children 9 to 11 years of age. The curriculum included classroom lessons for use with fourth-grade children, two take-home packets for use by children with their other household members, and a hypermedia software game on safe food handling.

2.0 REVIEW OF LITERATURE

In recent years food safety has emerged as a major health concern of consumers and federal agencies (Beran, 1991; Foster *et al.* 1985; Huang, 1992; Wolf, 1992). The concept of food safety has been defined to include all conditions and measures that are necessary during the production, processing, storage, distribution, and preparation of food to ensure that it is safe, wholesome, and fit for human consumption (Foster *et al.*, 1985).

2.1 Food Safety

In the area of food safety, many consumers are concerned about chemical hazards (Wolf, 1989). Chemical hazards include cleaning compounds, food additives, pesticide residues, food processing aids, and preservatives (Synder, 1992). However, most toxicologists and food safety experts concur that microbiological contaminants have been a more serious problem than chemical residues in the U.S. food supply (Lee, 1989; Swintek, 1991; Titus and Talbot, 1991; Wolf, 1992).

According to the Centers for Disease Control (CDC) data, bacterial pathogens caused the largest number of

foodborne disease outbreaks and cases from 1983 to 1987 (Bean *et al.*, 1990). Because of this fact, the U.S. Food and Drug Administration began to focus on the emphasis on foodborne microorganisms (Albrecht, 1986).

2.1.1 Foodborne Disease Problems in the U.S.

Foodborne disease is typically usually either infectious or toxic in nature. It is caused by agents that enter the body through the consumption of food (Foster, 1985).

Foodborne disease is a major cause of morbidity in the United States (Bean and Griffin, 1990). Estimates of the annual U.S. outbreaks of foodborne disease vary widely, from 6.5 million cases to 81 million cases (Amler and Dull, 1987; Archer and Kvenberg, 1985; USDA, 1989a; Synder, 1992).

Outbreaks of foodborne disease are believed to be under-reported (Eilers, 1990). Public health officials estimated that only one person out of 25-100 cases of food poisoning actually seeks medical attention (Archer and Kvenberg, 1985). During the period 1983-1987, 2,397 outbreaks accounting for 91,678 cases of foodborne disease were reported to the CDC . The number of outbreaks reported to the CDC was probably only a small fraction of the true number that occurred (Bean *et al.*, 1990).

Among outbreaks in which the etiology was determined, bacterial pathogens cause the largest number of outbreaks

(66%) and cases (92%) (Bean *et al.*, 1990). From 1973 to 1987, bacterial pathogens accounted for 90% of deaths from foodborne disease, with *Listeria monocytogens* (317/1,000 cases) and *Clostridium botulinum* (192/1,000) causing the highest death-to-case rate (Bean and Griffin, 1990).

Many new foodborne pathogens have been identified recently (Potter, 1989). Previous to 1975, only six pathogens were widely recognized as foodborne pathogens. Since 1975, this list has grown to over 25 organisms and continues to increase. Some of the newest pathogens to emerge are *Listeria monocytogens, Campylobacter jejuni,* and *Escherichia coli 0157:H7* (Potter, 1989; Cliver, 1990). Why new pathogens are emerging was discussed by Cox (1989). Changes in primary food production, changes in food processing technology, changes in food handling practices, and changes in the behavior of microorganisms have caused the emergence of new pathogens.

Unlike other types of disease, a large number of foodborne disease could be prevented by safe food handling (USDA, 1989b). Consumers and foodservice employees have the responsibility to use proper safe food handling practice. According to CDC data, foodborne outbreaks reported to the CDC between 1973-1987 were caused by commercial or institutional foodservice establishments in 79% of the cases, while mishandling of food in homes caused 21% (Bean and Griffin, 1990). Food industry employees have the

responsibility to follow sanitary regulations which ensure the safety and stability of food until it reaches the consumers (Wolf, 1989).

2.1.2 Foodborne Disease Related to Children

Not everyone faces the same risk from eating food contaminated with pathogenic microorganisms or their toxins. In fact, populations who are particularly at risk of foodborne disease include senior citizens, pregnant women, very young children, and people suffering from chronic diseases (Wolf, 1989; Synder, 1992).

Some foodborne pathogens such as *E. coli. 0157:H7* have been especially dangerous for children. One of the principle syndromes linked to *E. coli. 0157:H7*, hemolytic uremic syndrome (HUS), is the leading cause of renal failure in children (Cliver, 1990). In HUS, blood clots plug the convoluted tubules in the kidney which results in an accumulation of waste products in blood. The patient may require dialysis and may become permanently debilitated. In some cases the child will go into a coma or die. This syndrome has killed elderly people as well as children (Cliver, 1990).

2.2 Education of Nutrition and Safe Food Handling

Many studies have shown that school has an important role in health promotion for students (Nadar *et al.*, 1986; Kirks and Hughes, 1986; Williams and Wynder, 1976). Health professionals also agreed about the importance of interventions that teach health-enhancing eating patterns in childhood (Crockett, 1988).

2.2.1 Food Safety Education Programs For School Children

In the past 20 years there have been many changes in the educational system. Courses in home economics or "Survival in the Kitchen," once taught in every grade school and high school, have been reduced in number or even eliminated (Beard, 1992). The result has been that children have not had the chance to learn much about food handling in the classroom (Beard, 1992).

In the state of Michigan, the Michigan Model for Comprehensive Health Education (MDE, 1987) addresses safe food handling in only two units in the fourth grade. The topics of these two units were related to food storage and to the reasons why food spoils. However, topics related to nutrition are covered in more than 15 units, from kindergarten through grade eight. With such emphasis on nutrition issues, the importance of safe food handling was easily forgotten (Weinstein, 1990).

Although most all children in Michigan receive nutrition education through the Michigan Health Model (MDE, 1987), the major emphasis is on food choice and not on safe food handling. Using current school curricula, children are likely to have very limited exposure to safe food handling information. A number of research studies have found that young children are more knowledgeable about nutrition and other health care practices as a result of classroom efforts (Mather, 1984; Thompson, 1985, Essa, *et al.*, 1988).

2.2.2 Teachers' Attitude Toward and Knowledge About Nutrition

Elementary school teachers hold a distinct position of authority in the classroom. The student-teacher relationship can be used to provide good nutrition education and to help children develop good habits (Baird, 1981). Teachers' attitudes toward nutrition play a major role in the success of nutrition education for school children (Baird, 1981). Also, their attitudes affect whether nutrition education will be taught at all (Baird, 1981). For teachers' influence to be beneficial, they should have basic nutrition knowledge and know how to incorporate that knowledge into school lessons (Cortes, 1973).

A number of studies have evaluated school teachers' attitude toward nutrition and knowledge of nutrition. In the state of Oklahoma, 390 public school teachers were surveyed to determine their attitudes and practices of

nutrition (Baird, 1981). Over half the respondents (67%) thought that nutrition concepts should be taught at every grade level; 18% thought in elementary grades; only 1.35% thought that nutrition education is not the school's responsibility. The most frequently used teaching methods for nutrition included classification of food groups, discussions, keeping and/or revising records of food eaten in one day, using films or filmstrips, and having children develop plans for improving their food practices. Over 90% of the respondents thought that nutrition education is important to help children form good habits.

The second study involved the Kansas Nutrition Education and Training Program, which provided baseline data about Kansas elementary teachers' knowledge about, and practice of nutrition (Soliah *et al.*, 1983). Kansas elementary school teachers tended to have favorable attitudes toward nutrition. Almost all the teachers (90%) indicated that nutrition should be taught in all grades or in a combination of grades (Soliah *et al.*, 1983). Only 40% thought that they had sufficient materials to provide nutrition instruction to their students (Soliah *et al.*, 1983). In those schools with on-premise food production facilities, teachers tended to work with the school foodservice personnel and use the cafeteria as a laboratory for instruction more frequently than did teachers in schools with only satellite service centers (Soliah *et al.*, 1983).

Teachers in Kansas suggested that more nutrition education materials should be developed on these topics: (1) nutritious breakfasts, (2) healthful snacks, (3) dental health, (4) the importance of drinking milk, (5) proper food handling, and (6) food additives (Soliah *et al.*, 1983). Elementary teachers who had a background in nutrition had higher knowledge scores than teachers who did not had nutrition background. Similarly, teachers who were already teaching nutrition to their students had higher scores on nutrition knowledge and practices than those who were not teaching nutrition (Soliah *et al.*, 1983).

Petersen and Kies (1972) studied the nutrition knowledge and attitudes of early elementary school teachers in Nebraska. The survey results indicated that teachers did not have enough educational background for nutrition education. Overall nutrition knowledge scores of Nebraska elementary teachers were low. These authors concluded that this may be due to their lack of retention of nutrition facts from formal courses in nutrition (Petersen and Kies, 1975).

The importance of the development of favorable food attitudes was rated "highly positive" by the Kansas teachers (Soliah *et al.*, 1983). Ninety-one percent of the respondents agreed that developing a favorable attitude toward good nutrition was more important than teaching facts (Soliah *et al.*, 1983). However, 56% of the respondents

agreed that learning facts was the best way to achieve change in food habits for school children. The relationship between teachers' knowledge scores on nutrition and attitudes toward nutrition was determined by the study (Soliah *et al.*, 1983). The result indicated that attitudes toward teaching nutrition are not affected by the extent of the elementary school teachers' nutrition knowledge (Soliah *et al.*, 1983).

Another study was developed to assess the influence of teachers' attitudes toward school lunch programs and nutrition education by Perkins *et al.* (1980) in Texas. Teachers in the Texas study had a positive attitude toward the importance of nutrition and school lunch programs (Perkins *et al.*, 1980). The respondents believed that school foodservice personnel and nutritionists would be valuable resources of nutrition education. The Texas teachers believed that cooperation with school foodservice personnel was important for effective nutrition education (Perkins *et al.*, 1980). And they believed that school foodservice personnel can help children develop better eating habits if they offer a wide variety of foods (Perkins *et al.*, 1980).

2.2.3 The Application of Computers for Instruction

In a recent study of teachers (n=608) who have integrated computers into classroom practice, Sheingold and

Hadley (1990) found that software was used most frequently in word processing (95%). Instructional software followed with 89%, and analytic and information tools followed with 87%. When asked to give examples of their most productive and interesting uses of computers in their classrooms, 75% of the sample gave more examples of writing and language projects than of any other uses (Sheingold and Hadley, 1990).

Plomp and Pelgrum (1990) studied school computer use in eight countries for the International Evaluation Association. They found that the type of software programs most commonly available in U.S. schools were: (1) word processing (93%), (2) drill and practice (92%), (3) educational games (91%), and (4) tutorial programs (81%).

Swick (1989) suggested that the computer is effective with children when it provides a medium for extending learning to new visual and manipulative models. The environment should be flexible, unique, enjoyable, and produce a sense of achievement in the child (Swick,1989).

2.3 School Foodservice

School foodservice establishments may be considered as a primary health care provider (Sen, 1991). Foodservice personnel accept certain responsibilities at the food consumption point to supply adequate, nutritious and proper food for the consumers (Bryan, 1986).

2.3.1 The National School Lunch Program

The U.S. National School Lunch Program (NSLP) is permanently authorized under the National School Lunch Act of 1946. The NSLP was established because: (1) during physical examinations for military service many young men were found to be malnourished; (2) there was a need for an outlet for agriculture commodities produced by flourishing farms after World War II; and (3) a nutritious lunch at school facilitated learning (ASFSA, 1983; Hawkins *et al.*, 1989).

The U.S. National School Lunch program has been administered by the United States Department of Agriculture (USDA) at the federal level and by state departments of education (Pannell, 1990). Any public or nonprofit private school (high school or under) was eligible to participate in the NSLP, except for private schools with tuition of more than $2,000. Cash reimbursement and commodity assistance were provided to nonprofit foodservice operations that agreed to follow federal regulations (Pannell, 1990).

In 1988-1989, 91,485 U.S. public and private schools and residential institutions participated in the program, serving lunches to approximately 24.2 million children (USDA, 1989a). The federal government provided about $4.5 billion in cash assistance to lunch programs in schools, according to preliminary estimates in 1989 (USDA, 1989a).

2.3.2 Control of Microbial Problems in the School Foodservice Industry

Many research studies focused on methods to control microbial problems in the school foodservice programs. The phases of product flow in the preparation and service of spaghetti and chili in a school foodservice system producing 18,000 meals/day were developed by Cremer and Chipley (1977a; 1977b).

Thorough cooking of the products prior to assembly and thorough reheating of the products for service were considered important keys to the safety of the food (Cremer and Chipley, 1977a; Cremer and Chipley, 1977b). Because of pathogens, the potential for public-health hazards can be great if food is mishandling in satellite systems of school foodservice operations (Cremer and Chipley, 1980).

Raccach *et al.* (1985) suggested the use of a critical control point (CCP) system as shown in Table 1. Most of the phases in food preparation (expect for procurement, heating, and holding) were to be controlled by at least two CCPs--a time-temperature combination and sanitation of personnel and equipment. Procurement would be controlled through the raw materials, while heating and holding would be controlled by appropriate time-temperature combinations. Every CCP would contribute to the reduction or elimination of health hazards of microbial origin. Recommendations for time-temperature combinations and sanitary practices could be based on the

Table 1. Suggested Critical Control Point system for the school foodservice operations.

Phase	Critical Control Point			
	Raw Materials	Time-Temperature Combination	Sanitation	
			Personnel	Equipment
Procurement	+			
Storage		+		+
Thawing		+		+
Preparation		+	+	+
Heating		+		
Holding		+		
Portioning		+	+	+
Distribution		+	+	+
Reheating		+		
Serving		+	+	+

+ The sign + represents the Critical Control Point to the phase.
(Source: Raccach *et al.*, 1985)

Foodservice Sanitation Manual of the Food and Drug Administration (FDA, 1978).

2.3.3. The Roles Foodservice Personnel

Foodservice personnel at any establishment, including schools, may be considered as a primary health care provider (Sen, 1991). Foodservice personnel accept certain responsibilities at the food consumption point to supply adequate, nutritious and proper food for consumers (Raccach, *et al.*, 1985). In general, foodservice personnel play a significant role in reducing the morbidity and mortality of the consumer by interrupting the casual factors of diarrheal diseases and the malnutrition cycle (Sen, 1991). Therefore, they become a prominent member of the primary health care team (Sen, 1991).

Foodservice personnel should be well informed on all aspects of the relation between health and foodservice to the customer (Bryan, 1986). Foodservice personnel should provide appropriate information to the general consumer and should also assist children in minimizing the occurrence of foodborne disease (Bryan, 1986; Sen, 1991). Accordingly, the foodservice operator is concerned with three variables: (1) the quality of the food, (2) the consumer's health status and (3) the environmental factors for preventing contamination (Bryan, 1986; Sen, 1991).

2.3.4 Evaluation of School Foodservice Personnel

Evaluations of knowledge for school foodservice personnel have been reported in various areas such as nutrition. However, limited information about safe food handling knowledge was found in the published literature.

The knowledge about, and use of the Dietary Guidelines for Americans by school foodservice personnel were evaluated (Glover *et al.*, 1991). The results indicated that school foodservice managers had good knowledge of the Guidelines, but did not often follow them when serving meals to children. Managers expected the modified recipes from the USDA to assist them in preparing healthier meals.

In the Kansas Nutrition Education and Training Program Needs Assessment Project, a survey to determine the nutrition-related training, knowledge, attitude and practices of Kansas school foodservice personnel (n=464) was conducted (Bowen, 1982). Almost two-thirds of the Kansas school foodservice personnel indicated that they had not completed any type of nutrition-related training. Respondents with formal training in nutrition had a higher score on most knowledge measurements. Generally, nutrition knowledge was positively related to scores for nutrition-related attitudes and practices. The results also indicated that increased emphasis on training in nutrition for school foodservice personnel is needed.

2.3.5 Training for Foodservice Personnel

Several research papers described the functions of training school foodservice personnel. Ricci (1988) stressed the importance of job-related training. Training programs for school foodservice personnel are designed not only to provide important knowledge and job-related skills but also to improve job performance (Ricci, 1988).

Penninger (1984) reported that food safety training and certification of foodservice managers had improved the actual sanitary conditions of facilities in which they worked. All foodservice personnel should be offered frequent refresher courses.

Regulations should require that the majority of food handlers have a basic understanding of food safety. The specific areas of understanding included the ways and conditions in which bacterial grow, the effect of food poisoning, personal health and hygiene, how to keep equipment clean, pest control, and the food handler's responsibilities under law (Health and Hygiene, 1990).

2.3.6 Introduction of Training Programs

Four training programs related to safe food handling are available for Michigan school foodservice personnel. A brief description of these four programs follows.

2.4.6.1 Applied Foodservice Sanitation

The Applied Foodservice Sanitation course is a training program developed by the National Institute for the Foodservice Industry (NIFI) in liaison with the national Sanitation Foundation (Hauer, 1985). The NIFI course is designed for use as an introductory course in practical sanitation for foodservice operations. The course is suitable for use in professional level courses in schools offering a full complement of hotel and foodservice management instruction (Hauer, 1985).

The content of Applied Foodservice Sanitation includes information on sanitation and health, serving sanitary food, new equipment, and material on cleaning and sanitizing operations (Hauer, 1985). The course also includes vital information on how to work through people to maintain a sanitary operation, training workers, working with a pest control operator, and dealing with local health officers (Hauer, 1985).

2.3.6.2 American School Foodservice Association Program

The American School Food Service Association's Certification program gives recognition to school foodservice personnel who have achieved a specific level of professional development (ASFSA, 1990). The Sanitation and Safety course consists of ten hours of formal training for school foodservice personnel (ASFSA, 1990). Upon completion

they earn a certificate from American School Food Service Association (ASFSA).

This course provides school foodservice personnel with the knowledge and skills needed to maintain a sanitary foodservice operation (ASFSA, 1990). The content of the Sanitation and Safety course focuses on the principles and practices of sanitation, proper food handling, causes of foodborne illness, understanding how to control the growth of microorganisms, foodservice regulatory standards, insect and pest control, proper lifting techniques, and fire safety (ASFSA, 1990).

2.3.6.3 MDE 100 and MDE 120 courses

The Michigan Department of Education (MDE) provides several training courses for Michigan school foodservice personnel in Michigan related to nutrition and safe food handling (MDE, 1992). The statewide training program for school foodservice personnel was designed to stimulate personal and professional growth for school foodservice personnel (MDE, 1992).

MDE 100: School Foodservice Basics was designed for school foodservice personnel to provide simple explanations about the nutrition needs of school children (MDE, 1992). The purpose was recognize the Child Nutrition Programs, their main features, and their goals (MDE, 1989a). The course also helps school foodservice personnel identify reimbursable meal patterns. Topics in the six sections

after course were: current child nutrition programs, meeting meal patterns, the responsibilities for meal programs, record keeping requirements, and federal assistance (MDE,1989a).

MDE 120: Sanitation and Safety was designed to make Michigan school foodservice personnel knowledgeable about the Michigan Health Code and the causes of and protection from foodborne disease (MDE, 1992). The goal of this course is to teach principles and practices of foodservice sanitation to help school foodservice feed children safely. Topics of the MDE 120 course include: (1) the challenges to food safety, (2) a definition of sanitation and how it affects food quality, and (3) foodborne illness and its consequences (MDE, 1989b).

3.0 MICHIGAN THIRD-GRADE TEACHERS: KNOWLEDGE OF SAFE FOOD HANDLING

3.1 Abstract

Third-grade teachers in Michigan (n= 439/997 or 43.9% response rate) were surveyed to determine their knowledge of safe food handling. Most respondents were female (89%) and were between 31 and 50 years of age (66%). Their highest degree was Bachelor's (43.6%) or Master's degree (53.2%). Almost three-fourths of third-grade teachers in Michigan (74%) had never received any formal training in safe food handling. When asked about safe food handling practices of children, teachers responded that opportunities were "almost always" provided for third-grade children in school to wash their hands before eating a snack (61%), before lunch (74%), and after using a toilet (99.1%). Although teachers were knowledgeable about storage and thawing of food, they did not know the maximum safe operating temperature (45^0F) of a refrigerator. Teachers over 40 years of age were more knowledgeable about safe food handling than teachers under 40 years of age ($p \leq 0.05$). Information from this study could be used to develop statewide in-service workshops and graduate curricula for elementary teachers.

3.2 Introduction

Food safety has become one of the leading consumer issues of the 1990s. Each year approximately 24-81 million people in the United States contract foodborne disease, of which more than 9,000 die (Amler and Dull, 1987; Archer and Kvenberg, 1985). Unlike many other types of disease, foodborne disease is almost completely preventable by safe food handling (USDA, 1989b; Cliver, 1990; Pannell, 1990).

Young children may have a higher risk of infection from microbiological contamination of foods than do other populations (Wolf, 1990; Potter, 1989; Synder, 1992). For example, infections of *Escherichia coli 0157:H7* have been reported to occur most frequently in children ages 0-9 years (Potter, 1989). This type of foodborne disease may lead to death, especially in children (Cliver, 1990).

Many factors can be identified which increase the chance of foodborne disease in children. Lifestyle changes in the family, the food-quality preferences of children, the types of food marketed to children, and the lack of instruction for children in safe food handling have contributed to this higher risk (MDE, 1987; Auld, 1990; Hildebrand, 1990).

Many studies have shown that schools have been essential in health promotion (Nader *et al.*, 1986; Kirks and Hughes, 1986; Williams and Wynder, 1976). Schools have many opportunities to influence children's habits and food handling practice in the elementary school years (Soliah, *et al.*, 1983). Several research studies have found that young children were more knowledgeable about making nutritious food choices and following other health-care practices as a result of classroom efforts (Mather, 1984; Thompson, 1985; Essa, *et al.*, 1988). However, most school systems have placed a greater emphasis on nutrition, especially the selection of foods with a high nutrient density, rather than on safe food handling (MDE, 1987).

During the elementary school years, teachers are possibly the first adults outside of the home to play an important role in children's lives and have an influence on children's knowledge about food (Head, 1974; Baker, 1972). A review of the literature indicated that the nutrition knowledge of elementary teachers has been evaluated in many studies, but not their knowledge of safe food handling (Petersen and Kies, 1972; Perkins *et al.*, 1980; Baird and Sibley, 1981; Soliah *et al.*, 1983). Thus, the purpose of this study was to determine the safe food handling knowledge of Michigan third-grade classroom teachers.

This survey of teachers' safe food handling knowledge was a part of a larger safe food handling project which

surveyed Michigan third-grade children and four influential adult groups (household members, classroom teachers, school foodservice personnel, and health information providers) who might influence their knowledge of safe food handling. Third-grade children were chosen because they represented children prior to any formal instruction on safe food handling (MDE, 1987). The first concepts about safe food handling under the Michigan Model are introduced to fourth-grade children. Third-grade classroom teachers were surveyed because their knowledge of safe food handling could influence the knowledge about, and the practice of safe food handling of children in their classroom.

3.3 Methods

This study was one component of a statewide (Michigan) assessment project which evaluated safe food handling knowledge of third-grade children and the influential adult populations that could impact their knowledge. One such population was third-grade teachers. The purpose of this study was to determine the safe food handling knowledge of Michigan third-grade teachers. A mailed questionnaire was the method used to obtain the data on safe food handling knowledge. Mailed questionnaires were used because this method can (1) accommodate a large sample, (2) reach widely dispersed respondents inexpensively, and (3) get a high response rate (Alreck and Settle, 1985).

3.3.1 Description of Sampling Frame

Access to teachers was obtained by requesting from school principals' or other administrators' permission for teachers to participate in this study. A request letter and a reply card (Appendices 1 and 2) were sent to principals of all public elementary schools (N=1993) in the state of Michigan. The letters requested that principals give permission for third-grade teachers to participate in the

study. Third-grade teachers from all participating schools (n=271) were used as the sample population.

3.3.2 Design of the Questionnaire

The questionnaire for third-grade teachers, developed during March and April 1991 (Appendix 3), consisted of 35 questions. Included were questions about knowledge of safe food handling and questions about demographics.

Teachers' knowledge level of safe food handling was assessed by eight knowledge questions. The knowledge questions were based on the most frequently reported food-preparation practices that contribute to foodborne disease--improper storage, improper holding temperature, and poor personal hygiene (Bean, *et al.*, 1990). Areas of evaluation were food temperature and storage, potentially hazardous foods , personal hygiene, and cross-contamination.

Personal, professional, and school-related demographic data were collected. Personal demographic data requested were gender, age, education, income level, and perception of the importance of safe food handling. Professional demographic information included years on the job, sources of information on safe food handling, and safe food handling teaching materials and methods. School demographic information included class size, classroom resources, opportunities for children to keep their lunches cold, opportunities for children to wash their hands, and

teachers' perceptions of how often children eat spoiled foods.

A letter describing the proposed study and directions for answering the questionnaire was on the cover of each questionnaire. The questionnaire was approved for use by the University Committee on Research Involving Human Subjects (UCRIHS) at Michigan State University (MSU) in March 1991.

3.3.3 Pilot Testing of the Questionnaire

The questionnaire on safe food handling for teachers was pilot tested. The content, construct, and face validity of the questionnaire was assessed by expert review. Content validity was assessed by determining whether the questions chosen were accurate (right answers were correct; wrong answers were incorrect). Face validity was determined by ascertaining whether the survey was appropriate for the intended population. Construct validity was assessed by determining whether the items represented the concept (safe food handling) they were intended to measure.

The questionnaire was pilot tested (n=50) to determine criterion validity. Criterion validity was defined in this study by whether the instrument discriminated between masters and non-masters of information represented by the construct. The discrimination index was used to assessed criterion validity and was calculated for individual items

and for the total survey. The index of discrimination used in the item analysis was calculated as the difference between the proportion of the high scorers (27%) who selected the correct answer minus the proportion of the low scorers (27%) who selected the right answer.

The index of difficulty (proportion of the total group who got the item correct) was also calculated (Morris *et al.* 1987). A high index indicated the item was easy and a low index indicated the item was difficult. Both the difficulty and discrimination indices were acceptable (survey mean difficulty = 51; survey mean discrimination = 30) (Morris *et al.*, 1987).

3.3.4 Administration of the Questionnaires

All questionnaires (n=997) for teachers were sent to participating schools by bulk mail during April and May of 1991. To facilitate a high response rate, return postage for the surveys was prepaid. Each school included in the research sample was mailed a box/envelope including a cover letter (Appendix 4), an inventory sheet (Appendix 5), a direction sheet (Appendix 6), the appropriate number of an eight-page teacher questionnaire.

In late May 1991 the designated contact person in each school that did not respond (n=85, a nonresponse rate of 31.3%) was contacted by telephone. The contact person was

requested to obtain and return the completed questionnaires as soon as possible.

Two incentives for teachers to participate were offered. The first was a certificate of recognition from the College of Human Ecology, Michigan State University, signed by the College Dean. The certificate acknowledged their contribution to improving the health of third-grade children and their families. The second was a $5.00 gift-certificate (Appendix 7) to purchase educational materials from the Dairy Council of Michigan. The gift certificates were donated to MSU by a grant from the Dairy Council of Michigan.

A "thank you" letter (Appendix 8), the certificate, and the gift certificate were sent to the participating schools when the returned questionnaires were received between May and June, 1991.

3.3.5 Statistical Analysis

Responses to the questionnaire were statistically analyzed using The Statistical Package for the Social Sciences (SPSS/PC+, version 4.0.1, 1990). Analyses of data gathered from the surveys included frequency distribution and ANOVA methods (Moore, 1989). A probability of $p \leq 0.05$ was used as the significance level in all analyses.

3.4 Results And Discussion

The purpose of this study was to determine safe food handling knowledge of Michigan third-grade classroom teachers. Questionnaires on safe food handling for Michigan third-grade teachers (n=997) were mailed in May 1991. Completed questionnaires (n=439) from 194 schools were returned between May and June, 1991 (response rate = 43.9%). Demographic characteristics of Michigan third-grade teachers and their knowledge of safe food handling are discussed below.

3.4.1 Personal Demographics

Respondents were predominantly female (89.7%), between 31 and 50 years of age (66.1%), and had a Bachelor's (43.6%) or Master's degree (53.2%) (Table 1). Almost all respondents were white (92.7%). The private residential setting most frequently selected was "less than 10,000 people" (35.8%). More than half the third-grade teachers (54.1%) reported an annual household income in the range of $20,001 to $70,000. Over one-fourth of the respondents (32.0%) did not answer the optional income question.

Table 1. Personal demographic characteristics of Michigan third-grade teachers (n=439)[a] who responded to a mailed questionnaire on safe food handling in 1991.

Characteristic	No.[b] of responses	Percent (%)
Gender		
Male	41	9.4
Female	393	89.7
Total	434	99.1
Age[c] (years)		
22-30	37	8.4
31-40	89	20.2
41-50	202	45.9
51-60	69	15.7
61-65	5	1.1
Total	402	91.3
Education (highest degree)		
Associate Degree	5	1.2
Bachelor's Degree	191	43.6
Master's Degree	233	53.2
Ph.D. or Equivalent	3	0.7
Total	432	98.7
Residential Setting		
Farm	36	8.2
Less than 10,000 people	157	35.8
10,000-50,000 people	112	25.6
Suburb, more than 50,000	78	17.8
City, more than 50,000	44	10.0
Total	427	97.4
Household Income (optional)		
Less than $20,000	20	4.5
$20,001-30,000	50	11.4
$30,001-40,000	50	11.4
$40,001-50,000	47	10.7
$50,001-60,000	35	8.0
$60,001-70,000	55	12.6
$70,001-80,000	14	3.2
$80,000-90,000	12	2.7
$90,000-100,000	8	1.8
more than 100,001	7	1.6
Did not answer	141	32.0
Total	439	100.0

a. (439/997)*100%=42.6% response rate.
b. Total number of responses varies among demographic characteristics because some respondents did not answer all questions.
c. Mean age = 43.5 $\pm$ 9.4 years (Mean $\pm$ Standard Deviation)

The first question in the questionnaire (Appendix 3) for Michigan third-grade teachers was to determine the relative importance of safe food handling regarding maintenance of health for the respondents. Only 13.0% of the respondents thought safe food handling was the most important thing they did to maintain their health. Seventy nine percent (79.2%) of the respondents thought that it was important to maintain their health. A small portion of the respondents thought safe food handling was less important than most things they did (6.2%), or they were not familiar with safe food handling.

3.4.2 Professional Demographics

The "years of teaching experience" of Michigan third-grade teachers surveyed ranged from 1 to 36 years with a mean of 15.81 $\pm$ 8.67 years. The sources of information on safe food handling, training in safe food handling, and the methods of teaching safe food handling are discussed below.

3.4.2.1 Sources of information on safe food handling

The respondents were asked to identify the sources from which they obtained information on safe food handling. Newspaper/consumer magazines were most often reported as the source of information about safe food handling (66.0%) (Table 2). The Cooperative Extension Service, family and friends, and the National and Michigan Dairy Councils were also popular sources of information. When asked to identify

Table 2. Professional demographics of Michigan third-grade teachers (n=439)[a] who responded to a mailed questionnaire on safe food handling in 1991.

	Question Part	
	A	B
Questions/Foils on professional demographics	% of respondents	% of respondents who rated most accurate or best
Question 1[b].		
Part A. During the past year, from what **sources of** have you received information on food handling? (Check all that apply)		
Part B. Of your choices in the previous question, please circle the source of information that you believe provides the most accurate information on food handling. (Circle one)		
Cooperative Extension Service	23.3	14.8
Family and friends	40.4	1.8
Government pamphlets	11.6	6.2
Local school district	11.6	2.1
Newspaper/consumer magazines	66.0	23.5
National/Michigan Dairy Council	39.5	11.4
Professional journals	8.2	2.3
Professional or job-related meeting	7.3	2.3
Other[c]	5.9	2.5
None	16.9	32.0
Question 2[d].		
Part A. Which of the following **methods** did you use to teach safe food handling? (Check all that apply)		
Part B. Please circle the method in the previous that worked best for your class. (Check one)		
Computer	1.4	0.0
Discussion	43.8	21.4
Field trips/site visits	1.6	0.2
Games	2.7	0.5
Michigan Model materials	36.4	13.2
Presentation/lecture	20.9	3.1
Written exercise	8.9	0.2
Other[e]	5.0	2.7
None	46.6	59.8

a. (439/997)*100%=42.6% response rate.
b. Question 2 and 3 (Appendix 3).
c. Other=Michigan Model material, books, TV, videotape, classes taken in college.
d. Question 11 and 12 (Appendix 3).
e. Other=TV, video-tape.

the source of information on safe food handling they considered most accurate, 23.5% of the respondents indicated newspapers, 14.8% indicated the Cooperative Extension Service, and 11.4% indicated the National or Michigan Dairy Councils (Table 2).

The sources of information on safe food handling available to Michigan third-grade teachers are similar to the sources available to consumers (Gravani, 1992). In a nationwide consumer survey on home food preparation practices conducted by Cornell University, researchers learned that the most frequent sources of information on food safety preferred by U.S. consumers were newspapers, magazines, television, and health professionals (Gravani, 1992).

Newspapers, magazines, and health professionals were ranked as "reliable" or "very reliable" sources of safe food handling information by 75% of the respondents. Television was considered "the most convenient" way to obtain food safety information, followed by newspapers and magazines. Health professionals were ranked fourth (4% of the respondents), along with food manufacturers and pamphlets in supermarkets (Gravani, 1992).

Michigan third-grade teachers used some information sources on safe food handling similar to those of Kansas elementary school teachers. Science, health, and nutrition books were listed by many teachers in Kansas as major

sources of nutrition information (Soliah *et al.*, 1983). Films and filmstrips were used by approximately three-fourths of Kansas teachers; more than half used posters, and about a third used pamphlets. Other information sources and materials included National Dairy Council materials, journals, and magazines such as *School Foodservice Journal*, *Food Management*, *Learning*, *Instructor*, *Reader's Digest*, and *Newsweek* (Soliah *et al.*, 1983).

3.4.2.2 Training in safe food handling

In this study, third-grade teachers in Michigan reported that they had not received any training in safe food handling (94.3%) during the previous 12 months. Information on training in safe food handling for teachers in states other than Michigan was not found in the literature review.

In education literature, nutrition often includes safe food handling concepts (Soliah *et al.*, 1993). Soliah *et al.* (1983) indicated that almost 60% of elementary teachers in Kansas had had no training in nutrition. Only 20% of Kansas elementary teachers reported that they had completed one or more college or continuing education courses in nutrition (most often one to three hours in length). Twenty percent (20%) of Kansas elementary teachers had attended nutrition workshops, most within the last five years (Soliah *et al.*, 1993). Less than 1% had completed a correspondence course. Kansas elementary teachers listed two preferred ways of

obtaining additional nutrition training: nutrition education materials (65%) and attending nutrition workshops during the school year (50%). More than 80% indicated that they did not want summer school courses in nutrition (Soliah, *et al.* 1983).

3.4.2.3 Methods of teaching safe food handling

When the respondents of this study were asked whether they teach safe food handling concepts to third-grade children, only 53.4% answered affirmatively. "Discussion" and "Michigan Model materials" were the methods teachers used most frequently to teach safe food handling (Table 2). Only 1.4% of the respondents used a computer to teach the concept of safe food handling. Teachers rated "discussion" as the best method to teach safe food handling.

No other studies have reported methods of teaching safe food handling. However, several studies reported the methods that elementary school teachers use to teach nutrition. "Classification of foods according to four food groups," "discussion," "using films or filmstrips," and "having children develop plans for improving food practices" were listed as successful methods in nutrition education by Oklahoma elementary teachers of grades 1-7 (Baird, 1981). Over 90% of the Oklahoma respondents thought that nutrition education is important to help students form good habits (Baird, 1981).

A report from the Kansas Nutrition Education and Training Program provided baseline data about Kansas elementary teachers' practice of teaching nutrition (Soliah *et al.*, 1983). Over half the Kansas elementary teachers (70%) "rarely" or "never taught" safe food storage practices or involved their students in planning school lunch menus. Teachers in Kansas suggested that the topic of safe food handling should be included in the nutrition education materials. In those Kansas schools with on-premise food production facilities, teachers tended to work with the school foodservice personnel and use the cafeteria as a laboratory for instruction more frequently than did teachers in schools with only satellite service centers (Soliah *et al.*, 1983).

Safe food handling was considered by teachers to be a part of a nutrition knowledge base (Soliah *et al.* 1983). When teachers have learned to integrate safe food handling and nutrition, safe food handling could more easily be incorporated into classroom curricula. Other sources within the schools such as school foodservice personnel and kitchen facilities could be used by teachers in teaching safe food handling (Soliah *et al.* 1983).

3.4.3 School Demographics

Classroom demographics and classroom practice were reported by Michigan third-grade teachers.

3.4.3.1 Classroom demographics

About three-fourths of the respondents (76.6%) had a classroom size of 20-30 children. The number of teachers who used computers when teaching third-grade children was 79.2%. Apple was the brand of computer most often used in third-grade classrooms. Available computers were most often located in the teachers' classroom (68.6%). Other locations reported were laboratories (22.1%) and libraries (13.4%) (Appendix 9).

Since computers were available in most third-grade classrooms (68.6%) and 80% of teachers did use computers to teach students, computers could also assist teachers in teaching safe food handling if appropriate software such as Risk Raiders (Department of Food Science and Human Nutrition, Michigan State University) was available.

3.4.3.2 Classroom practice

Safe food handling as practiced in school was also reported by Michigan third-grade teachers. Over 80% of the respondents thought that children "almost never" brought a cold pack from home to keep their lunch cold (Table 3). About 40% of teachers (42.2)% reported that children almost never had the opportunity to wash fruits and vegetables before eating them, but only 8.3% believed that children "almost always" or "sometimes" brought to school and ate food that was spoiled or bad (Table 3).

Table 3. Practices regarding safe food handling of third-grade children as perceived by Michigan third-grade teachers (n=439)[a] who responded to a mailed questionnaire on safe food handling in 1991.

Practice Area and Question	Perceived Practice Level		
	almost always	sometimes	almost never
	<——— No. of responses[b] ———>		
	<——— (% of responses) ———>		
1. Cold Pack: How often do the children bring a cold pack from home to keep their lunch cold?	n=4 (0.9%)	n=77 (17.6%)	n=354 (80.8%)
2. Eat spoiled food: How often do children bring to school and eat food that is spoiled or bad?	n=2 (0.5%)	n=34 (7.8%)	n=356 (81.3%)
3. Fruit washing: Is an opportunity provided in the classroom for the children to wash fruits and/or vegetables before eating them?	n=185 (42.2%)	n=54 (12.3%)	n=172 (39.3%)
4. Hand washing: Is an opportunity provided for the children to wash their hands....			
before eating a snack?	n=271 (61.9%)	n=115 (26.3%)	n=47 (10.7%)
before eating lunch?	n=324 (74.0%)	n=72 (16.4%)	n=38 (8.7%)
after using the toilet?	n=434 (99.7%)	n=3 (0.7%)	n=1 (0.2%)

a. (439/997) * 100% = 43.9% response rate

Additionally, over half of the respondents believed that children "almost always" have an opportunity to wash their hands before eating snacks (61.9%) and lunch (41.0%). Almost all of the respondents (99.7%) reported that children had the opportunity to wash their hands after using the toilet. The opportunities for children to wash their hands does not always mean that hand washing actually occurred.

Based on observations of teachers, most children almost never brought a cold pack from home to keep their lunch safe to eat. Also, the opportunities to wash the vegetables/fruits and to wash hands before eating a snack were not always provided by about 40% of teachers. Teachers should realize that safe food handling practices such as bringing cold pack and washing hands before eating a snack could protect children from foodborne disease. Children need to be encouraged by teachers to bring cold pack from home to keep their lunch cold. Additionally, more opportunities of washing vegetables/fruits and washing hands before eating a snack should be provided to children. Equally important, safe food handling concept need to be taught in the classroom.

3.4.4 Knowledge of Safe Food Handling

The questionnaire for Michigan third-grade teachers contained eight questions about their knowledge of safe food handling (Appendix 3, Q14 to Q21). The four safe food

handling constructs presented were: (1) food temperature and storage, (2) identification of potentially hazardous foods (3) cross-contamination, and (4) personal hygiene. Table 4 summarizes the eight knowledge questions and the percentage of the respondents who answered correctly. Although teachers were knowledgeable about storage and thawing food, they did not know the maximum safe operating temperature (45^0F) of a refrigerator.

Figure 1 shows the distribution scores of safe food handling knowledge. The total number of correct answers to safe food handling questions by teachers was distributed in a normal curve. The mean score of all respondent was 55.5% $\pm$ 13.6% S.D. More than half the respondents (52.3%) correctly answered four or five questions. No respondent correctly answered all of the knowledge questions (n=8).

3.4.4.1 Food temperature and storage

Most respondents ($\geq$ 95%) correctly answered two questions about methods of storing and thawing ground beef (Appendix 3, Q14 and Q15) (Table 4). Almost all the respondents knew that a refrigerator is the safest place to store raw ground beef (99.3%) and to thaw frozen ground beef(95.9%). Only 39.3% knew the maximum safe operating temperature for a refrigerator (45°F) (FDA, 1976)(Appendix 3, Q18) (Table 4). The question related to the maximum safe

Table 4. Knowledge on safe food handling (n=8) items and percent of correct responses from Michigan third-grade teachers (n=439)* who responded to a mailed questionnaire on safe food handling in 1991.

Knowledge Item (Content)	% of respondents who correctly answered the question
A. Food temperature and storage	
1. Best location to store fresh, raw ground beef overnight	99.3
2. Best location to safely thaw frozen, ground beef	95.4
3. Recommended maximum temperature of an operating refrigerator	39.3
4. Chilled storage of leftover stew in a shallow container	14.4
B. Identification of potentially hazardous foods	
1. Potentially hazardous foods a. Chicken breasts (96.6% correct) b. Skim milk (91.6% correct) c. Baked potato (86.6% correct) d. Refried beans (91.8% correct) e. Corn oil (59.8% correct) f. White vinegar (80.4% correct)	44.3
2. Identification of unsafe food by sight, smell, and/or taste	46.6
C. Personal hygiene (Method of handwashing)	90.0
D. Cross-contamination (transfer of *Staphylococcus aureus* from foodhandlers to potato salad)	39.5

* (439/997) * 100% = 43.9% response rate

KNOWLEDGE SCORE OF SAFE FOOD HANDLING

Michigan third-grade teachers

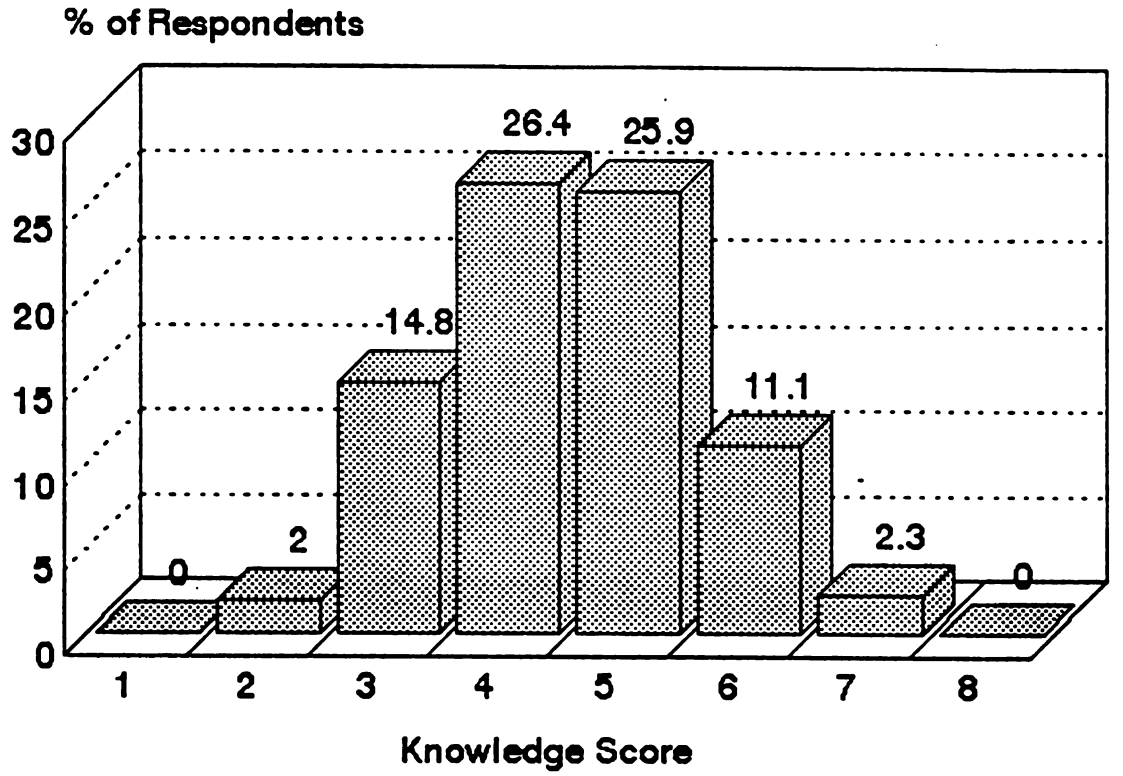


Figure 1. Knowledge scores of Michigan third-grade teachers (n=365) who responded to all knowledge questions (N=8) in a mailed questionnaire on safe food handling in 1991.

operating temperature for a refrigerator was more difficult than the other seven questions because it was open-ended instead of multiple-choice.

When asked about the proper type of container for storing leftovers (Appendix 3, Q21), 74.2% of the respondents answered that the depth of the container is not important (Table 4). Only 14.4% knew that a shallow container can limit the growth of harmful bacteria (Table 4).

In a nationwide survey of consumers related to safe food handling, 23% of the respondents said they would thaw hamburger meat on the counter top at room temperature (Gravani, 1992). In the present study, 99% of teachers knew that refrigerator is the best way to thaw frozen ground beef. Similarly, only 32% of consumers knew to store leftovers in a shallow container while only 14% of teachers had the same knowledge in this study.

Michigan third-grade teachers' knowledge about storage of food was similar to that of Kansas elementary school teachers. Soliah *et al.* (1983) reported that 80.5% of Kansas teachers knew that turkey should be refrigerated immediately after use. About half of Kansas teachers (49.2%) were able to identify a food not requiring refrigeration, but only 19.9% knew that meat can be refrozen if ice crystals are still present.

3.4.4.2 Identification of potentially hazardous food

On the questionnaire for third-grade teachers, respondents were asked to identify which of six foods were potentially hazardous (Appendix 3, Q16). "Potentially hazardous" foods were defined as "any perishable food which consists in whole or in part of milk or milk products, egg, meat, poultry, fish and shellfish, or other ingredients capable of supporting rapid and progressive growth of infectious or toxigenic microorganisms (FDA, 1976)."

Among the answers, 96.6% of the respondents considered meat products (chicken breasts) and 91.6% considered milk as potentially hazardous foods (Table 4). For vegetable products, baked potatoes were correctly identified by 86.6% of the respondents, and refried beans were correctly identified by 91.8% of the respondents (Table 4). Although corn oil and white vinegar were not potentially hazardous foods, many respondents still selected them (corn oil: 40.2% : white vinegar: 19.6%). Only 44.3% of the respondents were able to correctly identify all potentially hazardous foods (Table 4). Over half (51.6%) of third-grade teachers incorrectly responded that spoiled food could only be identified by looking at, smelling, or tasting it (Appendix 10, Q12) (Table 4). Third-grade teachers did not understand that unsafe food sometimes can not be identified by looking at, smelling or tasting it.

By contrast, a study by Gravani (1992) showed that 28% of consumers in the United States agreed with the statement that, "You can always tell when a food will cause foodborne disease because it will smell or taste bad."

3.4.4.3 Personal hygiene

Most Michigan third-grade teachers (90.0%) in this study knew that washing hands with soap and clean water before handling foods is the best way among the four foils given to prevent foodborne disease (Appendix 3, Q17)(Table 4). Other foils used with this knowledge item included: rinsing hands under hot water, wiping hands on a clean towel and none of these are important. Hand washing, identified as a way of controlling the spread of infection, has been viewed as a possible method of reducing foodborne disease (CDC, 1985; Larson, 1984). Proper hand washing can effectively remove transient food-borne pathogens (Guthrie, 1972).

3.4.4.4 Cross-contamination

Results of this study indicated that only 39.5% of the respondents correctly answered that *Staphylococcus aureus* is most often introduced into foods by food handlers (Appendix 3, Q19)(Table 4). Cross-contamination is a major food safety concern which can be controlled by food handlers at the preparation stage (Gravani, 1992).

3.4.4.5. Statistical analyses of safe food handling knowledge scores

Results of analyses of variance (ANOVA) of safe food handling knowledge score versus selected demographic characteristics of Michigan third-grade teachers is shown in Table 5. Age was categorized into two groups: under 40 years and over 40 years. The teaching experience of third-grade teachers was categorized into three groups: under 10 years, 11-20 years, and over 21 years. These values were selected as the dividing point because they would allow the two sets of data to be separated into approximately equal cell sizes.

A statistically significant difference in knowledge about safe food handling was found between third-grade teachers less than 40 years of age and third-grade teachers over 40 years of age ($p \leq 0.05$) (Table 5). Older respondents had a higher mean knowledge score (56.4% ± 13.4%) about safe food handling than did younger respondents (53.6% ± 14.3%).

This result was expected since convenience foods have become a way of life, all but eliminating regular food preparation in the kitchen of most U.S. consumers (Beard, 1991). Younger generations may not have had the chance to learn how to handle food safely. In addition, during the past 20 years, instruction in safe food handling in home economics courses has been replaced by the study of food

Table 5. Analysis of variance (ANOVA) of mean knowledge scores of safe food handling vs. selected demographic characteristics of Michigan third-grade teachers (n=439)[a] who responded to a mailed questionnaire on safe food handling in 1991.

Demographic Characteristics	No. of respondents	Knowledge score (Mean ± S.D.)	p value
I have taught safe food handling to children			0.932
Yes	184	55.9% ± 13.9%	
No	162	55.3% ± 13.4%	
Age			0.046*
Under 40 yrs	103	53.6% ± 14.3%	
Over 40 yrs	243	56.4% ± 13.4%	
Experience			0.457
1-10 yrs	98	56.1% ± 14.4%	
11-20 yrs	135	54.5% ± 13.0%	
21-36 yrs	113	56.0% ± 13.9%	
Highest academic degree			0.277
Bachelor's degree	160	56.4% ± 13.3%	
Master's degree	186	54.5% ± 15.2%	

a. (439/997) * 100% = 43.9% response rate.
b. No higher interactions among more than two factors were important.
* ($p \leq 0.05$) statistically significant.

choice in nutrition courses. One result is that children who did not learn much about safe food handling over the past twenty years are now adults who are "lost" in the kitchen (Beard, 1991).

In a survey related to the food safety knowledge of consumers (Gravani, 1992), the knowledge scores of consumers were also different among age groups and educational level. Respondents under 35 years of age scored the lowest. Mean food safety knowledge scores increased up to the 65-years-of-age group, and then decreased slightly for the over-65-years-of-age group. Educational level also had an effect in the study by Gravani (1992). Mean scores increased with educational level up to the associate degree, but decreased for college graduates and those with advanced degrees (Gravani, 1992). However, in the present study, there was no significant difference in knowledge scores among educational levels.

Several studies have explored the effect that teaching nutrition would have on those teachers' nutrition knowledge scores. Soliah (1983) found teachers who taught nutrition to their students achieved higher scores on food selection, nutrition practices, and food preparation than did those who did not teach nutrition. However, Spollen (1974) found no significant difference in nutrition knowledge scores between teachers who taught nutrition and those who did not. In the present study, no significant difference in knowledge scores

of safe food handling was found between teachers who taught safe food handling and those who did not.

The positive and negative impacts of nutrition training for teachers has been explored in some research papers. Spollen (1974), Wasley (1975), and Soliah *et al*. (1983) reported that teachers trained in nutrition scored higher on nutrition tests than did those without training. However, Byrd (1977) and Petersen and Kies (1972) found that including nutrition courses in the undergraduate curriculum of elementary teachers did not result in higher nutrition knowledge scores. In the present study, there was no significant difference in knowledge scores between teachers who received training and those who did not.

3.4.4.6 Discussion of safe food handling knowledge

Although almost three-fourths of third-grade teachers (74%) had never received any formal training in safe food handling, teachers had knowledge scores of $\geq$ 50% correct on the knowledge questions about location of storing ground beef overnight, locations to safely thaw ground beef, and the best method of hand washing. Teachers had score of $\leq$ 50% correct on the knowledge questions about maximum safe temperature for an operating refrigerator, chilled storage of leftover stew in a shallow container, methods to identify unsafe foods, and identification of potentially hazardous foods.

If teachers became more familiar with the proper methods to identify unsafe food, they could help to protect children from eating unsafe food. Teachers need more training in safe food handling if they are to provide children with correct information in this area. Constructs related to safe food handling in which teachers should receive further training are in Table 6.

3.5 Conclusions

Although teachers correctly answered questions about chilled storage of food and hand washing, they had low score in identification of potentially hazardous foods, proper methods for storing leftovers and correct methods to identify unsafe foods. Post-graduate nutrition courses for teachers should include safe food handling constructs (Table 6).

Teachers should be encouraged to enhance the safe food handling/nutrition curricula of their students by using available school sources such as foodservice personnel, tours of school food production sites, and the use of computers. Attendance at such courses can be facilitated by the use of new technologies such as satellite conference where downlink sites are within easy driving distance.

Table 6. (Page 1 of 2) Constructs, learning objectives, classroom applications, and rationale to improve the safe food handling knowledge of third-grade teachers who will teach this topic in school.

Constructs	Learning objective	Classroom applications	Rationale
Potentially hazardous foods	After receiving accurate information about safe food handling, teachers should be able to identify potentially hazardous foods.	Teachers should give children the definition of potentially hazardous foods and explain to children how potentially hazardous foods should be handled to remain safe to eat.	Because only 44.3% of teachers can correctly identify all potentially hazardous foods (Table 4).
Food temperature and storage	After receiving accurate information about safe food handling, teachers should be able to describe safe methods of chilled storage for potentially hazardous foods.	Teachers should encourage children to use cold packs in lunches brought from home to keep potentially hazardous foods cold.	Because only 0.9% of teachers believed that children almost always bring a cold pack from home to keep their lunch cold (Table 3).
Hand washing	After receiving accurate information about safe food handling, teachers should be able to wash their hands correctly.	Teachers should encourage and provide opportunities for children to wash their hands before eating lunch, before eating snacks, and after using the toilet.	Because 10.7% of teachers believed that children almost never had an opportunity to wash their hands before eating snacks (Table 3).

Table 6. (Page 2 of 2) Constructs, learning objectives, classroom applications, and rationale to improve the safe food handling knowledge of third-grade teachers who will teach this topic in school.

Constructs	Learning objective	Classroom applications	Rationale
Identification of unsafe foods	After receiving accurate information about safe food handling, teachers should be able to identify unsafe foods.	1. Teachers should be able to help children learn about methods to identify unsafe food[a]. 2. Teachers should encourage children to identify unsafe food in their lunch before consumption. 3. Teachers should encourage and provide facilities for children to wash fruits/vegetables in their lunch before consumption.	1. Because only 46.6% of teachers knew that unsafe food can not be identified by tasting it (Table 4). 2. Because 39.3% of teachers believed that children almost never had an opportunity to wash fruits /vegetables before eating them (Table 3).

a. Curriculum such as Operation RISK would facilitate completion of the recommended classroom applications (Sawyer *et al.*, 1993).

4.0 MICHIGAN SCHOOL FOODSERVICE PERSONNEL: KNOWLEDGE OF SAFE FOOD HANDLING

4.1 Abstract

School foodservice personnel in Michigan (n= 597/1400 or 42.6% response rate) were surveyed to determine their knowledge of safe food handling. While almost all respondents (98%) had received some formal training in safe food handling during the previous year, they still were unable to correctly respond to questions about the recommended operating temperature of a refrigerator (68% correct answer), identification of potentially hazardous foods (40% correct answer), and methods to identify spoiled foods (53.9% correct answer). Significant differences in the safe food handling knowledge scores were found among school foodservice personnel with different job titles ($p \leq .05$). "Managers" and "supervisors" had higher mean knowledge scores than did others with job titles such as "cooks" and "kitchen assistants." Further training provided by units such as the Michigan Department of Education, especially for cooks and cook assistants, should provide information about safe food temperatures, proper storage methods, and the identification of potentially hazardous foods.

4.2 Introduction

School foodservice was the third largest market segment in the foodservice industry during the 1990s with an annual expenditure in excess of 14 billion dollars (Pannell, 1990). Major goals of school foodservice have been not only to provide safe and nutritious meals, but also to provide information about food safety and nutrition to school children (Sen, 1991).

Foodborne disease in the United States has been a significant problem, especially in foodservice establishments such as school cafeterias (Bean and Griffin, 1990). Between 1973 and 1987, 79% of foodborne outbreaks reported to the CDC occurred in foodservice establishments (Bean and Griffin, 1990). Limited information on the actual number of school children involved in foodborne disease outbreaks was available. The largest reported outbreak in school foodservice was caused by Campylobacter (Stern and Kazini, 1989). This outbreak was associated with the consumption of raw milk. The outbreak resulted in illness among 2,500 school children in Nebraska (Stern and Kazini, 1989).

Most outbreaks of foodborne disease have involved contamination of food by microbial pathogens or some

chemical agent (Synder, 1986). The most commonly reported food preparation practices that contributed to foodborne disease in the United States from 1982 to 1987 were improper storage, improper holding temperatures, and improper personal hygiene of food handlers (Bean *et al.*, 1990). Unlike other diseases, foodborne disease can be prevented by proper food handling (USDA, 1989b). Correction of faulty food preparation practices in foodservice establishments such as school cafeterias is especially important (Bean *et al.*, 1990).

School foodservice personnel have an important role in preventing the occurrence of foodborne disease both during production of school meals and during interaction with children either in the cafeteria or classroom. However, some foodservice personnel lack accurate knowledge of foodservice sanitation and often do not understand the causes of foodborne disease (Avens, 1980). According to Neill (1979), many problems in foodservice operations were due to inadequate training of staff.

Unlike commercial foodservice, the goal of the school lunch program is not only to provide adequate meals to students but also to provide nutrition education (Hinton, 1964; Neill, 1981; Sen, 1991). School lunch programs are also recognized as a part of the educational program in many schools (Hinton, 1964). Nutrition education which includes constructs related to food safety will assist students in

developing proper attitudes about food choice and food preparation (Neill, 1981).

Various areas of school foodservice have been evaluated (Bowen *et al.*, 1982; Parcel *et al.*, 1989; Frank *et al.* 1989; Glover *et al.*, 1990; Ho *et al.*, 1991; Synder, 1992). A review of the literature indicated that limited information about safe food handling training and knowledge of school foodservice personnel was available. The purpose of this study was to determine the safe food handling knowledge of school foodservice personnel.

This study was part of a larger safe food handling project in Michigan. The overall project objective was to determine the safe food handling knowledge of children and adult population groups such as school foodservice personnel who could influence their safe food handling knowledge.

4.3 Methods

This study was one component of a statewide (Michigan) assessment project that evaluated the safe food handling knowledge of third-grade children and the influential adult populations that could impact their knowledge. The purpose of this study was to determine safe food handling knowledge of Michigan school foodservice personnel.

A mailed questionnaire was used to obtain the information. Mailed questionnaires were used because this method can: (1) accommodate a large sample (2) reach widely dispersed respondents inexpensively, and (3) get a high response rate (Alreck and Settle, 1985). The sampling frame and the design, administration, and pilot testing of the questionnaire for school foodservice personnel are discussed below.

4.3.1 The Sampling Frame

The population for this study was defined as "employees who worked in Michigan school foodservice operations during the 1991-1992 academic year." The sampling frame was a mailing list of Michigan school foodservice personnel provided by the Michigan Department of Education (MDE).

This list included names and addresses of Michigan school foodservice personnel who had taken or were registered to take the two courses: *MDE 100 School Foodservice Basics* and *MDE 120 Sanitation and Safety* between 1985 and the Present (N=2839). This list was used because other mailing lists for this population were not available. Fourteen hundred (1,400) names of school foodservice personnel from the MDE list were randomly selected to participate in the study.

4.3.2 Design of the Questionnaire

The questionnaire for school foodservice personnel, developed in October 1991 (Appendix 10), consisted of 25 questions. Questions on knowledge of safe food handling and questions designed to collect information about demographic characteristics were included.

The knowledge level of safe food handling of school foodservice personnel was assessed using eight questions. Content areas of knowledge items were food temperature and storage, potentially hazardous foods, personal hygiene, and cross-contamination.

The questionnaire requested information on three types of demographic factors: personal, professional, and school. In this study, personal demographics included gender, age, generations of family living in the United States, ethnicity, residential setting, education, income level, and attitude toward safe food handling. Professional

demographics included type of facility in which the respondent was employed, job title, job functions, and number of years on the job. School demographics included frequency and types of interactions between school foodservice personnel and school children, opportunities for children to keep their lunch cold, opportunities for children to wash their hands, and the estimated frequency that children in school ate unsafe foods.

A letter describing the study and directions on how to answer the questionnaire were on the cover of each questionnaire. The questionnaire was approved for use with the specified population by the University Committee on Research Involving Human Subjects (UCRIHS) at Michigan State University in March 1991.

4.3.3 Pilot Testing of the Questionnaires

The questionnaire was pilot-tested with 50 Michigan elementary school foodservice personnel. The content, construct, and face validity of the questionnaire was assessed by expert review. Content validity in this research was assessed by determining whether the questions chosen were accurate (right answers were correct; wrong answers were incorrect) (Morris, 1987). Face validity was determined by assessing whether the survey was appropriate for the intended population (Morris, 1987). Construct validity assessed whether the items represented the concept

(safe food handling) it was intended to measure (Morris, 1987).

The questionnaire was pilot tested (n=50) to determine criterion validity and difficulty level. Criterion validity was defined in this research as whether the instrument discriminates between masters and non-masters of the information represented by the construct. The discrimination index was used to assess criterion validity and was calculated for individual items and for the total survey. The index of discrimination used in this item analysis was calculated as the difference between the proportion of the high scorers (27%) who selected the correct answer minus the proportion of the low scorers (27%) who selected the right answer. An item discrimination index of greater than 0.33 was the standard for acceptability in this research.

The index of difficulty (proportion of the total group who got the item correct) was also calculated for each item on the questionnaire. A high index indicated the item was easy and a low index indicated that the item was difficult (Morris, 1987). Both the discrimination and difficulty indices for the survey were acceptable (mean difficulty = 0.73; mean discrimination = 0.40) (Morris, 1987).

4.3.4 Administration of the Questionnaires

All questionnaires (N=1400) were sent to school foodservice personnel during October and November of 1991. Each school foodservice employee included in the research sample was mailed an envelope (4.25" x 9.50") which included a cover letter (Appendix 11), an addressed, stamped, return envelope and the 6-page questionnaire in booklet form.

4.3.5 Statistical Analysis

Responses to the questionnaire were statistically analyzed using The Statistical Package for the Social Sciences (SPSS/PC+, version 4.0.1, 1990). Analysis of the data gathered from the surveys included frequency distribution and ANOVA (Moore, 1989). A probability of $p \leq 0.05$ was used as the test of significance level in all analyses.

4.4 Results and Discussion

The purpose of this study was to determine the safe food handling knowledge of Michigan school foodservice personnel. Questionnaires on safe food handling for Michigan school foodservice personnel (N=1400) were mailed in October and November 1991. Completed questionnaires (n=597) were returned between November 23 and December 11, 1991 (response rate = 42.6%). Demographic characteristics of Michigan school foodservice personnel and their knowledge of safe food handling are discussed below.

4.4.1 Personal Demographics

Data in Table 1 summarizes personal demographic characteristics of Michigan school foodservice personnel who responded to a questionnaire on safe food handling. Respondents were predominantly female (97.2%) with a mean age of 48 $\pm$ 9.29 years; most had either graduated from high school or had received a General Education Diploma (GED)(79.4%). The residential setting most frequently selected was "less than 10,000 people" (39.5%). More than half the school foodservice personnel (52.8%) respondents

Table 1. Personal demographic characteristics of Michigan school foodservice personnel (n=597)[a] who responded to a mailed questionnaire on safe food handling in 1991.

Characteristic	No. of responses[b]	Percent (%)
Gender		
Male	9	1.5
Female	580	97.2
Total	589	98.7
Age[c] (years)		
19-30	9	1.5
31-40	126	21.1
41-50	202	33.8
51-60	179	30.0
Over 60	57	9.8
Total	573	96.2
Education (highest degree)		
Grade school	5	0.8
Some high school	30	5.0
High school or GED	474	79.4
Associate degree	39	6.5
Bachelor's degree	18	3.0
Others[d]	25	4.2
Total	591	97.9
Residential Setting		
Farm	77	12.9
Less than 10,000 people	236	39.5
10,000-50,000 people	126	21.1
Suburb, more than 50,000	78	13.1
City, more than 50,000	52	8.7
Total	569	95.3
Household Income (optional)		
Less than $10,000	34	5.7
$10,001-20,000	67	11.2
$20,001-30,000	78	13.1
$30,001-40,000	93	15.6
$40,001-50,000	77	12.9
$50,001-60,000	39	6.5
$60,001 or more	33	5.2
Did not answer	176	29.4
Total	597	99.6

a. (597/1400)*100%=42.6% response rate
b. Total number of responses varies among demographic characteristics because some respondents did not answer all questions.
c. Mean age = 48 $\pm$ 9.29 years (Mean $\pm$ Standard Deviation)
d. Other= Some years in college, vocational training in foods, Master's degree

reported an annual household income between $10,001 to $50,000.

The first question on the questionnaire was to asked the respondent about the relative importance of safe food handling to their other health maintenance practices. Over half of the Michigan school foodservice personnel (64.2%) responded that safe food handling was the "most important" thing they did to maintain their health; 35.0% thought it was as important as most things they did to maintain their health.

Personal demographic characteristics of school foodservice personnel in the present study were similar to those of other studies. The demographic profile of Kansas school foodservice personnel in the study by Bowen *et al.* (1982) indicated that most respondents were female (99.3%), 31 to 60 years old (80.4%), and most were high school graduates (71.5%).

The demographic characteristics of Michigan school foodservice personnel who responded to the questionnaire were also similar to a national population of school foodservice personnel (USDA, 1978). In the national sample, the typical school foodservice employee was 45 to 50 years old and had a high school diploma.

4.4.2 Professional Demographics

The professional demographic characteristics reported by Michigan school foodservice personnel are shown in Table 2. Almost one-third of the respondents (32.0%) had the job title of "cook," and 25.6% were employed in positions entitled "kitchen assistant." On the average, these respondents had 8.67 $\pm$ 6.54 years of foodservice work experience in schools. When asked, "In what type/types of facility do you primarily work?" they most often answered elementary school (46.0%) or high school (46.9%).

The professional demographic characteristics of school foodservice personnel in the present study were similar to those in other studies. In the study by Bowen *et al. (1982)* almost 70% of the school foodservice personnel were "cooks," "kitchen assistants," "bakers," or "foodservice workers." Of that total, 43.8% had been employed eight or more years. In the national sample by USDA (1978), the typical school foodservice employee had about eight years of experience in school foodservice.

4.4.2.1 Sources of information on safe food handling

Personnel working in Michigan school foodservice operations were asked to identify the sources from which they received information about safe food handling (Table 3). Professional or job-related meetings were most often reported as the source of information on safe food handling. When asked to identify the most accurate source of

Table 2. Professional demographic characteristics reported by Michigan school foodservice personnel (n=597)[a] who responded to a mailed questionnaire on safe food handling in 1991.

Characteristic	Number of Responses	Percent(%) of Respondents
Job title		
Cook	191	32.0
Kitchen assistant	153	25.6
Supervisor/director	78	13.1
Manager	74	12.4
Foodservice worker	40	6.7
Cashier	11	1.8
Baker	10	1.7
Maintenance/delivery	10	1.6
Salad maker	7	1.2
Secretary/office assistant	6	1.0
Other[b]	4	0.7
Total	584[c]	97.8
Years of experience in foodservice		
1-10	394	66.0
11-20	168	28.1
21-30	30	5.1
31-36	2	0.4
Total	594[c]	99.6
Type of facility		
Elementary school	275	46.0
Middle school	226	34.9
High school	280	46.9
Commissary kitchen	85	14.2
Other	50	8.4
Total	916[d]	150.4[e]

a. (597/1400)*100=42.6% response rate.
b. Other= dishwasher, meal packer and foodservice consultant
c. n < 597 because some respondents did not answer all questions.
d. n > 597 because some school foodservice personnel checked more than one type of facility.
e. Multiple responses were made.

Table 3. Sources from which Michigan school foodservice personnel (n=597)[a] received information on safe food handling as reported in a mailed questionnaire on safe food handling in 1991.

Sources of information on safe food handling	Respondents who received information from this source[b]	Respondents who rated the source as most accurate
	<— % of respondents —>	
Cooperative Extension Service	24.1	7.0
Family and friends	16.8	0.2
Government pamphlets	38.7	9.5
Local school district	47.9	4.5
Newspaper/consumer magazines	45.4	1.8
National/Michigan Dairy Council	21.9	2.0
Professional journals	42.0	9.2
Professional or job-related meeting	71.0	32.0
Other[c]	22.4	13.1
None	2.8	20.7

a. (597/1400)*100=42.6% response rate.
b. Multiple choices were made.
c. Other=Class taken at college, work experience, television, videotape and book.

information on safe food handling, 32% of the respondents indicated job-related meetings, 9.5% indicated government pamphlets, and 9.2% indicated professional journals (Table 3).

The sources of information on safe food handling for Michigan school foodservice personnel are different from the sources of information identified by some consumers. In a nationwide consumer survey on home food preparation practices conducted at Cornell University, the researchers learned that the most frequent sources of information on food safety for consumers in the United State were newspapers, magazines, television, and health professionals (Gravani, 1992).

The results of this study indicated school foodservice personnel differed from the typical U.S. consumer, because they considered professional or job-related meetings more accurate than other sources when providing information on safe food handling.

Newspapers, magazines, and health professionals were ranked as "reliable" or "very reliable" sources of safe food handling information by 75% of the respondents (Gravani, 1992). Television was considered as "the most convenient" way to obtain food safety information, followed by newspapers and magazines. Health professionals were ranked fourth (4%), along with food manufacturers and pamphlets in supermarkets.

4.4.2.2. Training in safe food handling

Courses in safe food handling available to Michigan school foodservice personnel are shown in Table 4. Almost all respondents (98.8%) had taken at least one training course on safe food handling during the previous five years. Training courses offered by the Michigan Department of Education (MDE 100 and MDE 120) were the courses most frequently reported taken by the respondents (72.9% and 62.6% respectively). This result could be expected since the MDE mailing list used to identify potential respondents was a list of Michigan school foodservice personnel who had signed up, or signed up and taken one or more of the MDE courses.

Respondents in the present study suggested that all school foodservice personnel in Michigan should be required to take the *MDE 100 Basics of Foodservice* and the *MDE 120 Sanitation and Safety*. One respondent strongly wrote on the questionnaire that she believed that certification should be a requirement for at least one person in each foodservice operation.

4.4.3 School Demographics

More than half of Michigan school foodservice personnel reported interacting with children on the topic of safe food handling (Table 5). The most frequent type of interaction

Table 4. Courses in safe food handling taken by Michigan school foodservice personnel (n=597)[a] between 1985 and 1991 as reported in a mailed questionnaire on safe food handling in 1991.

Name of Course	Agency or Association Sponsor	% of respondents who had taken the course[b]
1. MDE[c] 100: School Foodservice Basics	Michigan Dept. of Education	72.9
2. MDE 120: Sanitation and Safety	Michigan Dept. of Education	62.6
3. Sanitation and Safety	American School Foodservice Association	47.7
4. Sanitation and Safety	Local County Health Department	17.9
5. Applied Foodservice Sanitation (NIFI)[d]	National Restaurant Association	14.4
6. Other[e]		18.4

a. (597/1400)*100=42.6% response rate.
b. Some respondents could have taken more than one course.
c. MDE=Michigan Department of Education.
d. NIFI=National Institution of Foodservice Industry.
e. Other responses included Michigan School Foodservice Association, MDE 160: Principles of Food Preparation; MDE: Introduction to Nutrition.

Table 5. Type of interaction on safe food handling with school children reported by Michigan school foodservice personnel (n=597)[a] who responded to a mailed questionnaire on safe food handling in 1991.

Types of Interaction	Percent of responses (%)
1. Conversation with children in the lunch room	37.3
2. Tours of the school foodservice facility to children	11.3
3. Talk to children in a classroom setting about safe food handling	5.7
4. Other[b]	5.3
TOTAL	**53.7**[c,d]

a. (597/1400)*100=42.6% response rate.
b. Examples of other types of interaction were : cook for children, plan menu with children.
c. Multiple choices were made.
d. 43.2 % respondents answered " None"; 8.6% did not answer the question.

was conversation with children in the lunch room (37.5% of responses) followed by giving children tours of the school foodservice facility. This result indicated that school foodservice personnel in Michigan have an opportunity to decrease the occurrence of foodborne disease. Not only must they use their knowledge of safe food handling during production of school meals and but also during interaction with children either in lunchrooms and in classrooms.

Perceived practices of children related to safe food handling in school were also reported by school foodservice personnel on the questionnaire (Table 6). The majority of respondents (69.4%) believed that children almost never used a cold pack to keep cold lunches brought from home. Similarly, over one-fourth of the respondents believed that children "sometimes" or "almost always" brought to school and ate food that was spoiled or bad. Lastly, almost 40% of school foodservice personnel believed that children sometimes or almost never had an opportunity to wash their hands before eating lunch. One respondent added this comment: "Children's hands are not washed most of the time after they come in from the playground just before lunch. Most high school students do not wash their hands before coming to lunch also." These results should only be considered in light of the facts: (1) that children may have an opportunity to wash their hands does not mean that hand washing has actually occurred; and (2) most school

Table 6. Practices regarding safe food handling of Michigan school children as perceived by Michigan school foodservice personnel[a] (n=597) who responded to a 1991 mailed questionnaire.

Practice Area and Question	Perceived Practice Level		
	almost always	sometimes	almost never
1. Use of cold pack[b]:	<——— No. of responses ———		———>
	<——— % of respondents ———		———>
How often do the children bring a cold pack from home to keep their lunch cold?	n=8 (1.3%)	n=137 (22.8%)	n=415 (69.4%)
2. Eat spoiled food:			
How often do children bring to school and eat food that is spoiled or bad?	n=1 (0.2%)	n=158 (26.4%)	n=314 (52.4%)
3. Hand washing:			
Is an opportunity provided for the children to wash their hands before eating lunch?	n=309 (51.5%)	n=131 (21.9%)	n=107 (18.0%)

a. (597/1400) * 100%=42.6% response rate
b. Or freezer pack. Cold pack was the term used in the questionnaire.

foodservice personnel do not have direct interaction with children before they come into the lunchroom.

Hand washing has been identified as a way of reducing the absenteeism and foodborne disease rate of school children (Larson, 1984). Results of the present study (Table 6) indicated that students may need more opportunities to wash their hands before going to lunch. Also, children need more encouragement about the importance of good hand washing practices from teachers and school foodservice personnel as well as classroom lessons on safe food handling.

4.4.4 Knowledge of Safe Food Handling

The questionnaire for Michigan school foodservice personnel contained eight knowledge questions about safe food handling. The four safe-food-handling constructs used were presented: (1) food temperature and storage, (2) identification of potentially hazardous foods, (3) cross-contamination, and (4) personal hygiene. Table 7 contains the knowledge items and percent of respondents who answered correctly.

Figure 1 shows the distribution of knowledge scores for eight questions on safe food handling. The mean score of all respondent was 75.6% $\pm$ 15.6%. About 56.0 % of the respondents answered six or more knowledge questions

Table 7. Knowledge about safe food handling (n=8) items and percent of correct responses from Michigan school foodservice personnel (n=597)[a] who responded to a mailed questionnaire on safe food handling in 1991.

Knowledge Item (Content)	% of respondents who correctly answered the question
A. Food temperature and storage	
1. Best location to store fresh, raw ground beef overnight	98.9
2. Best location to safely thaw frozen, ground beef	98.0
3. Recommended maximum operating temperature of a refrigerator	68.8
4. Chilling of leftover foods in a shallow container	70.7
B. Identification of potentially hazardous foods	
1. Potentially hazardous foods a. meat product (chicken breasts)(98.8% correct) b. milk (skim milk)(85.4% correct) c. vegetables (baked potato)(76.9% correct) (refried beans)(81.8% correct) d. oil (corn oil)(69.8% correct) e. vinegar (white vinegar)(83.7% correct)	40.9
2. Identification of unsafe food by sight, smell, and/or taste	53.9
C. Personal hygiene (Method of hand washing)	91.0
D. Cross contamination (transfer of *Staphylococcus aureus* from foodhandlers to potato salad)	58.8

a. (597/1400) * 100% = 42.6% response rate

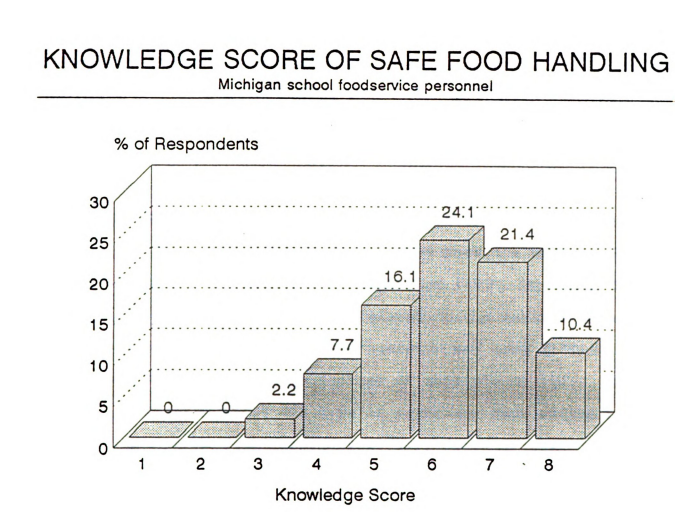


Figure 1. Knowledge scores of Michigan school foodservice personnel (n=489) who responded to all knowledge questions (N=8) in a mailed questionnaire on safe food handling in 1991.

correctly while only 10.4% of the respondents correctly answered all the knowledge questions.

4.4.4.1 Food temperature and storage

Most school foodservice personnel (≥ 98%) correctly answered the first two questions about the method of storing and thawing ground beef (Appendix 10, Q6 and Q7). Although almost all school foodservice personnel knew that a refrigerator was the safest place to store (98.9%) and to thaw (98.0%) raw ground beef, only 69% knew the maximum safe operating temperature of a refrigerator (45°F) (Appendix 10, Q10) (Table 7). The question related to the maximum safe operating temperature of a refrigerator was more difficult because it was open-ended instead of multiple-choice.

When asked about the type of container best suited to chill precooked food (Appendix 11, Q), 70.7% of the respondents knew that a shallow (Figure 1) container would minimize the growth of harmful bacteria during the chilling process. Conversely, only 22.6% of the respondents thought that the depth of the container was not important in chilled storage.

In a nationwide survey of consumers about safe food handling, 23% of consumers said they would thaw hamburger meat on the counter top at room temperature (Gravani, 1992). In the present study, 98% of school foodservice personnel knew that refrigerator was the best place to thaw frozen ground beef. Similarly, 32% of consumers knew that

precooked food should be chilled in a shallow container while 70.7% of school foodservice personnel had the same knowledge in this study (Gravani, 1992).

4.4.4.2 Identification of potentially hazardous foods

On the questionnaire for school foodservice personnel, respondents were asked to identify which of six foods were potentially hazardous (Appendix 10, Q8). "Potentially hazardous foods" have been defined as "any perishable food which consists in whole or in part of, milk or milk products, egg, meat, poultry, fish and shellfish, or other ingredients capable of supporting rapid and progressive growth of infectious or toxigenic microorganisms (FDA, 1976)."

Among the answers, 98.8% of the respondents considered meat products (chicken breasts) and 85.4% considered milk as potentially hazardous foods (Table 7). For vegetable products, baked potatoes were correctly identified by 76.9% of the respondents and refried beans were correctly identified by 81.8% of the respondents (Table 7). Although corn oil and white vinegar are not considered as potentially hazardous foods, many respondents selected them (corn oil: 30.2%; white vinegar: 16.3%). Only 40.9% of the respondents could correctly identify all the potentially hazardous foods (Table 7). Over half (53.9%) of the school foodservice personnel incorrectly responded that spoiled food could only

be identified by looking at, smelling, or tasting it (Appendix 10, Q12) (Table 7). School foodservice personnel did not understand that unsafe food sometimes cannot be identified by looking at, smelling or tasting it.

By contrast, a study by Gravani (1992) showed that 28% of consumers in the United States agreed with the statement: "You can always tell when a food will cause foodborne disease because it will smell or taste bad."

4.4.4.3 Personal hygiene

Most of the respondents (91.0%) in the present study knew that "washing hands with soap and clean water before handling foods" is the best way to prevent foodborne disease (Table 7). Other foils used in this knowledge item included: rinsing hands under very hot water, wiping hands on a clean towel and none of these are important. About 5% of the respondents answered that washing hands with soap and clean water "after" handling food is as important as "before" handling foods (Appendix 10, Q9).

Hand washing, identified as a way of controlling the spread of infection, has been viewed as a possible method of reducing foodborne disease (CDC, 1985; Larson, 1984). Proper hand washing can effectively remove transient foodborne pathogens (Guthrie, 1972).

4.4.4.4 Cross-contamination

Results of the present study indicated that only half of Michigan school foodservice personnel (58.8%) knew that *Staphylococcus aureus* was most often introduced into potato salad from food handlers (Appendix 10, Q12) (Table 7). Cross-contamination is a major food safety concern that can, for the most part, be controlled by school foodservice personnel.

4.4.5 Statistical Analysis

Results of an analysis of variance (ANOVA) of safe food handling knowledge scores versus selected demographics of Michigan school foodservice personnel is shown in Table 8. Significant differences of scores were determined by an ANOVA ($p \leq .05$). Age was categorized into three groups: under 40 years of age, 41-50 years of age, and over 40 years. These values were selected as the dividing points because they allowed the population to be into three groups of the approximately same size. Work experience in the foodservice area was categorized into two groups: under 10 years and over 10 years. This value was selected as the dividing point because it was the median value, resulting in the development of two groups of equal size. Also, job title was categorized by the functions of the job into four groups: managers/supervisors, cooks, kitchen assistants, and others. A statistically significant difference in

Table 8. Analysis of variance (ANOVA) of mean knowledge scores of safe food handling vs. selected demographic characteristics of Michigan school foodservice personnel (n=597)[a] who responded to a mailed questionnaire on safe food handling in 1991.

Demographic Characteristics	No. of respondents	Knowledge score (Mean ± S.D.)	p value
Age			0.214
under 40 yrs	116	73.6% ± 14.8%	
41-50 yrs	170	75.3% ± 15.5%	
51-over 60 yrs	203	77.1% ± 16.4%	
Experience			0.376
over 10 yrs	163	75.9% ± 16.4%	
under 10 yrs	326	75.5% ± 15.4%	
Job title			0.025*
managers/ supervisors	135	79.1% ± 15.4%	
cook	151	74.6% ± 15.1%	
kitchen assist.	121	73.1% ± 16.3%	

* ($p \leq 0.05$) statistically significant.
a. (597/1400) * 100% = 42.6% response rate.
b. No higher interactions between/among two or more factors were important.

knowledge of safe food handling was found among school foodservice personnel with different job titles ($p \leq 0.05$). Respondents with the job titles of "manager" and "supervisor" had a significantly higher knowledge score (mean score = 79.1%) than did respondents with the job titles of "cook" (mean score = 74.6%), "kitchen assistant" (mean score = 73.1%), and "others" (mean score = 75.5%).

Results from this study indicated that cooks and cook assistants had significantly lower mean knowledge scores on safe food hadnling than did managers/supervisors. Cook and cook assistants prepare food for service to school children. Outbreaks of foodborne disease could occur in school foodservice operations because of unsafe handling of food by cooks or their assistants. Because of the lower mean knowledge scores on safe food handling, administrators of school foodservice personnel as well as school foodservice managers have the responsibility to provide training in safe food handling to cook and cook assistants.

Managers/supervisors probably had a higher knowledge score because they had higher education levels and more experience in the foodservice industry. In this study, more than 80% of cooks, kitchen assistants, and personnel with other job titles were high school graduates; only 68% of managers/supervisors were high school graduates. Burch and Sawyer (1991) reported that the manager's knowledge of safe food handling was significantly correlated with the actual

sanitation score of the food preparation area in a convenience store. If school foodservice operations are in any way similar to those of convenience stores, then managers' knowledge of safe food handling is important. Mandatory certification in foodservice sanitation should be recommended for managers of school foodservice facilities; a certified manager should be on duty during all school hours when food being prepared and served.

4.5 Conclusions

Based on findings from this research, specific constructs suggested for use in training are the maximum safe operating temperature for a refrigerator and identification of potentially hazardous foods (Table 9). Classroom teachers and other adults interacting with school children should consider use of school foodservice personnel especially managers/supervisors who had a higher mean knowledge score of safe food handling as an important resource for information about safe food handling. Professional societies such as the American School Foodservice Association should emphasize knowledge about safe food handling as a significant component in a professional education program.

Table 9. Recommendations related to education about safe food handling for Michigan school foodservice personnel.

Educational factors	Recommendations	Rationale
Construct/ objectives	A. Food temperature and storage: After a course on safe food handling taught by a food safety professional, school foodservice personnel would be able to identify the recommended operating temperature of refrigerator. B. Potentially hazardous foods: After receiving accurate information about safe food handling, school foodservice personnel would be able to accurately identify potentially hazardous foods.	1. Because only 68.8% respondents knew the recommended maximum temperature of an operating refrigerator (Table 7). 2. Because only 40.9% respondents can correctly identify four of six potentially hazardous foods (Table 7).

5.0 CONCLUSIONS AND RECOMMENDATIONS

As part of a larger food safety education assessment project in the state of Michigan, third-grade teachers (n=439) and school foodservice personnel (n=597) were surveyed to determine their safe food handling knowledge.

5.1 Conclusions

As a result of the present study, the following conclusions were drawn:

(1) Michigan third-grade teacher respondents could only correctly answer half the knowledge questions on safe food handling. Most of them (74%) had not previously received any formal training in safe food handling.

(2) Over three-fourths (80.8%) of the teachers reported that children almost never bring a cold pack from home to keep their lunch cold. About 40% (39.3%) of teachers believed that children almost never had an opportunity to wash vegetables/fruits before eating them.

(3) Constructs and specific learning objectives for safe food handling training programs for third-grade teachers were developed (Table 3.6).

(4) Teachers over 40 years of age were more knowledgeable about safe food handling than were teachers under 40 years of age. This difference in age/knowledge may be attributed to single generation of change. Younger teachers were more likely to have grown up during the (recent) era of convenience foods in their homes; they were less likely to have learned about meal preparation from their parents or significant adults in their household. Further, the study of food in schools since the 1960s has more often emphasized food choice (nutrition) than food preparation (safe food handling or home economics).

(5) Results indicated that Michigan school foodservice personnel could only correctly answer two-thirds of the eight knowledge questions (76%). This result was unexpected since 98% reported that they had received training in safe food handling.

(6) Constructs in which more knowledge on safe food handling is needed by Michigan school foodservice personnel and specific learning objectives are in Table 4.9.

(7) Michigan school foodservice personnel, especially cooks and kitchen assistants, should have more training in safe food handling because they had significantly lower scores than did their managers/supervisors.

(8) Teachers should consider involving school foodservice personnel when teaching safe food handling to children 9 to 11 years of age. Other school resources such as school foodservice production and service facilities could also be used by teachers for this purpose.

5.4 Recommendations for Future Research

The use of new food technologies such as cook/chill foodservice operations, aseptic canning, and controlled atmosphere packaging have resulted in the identification of new bacterial pathogens. Some of the newly emerging pathogens such as Listeria and Yersinia grow at temperatures used for refrigeration (35°-45°F). Teachers and school foodservice personnel should be retested and retrained on the implications of these emerging pathogens.

In this study, Michigan third-grade teachers were tested on their knowledge of safe food handling. Most teachers were knowledgeable about the methods of thawing frozen foods and personal hygiene, but they did not know the maximum temperature of an operating refrigerator. Further training related to safe food handling for third-grade teachers should focus on the topics in Table 3.6.
The knowledge on safe food handling of teachers in other grades also should be assessed. The resulting information could be used to determine constructs and learning objectives for the training of all school teachers.

Teachers need more opportunities to learn about safe food handling. Satellite conferences, in-service workshops, and graduate courses were by teacher as the methods they preferred to use for such learning. More training was also necessary for Michigan school foodservice personnel in the area of safe food handling. Development of training materials related to safe food handling for use in in-service workshops, and courses taught by the Michigan Department of Education and professional societies is necessary. Professional organizations to which Michigan school foodservice personnel belong should consider the topic of safe food handling (Table 4.9) when establishing criteria for certification programs.

In this study, safe food handling knowledge of school foodservice personnel were assessed about their safe food handling knowledge. Further research should focus on the evaluation of the sanitary quality of school foodservice operations as well as the safe food handling practices of school foodservice personnel.

APPENDICES

APPENDIX 1. REQUEST LETTER

APPENDIX 1. REQUEST LETTER

MICHIGAN STATE UNIVERSITY

DEPARTMENT OF FOOD SCIENCE AND HUMAN NUTRITION EAST LANSING • MICHIGAN • 48824-1224

February 21, 1991

Dear Principal:

Your assistance is requested in a study that will help clarify the relationships between children and foodborne illness.

We are three researchers at Michigan State University who are interested in the food practices of young children and their families, and how these may create susceptibility to foodborne illness. The occurance of foodborne illness is a growing problem in the U.S. As one outcome of this study, instructional materials will be developed for use with young children. Specifically, a computer hypermedia program on food safety will be developed which can be used by elementary school children.

Would you allow teachers in third grade classrooms to administer to children a short survey about their food preparation, food handling, and eating habits? A draft survey is enclosed for your review. The survey is intended to require only a few minutes of classroom time, and very little teacher assistance. Please be assured that surveys will only be identified by school; individual names of children or their families will not be requested. For their assistance, each teacher participant will receive a nutrition-related teaching resource. We also hope to learn about the food safety knowledge of adult populations in your school district, including third grade teachers, parents of third grade students and food service personnel.

Findings from the study will be available to you upon request. As a school administrator, you might be interested to know how many meals children are preparing for themselves, their "typical" meals, and what they know about proper food handling. Such nutrition-related information is of growing concern to school personnel. Current research is showing a clear link between proper nutrition, intellectual growth, and achievement of young children.

While we appreciate the constraints of accessing school children as part of research projects, we hope your school district is open to assisting us in this way. Please return the enclosed card before March 1, 1991, and we will forward to you the requested number of copies of the survey. An informational

letter describing this study has been forwarded to your school district superintendent and the local area coordinator for the Michigan Model for Comprehensive School Health Education.

Thank you again for your interest and assistance.

Sincerely,

June Youatt, Ph.D.*
Associate Professor
Family and Child Ecology
1-800-327-4691

Carol Sawyer, Ph.D., R.D.
Associate Professor
Food Science and Human Nutrition

Sandra Andrews, Ph.D., R.D.
Assistant Professor
Food Science and Human Nutrition

*Contact person

Enclosures: Postcard for Reply
Child Survey

APPENDIX 2. REPLY CARD

APPENDIX 2. REPLY CARD

Michigan State University
Carol Sawyer, Ph.D.
Department of Food Science
and Human Nutrition
East Lansing, Michigan 48824

Contact Person _____

School Name _____

Address _____

Check All That Apply:

☐ Our third grade teachers are willing to assist. Send ____ copies of the survey.

☐ Our school is also willing to collect similar data from parents, teachers and food service personnel.

☐ Our school is unable to assist you.

Thank you.

Please return this card no later than March 1, 1991.

APPENDIX 3. QUESTIONNAIRE FOR THIRD-GRADE TEACHERS

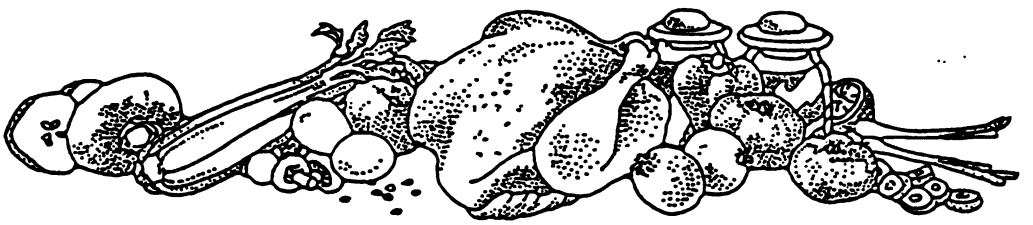
APPENDIX 3. QUESTIONNAIRE FOR THIRD-GRADE TEACHERS

MICHIGAN STATE UNIVERSITY

FOOD HANDLING STUDY

to improve the health of our Michigan children

QUESTIONS FOR TEACHERS



Dear Third Grade Teacher:

This study is designed to learn about your beliefs, knowledge and practices related to food handling. Food handling refers to the things typically done when storing, preparing, cooking, and/or serving food. Information learned from this study will be used to educate Michigan children about safe food handling.

Please note:

1. The questionnaire will take about ten minutes to complete.
2. Answers are confidential.
3. Your name is <u>not</u> required.

You indicate your voluntary agreement to participate by completing and returning this questionnaire. You may decline to answer any of the questions.

Thank you in advance for your participation.

Department of Food Science and Human Nutrition
Michigan State University
East Lansing, MI 48824
517/353-9663

QUESTIONS FOR THIRD GRADE TEACHERS

1. You do many important things to keep yourself healthy. Compared to most of the things you do to maintain your health, how important is **safe food handling**? (Check one)

13.0% Safe food handling is the most important thing I do.

79.2% Safe food handling is as important as most things I do.

6.2% Safe food handling is less important than most things I do.

0% Safe food handling is not important.

0.7% I am not familiar with methods of safe food handling.

2. During the past year, from what **sources** have you received information on food handling? (Check all that apply)

Q2.	Q3.	
23.3%	14.8%	Co-operative Extension Service (CES)
40.4%	1.8%	Family and friends
11.6%	6.2%	Government pamphlets
11.6%	2.1%	Local school district
66.0%	23.5%	Newspapers, consumer magazines
39.5%	11.4%	National/Michigan Dairy Council
8.2%	2.3%	Professional journals
7.3%	2.3%	Professional or job related meeting
5.9%	2.5%	Other. Please specify: Michigan Model materials, books, TV, videotape, classes taken in college.
16.9%		I have not received information on food handling. (Go to question 5)

3. Of your choices in question number 2 above, please circle the source of information that you believe provides the most **accurate** information on food handling. (Circle one choice in question 2 above).

4. Describe the most beneficial **formal training** in food handling that you received during the past 12 months (April 1, 1990 to March 31, 1991). (Check A or B below and fill in the blank if applicable)

5.7% A. Topic/Name of Training Session_____

_____

Length of training_____ hrs or _____ days

Location_____

Presenter (Sponsoring agency)_____

_____

Date _____

74.0% B. I have not received any formal training in food handling.

5. How many children are in your third grade classroom? _____

6. Do you teach with **computer(s)** in your third grade classroom? (Check one)

79.2% Yes 19.9% No (Please go to question 10)

7. Children in my classroom have a computer(s) available to them during school hours: (Check all that apply)

68.6% in my classroom. 7.7% in another classroom.

22.1% in a laboratory. 13.4% in a library.

0.6% in another building.

4.7% other. Please specify: _____

8. The **brand(s)** of computer available to children in your third grade classroom during school hours is(are): (Check all that apply)

74.8% Apple.

7.5% IBM.

2.2% IBM compatible (Tandy, CompuAdd, Zenith).

12.7% Other. Please specify:_____

9. When using computers for instruction with your third grade students, what is the usual **ratio** of computers to children? (Fill in two blanks)

   There is (are)_____ computer(s) for _____ children
   (number of computers) (number of children)
   in my third grade classroom.

10. Have you taught any safe food handling concepts to the third grade children in your classroom during the past school year? (Check one)

    53.4% Yes 46.6% No (Please go directly to the question 14)

11. If you answered yes to question 10, which of the following methods did you use to teach safe food handling? (Check all that apply)

1.4%	Computer	20.9%	Presentation/lecture
43.8%	Discussion	36.4%	Michigan Model materials
2.7%	Games	1.6%	Field trips/site visits
8.9%	Written exercise		
5.0%	Other.Please specify: TV, vediotape		

12. Please circle the method in question 11 that has worked best for your class. (Circle one choice in question 11)

13. Please describe below any **instructional materials** on safe food handling that you have found useful with the third grade children in your classroom. (Please fill the blanks below or go directly to question 14)

    Title_____

    Author_____

    Publisher and address_____

    _____

    Year_____ Price $_____

14. To keep fresh, raw ground beef safe to eat, the best place to store it overnight is (Check one)

0% in a cupboard. 0% in a kitchen sink.

99.3% in a refrigerator. 0% on the top of a kitchen counter.

0% all of these choices are OK.

15. The best place to safely **thaw** frozen, raw ground beef is (Check one)

0% in a cupboard.

1.4% in a kitchen sink (without water).

95.4% in a refrigerator.

0.7% on the top of a kitchen counter.

0.2% all of these choices are OK.

16. On which of the following foods are bacteria (germs) able to grow? (Check all that apply)

86.6% baked potato 96.6% chicken breast

40.2% corn oil 91.6% glass of skim milk

91.8% refried bean 19.6% white vinegar

17. Which of the following activities is the best way to **prevent** getting sick from bacteria and viruses (germs) in food? (Check one)

1.4% rinsing hands under very hot water before handling raw chicken

90.0% washing hands with soap and clean water before handling raw chicken

0.7% Wiping hands on a clean towel before handling raw chicken

4.3% none of these are important

18. A unopened carton of milk is stored in a refrigerator overnight. The **highest safe temperature** of the refrigerator would be (Check one and fill in the temperature if required)

39.3% The temperature would be 40-45^{0}F (or _____^{0}C).

I do not know the temperature.

19. *Staphylococcus aureus*, a potentially harmful bacteria, is most often introduced into potato salad from (Check one)

39.5% people who handle the potatoes.

0.5% diseased potatoes.

1.8% soil and dust on the potatoes.

12.3% all of these choices are OK.

38.8% none of these choices.

20. You usually can tell when a food such as ham has bacteria (germs) that could make you sick by how it looks, smells or tastes. (Check one)

51.6% true 46.6% false

21. When refrigerating leftover stew, which container will best limit the growth of harmful bacteria (germs)? (Check one)

14.4% a shallow container such as an uncovered cake pan (2 inches deep)
7.5% a deep container such as an uncovered, eight-quart pot (12 inches deep)
74.2% the depth of container is not important

22. Below are some things that kids do. Do you **believe** that the children in your third grade classroom do these things almost always? sometimes? almost never? (For each question, please circle the one answer you **believe** is right)

a. How often do the children bring a cold pack from home to keep their lunch cold?	almost always 0.9%	sometimes 17.6%	almost never 80.8%
b. Is an opportunity provided for the children to wash their hands before eating a snack?	almost always 61.9%	sometimes 26.3%	almost never 10.7%
c. Is an opportunity provided for the children to wash their hands before eating lunch?	almost always 74.0%	sometimes 16.4%	almost never 8.7%
d. Is an opportunity provided for the children to wash their hands after using the toilet?	almost always 99.7%	sometimes 0.7%	almost never 0.2%
e. How often do children bring to school and eat food that is spoiled or bad?	almost always 0.5%	sometimes 7.8%	almost never 81.3%
f. Is an opportunity provided in the classroom for the children to wash fruits and /or vegetables before eating them?	almost always 42.2%	sometimes 12.3%	almost never 39.3%

23. Guidelines on safe food handling are provided for parents (other householders) who bring food to school for parties or snacks. (Check one)

5.7% Yes 92.9% No (Please go directly to question 24)

If you answered yes to the question above, please enclose, if conveniently available, a copy of the guidelines on safe food handling for parents.

24. Please tell us your job title. (Fill in the blank below)

_____

25. How many years has you been in this job? (Fill in the blank)

_____ years

26. What is your gender (sex)? 89.7% female 9.4% male

27. What is your age? (Fill in the blank) _____ yrs.

28. During a typical week, how many meals are made in your household? (Write in number of meals)

_____ meals per week are made in my household.
(number)

29. Of the meals made in your household during a typical week, how many do you personally prepare? (Write in number of meals)

I typically make _____ meals per week.
(number)

30. For how many **generations** have your mother's ancestors been in the US? (Check one)

0.9% newly immigrated (you were born outside of the US)

3.7% one generation (your mother was born outside of the US)

21.7% two generations (your mother's mother was born outside of the US)

70.1% more than two generations

2.3% I am not sure.

0% a visitor to the US (for example, an ex-change student)

31. The following question is **optional**. What is your main family background? The reason for this question is that we would like to learn about the special food handling practices of the various ethnic groups in Michigan. (Check all that apply)

2.1% African-American (Black)

0.2% Arab/Chaldean

0% Asian/Pacific Islander

_____ Asian Indian	_____ Chinese
_____ Filipi	_____ Japanese
_____ Hmong	_____ Laotian
_____ Vietnamese	

0% Hispanic (Latino)

_____ Central America	_____ Cuban
_____ Mexican	_____ PuertoRican
_____ South American	

0% Native American (American Indian) or Alaskan Native

92.7% White, non-hispanic

If none of the above adequately describes your ethnic heritage, please write it in here.

_____

32. Please describe your **residential setting**. (Check one)

8.2% farm

35.8% town under 10,000 people or rural non-farm

25.6% town or city of over 10,000 to 50,000 people

17.8% suburb of city over 50,000 people

10.0% city of over 50,000 people or more

33. Please describe the setting of your **school district**. (Check one)

7.8% farm

35.6% town under 10,000 people or rural non-farm

25.1% town or city of over 10,000 to 50,000 people

15.1% suburb of city over 50,000 people

10.0% city of over 50,000 people or more

34. What is the **highest** academic degree you have achieved? (Check one)

43.6% Bachelor's degree

53.2% Master's degree

0.7% Ph.D. or equivalent
0.5% Professional degree. Please specify: _____

0.7% Other. Please specify_____

35. The following question is **optional**. In what range is your annual **householdincome**? (Check one)

0%	less than $10,000	3.2%	$80,001 to $90,000
0.2%	$10,001 to $20,000	2.7%	$90,001 to $100,000
4.3%	$20,001 to $30,000	1.8%	$100,001 to $110,000
11.4%	$30,001 to $40,000	0.5%	$110,001 to $120,000
11.4%	$40,001 to $50,000	0.2%	$120,001 to $130,000
10.7%	$50,001 to $60,000	0.2%	$130,001 to 140,000
8.0%	$60,001 to $70,000	0.2%	$140,001 to 150,000
12.6%	$70,001 to $80,000	0.5%	$150,001 or greater
_____	I do not wish to say or I do not know.		

We would like to hear your comments. Please write any additional comments in the space provided below.

THANK YOU FOR PARTICIPATION IN THE MSU FOOD HANDLING STUDY.

Please return questionnaires to:
Carol A. Sawyer, Ph.D., R.D.
Dept. of Food Science and Human Nutrition
Michigan State University
East Lansing, MI 48824
If you have any questions about this study, please call Dr. Sawyer at 517/353-9663.

APPENDIX 4. COVER LETTER TO THIRD-GRADE TEACHERS

APPENDIX 4. COVER LETTER TO THIRD-GRADE TEACHERS

FOOD HANDLING STUDY
to improve the health of our Michigan children

COVER LETTER

April 16, 1991

Your box contains the questionnaires from the MSU Food Handling Study. These were requested by your school. The purpose of this study is to help to determine beliefs and knowledge of food handling of third grade students.

The inventory sheet attached to this cover letter indicates the number of questionnaires enclosed. Please check the contents of your box against the inventory sheet to make sure you have received all of the materials your school requested.

A sheet of directions entitled Directions for Assisting Students with the Food and You Survey has also been enclosed. The sheet of directions explains how to administer the survey to third grade students.

Please feel free to duplicate the questionnaires.

If possible, please return the questionnaires to MSU by May 20, 1991. The enclosed self-addressed mailing label and stamps are for your use when returning the questionnaires to MSU.

If you have any questions about the contents of your box, or about the procedure for distributing and collecting questionnaires, we do want to know. Please call us at 517/336-2295.

The return address is:

Carol Sawyer
Department of Food Science and Human Nutrition
139 Food Science Building
Michigan State University
East Lansing, MI 48824

Thank you for your assistance.

APPENDIX 5. INVENTORY SHEET SENT TO CONTACT PERSON AT EACH SCHOOL

APPENDIX 5. INVENTORY SHEET SENT TO CONTACT PERSON AT EACH SCHOOL

MSU FOOD HANDLING STUDY

to improve the health of our Michigan children

RETURN SHEET

DIRECTIONS:

Complete and return this sheet with your questionnaires.

1. Fill in information for the contact person who distributed and collected the questionnaires.
2. Write in the table below the quantity of questionnaires returned.

CONTACT PERSON _____

SCHOOL NAME _____

ADDRESS _____

_____ ZIP CODE_____

SCHOOL DISTRICT _____

COUNTY _____ DATE RETURNED_____

PHONE NUMBER (DAY) ___(____)_____-_____

TYPE	QUANTITY OF QUESTIONNAIRES		NUMBERS ON THE QUESTIONNAIRES* SENT TO SCHOOL	
	SENT	RETURNED	BEGIN	END
1. Student Questionnaire	_____	_____	S_____	S_____
2. Foodservice Personnel Questionnaire	_____	_____	F_____	F_____
3. Household Questionnaire	_____	_____	H_____	H_____
4. Third Grade Teacher Questionnaire	_____	_____	T_____	T_____

*F=Foodservice Personnel Questionnaire H=Household Questionnaire
T=Third Grade Teacher Questionnaire S=Student Questionnaire

Please return all available questionnaires by May 20, 1991.

THANK YOU

APPENDIX 6. DIRECTION SHEET

APPENDIX 6. DIRECTION SHEET

FOR THIRD GRADE TEACHER

MSU FOOD HANDLING STUDY

to improve the health of our Michigan children

DIRECTIONS FOR ASSISTING STUDENTS WITH THE FOOD AND YOU QUESTIONNAIRE

1. The student questionnaire, entitled **Food and You** should be completed in class. The University Committee on Research with Human Subjects requires, however, that we provide to you some language to read to students who may choose not to complete this questionnaire. "You may choose to answer some or all of the questions on this questionnaire. If you choose not to do the questionnaire, please draw your favorite food and write two sentences that explain why it is your favorite food."

2. Since the questionnaire asks students to recall typical "school week" behaviors, please administer the questionnaire on Tuesday, Wednesday, Thursday, or Friday. Please DO NOT have students complete the questionnaire on Monday.

3. Since the questionnaire asks students to recall what they ate for lunch, if possible, please administer the questionnaire in the afternoon.

4. Please encourage students to read all the responses before choosing one. For each multiple choice question, have students mark the box in whatever way they are used to doing so in your classroom -- with an "x", darkening the entire box, etc. You will want to note that for all questions except #3 students should select only one answer.

5. Question 4 on the questionnaire asks students to identify their family background. This refers to their race or ethnic heritage. This is always an optional question, but we hope to learn the food ways of various cultures. If students do not identify with any of the provided choices, they may write in their own identification (Puerto Rican, Lebanese, etc.)

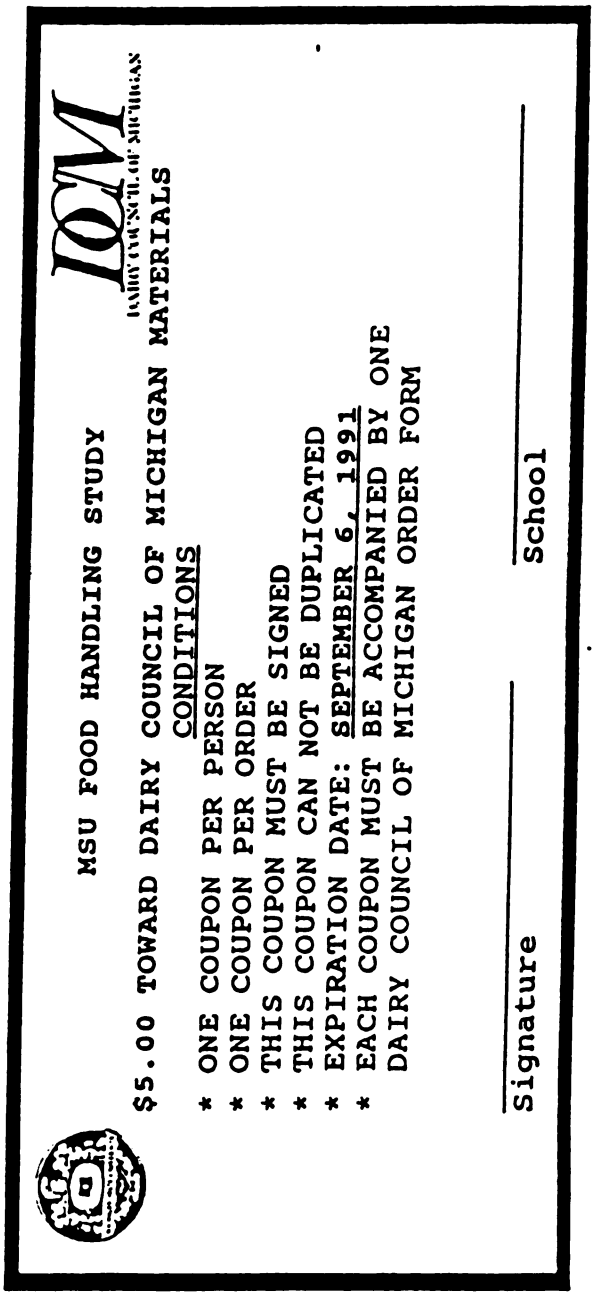
6. Students are encouraged to use their own spelling. Don't worry if their spelling is unconventional.

7. If you are sending home household questionnaires, please make sure the household number corresponds to the student number. For example, if Nancy Smith has questionnaire S-1 (Student-1), please make sure you send home to the Smith household questionnaire H-1 (Household-1). No attempt will be made to identify the respondents, but we do need to correlate the student questionnaire to the household questionnaire. A " TEACHER WORKSHEET" is included to assist you in keeping track. DO NOT return the worksheet to us.

Carol A. Sawyer, Ph.D., R.D.
Department of Food Science and Human Nutrition
Michigan State University
East Lansing, MI 48824
517/ 336-2295

APPENDIX 7. GIFT-CERTIFICATE FOR THIRD-GRADE TEACHERS

APPENDIX 7. GIFT-CERTIFICATE FOR THIRD-GRADE TEACHERS



MSU FOOD HANDLING STUDY

DAIRY COUNCIL OF MICHIGAN MATERIALS

$5.00 TOWARD DAIRY COUNCIL OF MICHIGAN MATERIALS

CONDITIONS

* ONE COUPON PER PERSON
* ONE COUPON PER ORDER
* THIS COUPON MUST BE SIGNED
* THIS COUPON CAN NOT BE DUPLICATED
* EXPIRATION DATE: SEPTEMBER 6, 1991
* EACH COUPON MUST BE ACCOMPANIED BY ONE DAIRY COUNCIL OF MICHIGAN ORDER FORM

Signature _____ School _____

APPENDIX 8. THANK YOU LETTER TO THIRD-GRADE TEACHERS

APPENDIX 8. THANK YOU LETTER TO THIRD-GRADE TEACHERS

DAIRY COUNCIL OF MICHIGAN

(517) 349-8480 2163 Jolly Road Okemos, Michigan 48864 1-800-5-MI-MILK

July 25, 1991

Dear Ms. Purvis:

Thank you for your participation in the MSU Food Handling Study. As researchers we are anxious to learn about the food handling practices of Michigan children and their families and to explore ways to keep our children healthy!

In appreciation for your assistance, the Michigan Dairy Council and the MSU Food Handling Project would like to provide a nutrition education-related teaching resource to each classroom teacher whose students participated in this study. Enclosed is a $5.00 coupon for each teacher toward any Dairy Council material. Each coupon must be returned to the Dairy Council with an order blank before September 6, 1991.

You may want to consider the Super You series of materials in the Dairy Council Catalog (enclosed). These materials emphasize nutrition and fitness, and were developed for children 9-11 years old. Super You includes a Parent/Leader guide ($2.00), a children's workbook ($.60), a poster ($.40), and stickers ($.60).

The enclosed certificate is also to thank the participants of your school for their help. Your assistance has made a significant contribution to our understanding of children and food safety.

Sincerely,

Sandra Andrews, R.D., Ph.D.
Food Science and Human Nutrition
Michigan State University

June Pierce Youatt, Ph.D.
Family and Child Ecology
Michigan State University

Carol Sawyer, R.D., Ph.D.
Food Science and Human Nutrition
Michigan State University

Grace Tasker, Ph.D.
Executive Director
Dairy Council of Michigan

Enclosures: 3

APPENDIX 9. LOCATIONS AND BRANDS OF COMPUTERS AVAILABLE IN THIRD-GRADE CLASSROOM

APPENDIX 9. LOCATIONS AND BRANDS OF COMPUTERS AVAILABLE IN THIRD-GRADE CLASSROOM

The brands and locations of computers available in third-grade classroom

Items	% of respondents
Brand of computer	
Apple	74.8
IBM	7.5
IBM compatible	2.2
Other	12.8
Location of computer	
Third-grade classroom	68.8
Another classroom	7.7
Laboratory	22.1
Library	13.4
Another building	0.6
Other	4.7

APPENDIX 10. QUESTIONNAIRE FOR SCHOOL FOODSERVICE PERSONNEL

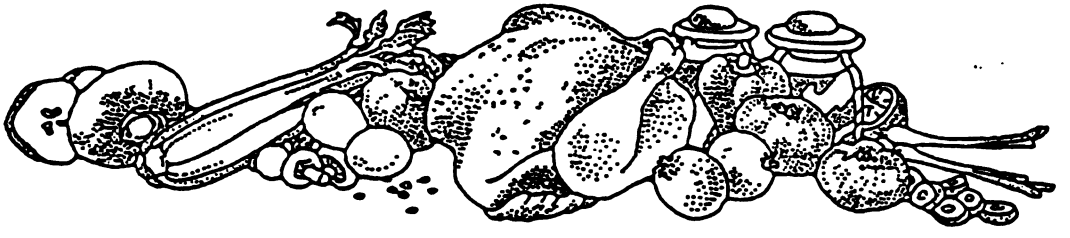
APPENDIX 10. QUESTIONNAIRE FOR SCHOOL FOODSERVICE PERSONNEL

MICHIGAN STATE UNIVERSITY

FOOD HANDLING STUDY

to improve the health of our Michigan children

QUESTIONS FOR FOODSERVICE PERSONNEL



Dear Foodservice Employee:

This study is designed to learn about your beliefs, knowledge and practices related to food handling. Food handling refers to the things typically done when storing, preparing, cooking, and/or serving food. Information learned from this study will be used to educate Michigan children about safe food handling.

Please note:

1. The questionnaire will take about ten minutes to complete.
2. Answers are confidential.
3. Your name is <u>not</u> required.

You indicate your voluntary agreement to participate by completing and returning this questionnaire. You may decline to answer any of the questions.

Thank you in advance for your participation.

Department of Food Science and Human Nutrition
Michigan State University
East Lansing, MI 48824
517/353-9663

QUESTIONS FOR FOODSERVICE PERSONNEL

1. You do many important things to keep yourself healthy. Compared to most of the things you do to maintain your health, how important is **safe food handling**? (Check one)

   64.2% Safe food handling is the most important thing I do.

   35.0% Safe food handling is as important as most things I do.

   0% Safe food handling is less important than most things I do.

   0% Safe food handling is not important.

   0% I am not familiar with methods of safe food handling.

2. During the past year, from what **sources** have you received information on food handling? (Check all that apply)

Q2	Q3	
24.1%	7.0%	Co-operative Extension Service (CES)
16.8%	0.2%	Family and friends
38.7%	9.5%	Government pamphlets
47.9%	4.5%	Local school district
45.4%	1.8%	Newspapers, consumer magazines
21.9%	2.0%	National/Michigan Dairy Council
42.0%	9.2%	Professional journals
71.0%	32.0%	Professional or job related meeting
22.4%	13.1%	Other. Please specify: Classes taken in college, work experience.
2.8%		I have not received information on food handling. (Go to question 6)

3. Of your choices in question number 2, please circle the source of information that you believe provides the most **accurate** information on food handling. (Circle one choice in question 2 above).

4. What kind of training have you received during the past 6 school years (1985-1991)? Did you pass the test at the end of the training? (Check all that apply)

Name of Course	Agency or Association Sponsor	Year Taken	Pass The Test
Applied Foodservice Sanitation (NIFI)	National Restaurant Association	19____	14.4% Yes ____No
Basics of School Foodservice 100	Michigan Department of Education	19____	72.9% Yes ____No
Sanitation and Safety	American School Foodservice Association	19____	47.7% Yes ____No
Sanitation and Safety 120	Michigan Department of Education	19____	62.6% Yes ____No
Other. Please specify		19____	18.4% Yes ____No

5. Describe any <u>interaction</u> on food handling you may have had with third grade children in your school(s). (Check all that apply)

5.7% Talk to students in a classroom setting

37.3% Conversation with children in the lunch room

11.3% Give children tours of the school foodservice facility

43.2% None

5.3% Other. Please specify: cook for children, plan menu for children.

_____ I would like an opportunity to work in this area.

6. To keep fresh, raw ground beef safe to eat, the best place to <u>store</u> it overnight is (Check one)

0% in a cupboard.

0% in a kitchen sink.

98.8% in a refrigerator.

0.5% on the top of a kitchen counter.

0% all of these choices are OK.

7. The best place to safely <u>thaw</u> frozen, raw ground beef is: (Check one)

   0.8% in a cupboard.

   98.0% in a kitchen sink (without water).

   0.2% in a refrigerator.

   0% on the top of a kitchen counter.

   0% all of these choices are OK.

8. On which of the following foods are bacteria (germs) able to grow? (Check all that apply)

76.9% baked potato	98.8% chicken breast
30.2% corn oil	85.4% glass of skim milk
81.8% refried beans	16.3% white vinegar

9. Which of the following activities is the best way to <u>prevent</u> getting sick from bacteria and viruses (germs) in food? (Check one)

   0% rinsing hands under very hot water before handling raw chicken

   91.0% washing hands with soap and clean water before handling raw chicken

   0.2% wiping hands on a clean towel before handling raw chicken

   0% none of these are important

10. A unopened carton of milk is stored in a refrigerator overnight. The <u>highest safe temperature</u> of the refrigerator would be: (Check one and fill the temperature if required)

    68.9% The temperature would be 40-45^{0}F (or _____^{0}C).

    5.5% I do not know the temperature.

11. *Staphylococcus aureus*, a potentially harmful bacteria, is most often introduced into potato salad from (Check one)

    58.8% people who handle the potatoes.

    1.3% diseased potatoes.

    1.0% soil and dust on the potatoes.

    7.5% all of these choices are OK.

    23.3% none of these choices.

12. You usually can tell when a food such as ham has bacteria (germs) that could make you sick by how it looks, smells or tastes. (Check one)

    44.9% true 53.9% false

13. When refrigerating leftover stew, which container will best limit the growth of harmful bacteria (germs)? (Check one)

70.7% a shallow container such as an uncovered cake pan (2 inches deep)

3.7% a deep container such as an uncovered eight-quart soup pot (12 inches deep)

22.6% the depth of container is not important

14. Below are some things that kids do. Do you **believe** that the children in your school do these things almost always? sometimes? almost never? (For each question, please circle the one answer you **believe** is right)

a. How often do the children bring a cold pack from home to keep their lunch cold?	almost always 1.3%	sometimes 22.8%	almost never 69.4%
b. Is an opportunity provided for the children to wash their hands before eating lunch?	almost always 51.5%	sometimes 21.9%	almost never 18.0%
c. How often do children bring to school and eat food that is spoiled or bad?	almost always 0.2%	sometimes 26.4%	almost never 52.4%

15. In what types of facility do you primarily work? (Check all that apply)

46.0% Elementary school.

34.9% Middle school.

46.9% High schol.

14.2% Commissary kitchen for school district.

8.4% Other. Please specify _____

16. Please tell us your job title. (Fill in the blank below)

_____

17. How many years have you been in this job? (Fill in the blank _____ years

18. What are your main job functions? (Check all that apply)

_____ Management	_____ Dishwashing
_____ Supervision	_____ Bake/cook foods
_____ Prepare salad/sandwich fixings	_____ Reheat prepared foods

_____ Other. Please specify. _____

19. What is your gender (sex)? 97.2% female 1.5% male

20. What is your age? (Fill in the blank) _____ yrs.

21. For how many **generations** have your mother's ancestors been in the US? (Check one)

2.0% newly immigrated (you were born outside of the US)

3.7% one generation (your mother was born outside of the US)

16.4% two generations (your mother's mother was born outside of the US)

69.3% more than two generations

5.5% I am not sure.

0% a visitor to the US (for example, an ex-change student)

22. The following question is **optional**. What is your main family **background**? The reason for this question is that we would like to learn about the special food handling practices of the various ethnic groups in Michigan. (Check all that apply)

1.8% African-American (Black)

0% Arab/Chaldean

0% Asian/Pacific Islander

_____ Asian Indian	_____ Chinese
_____ Filipino	_____ Japanese
_____ Hmong	_____ Laotian
_____ Vietnamese	

0.7% Hispanic (Latino)

_____ Central American	_____ Cuban
_____ Mexican	_____ Puerto Rican
_____ South American	

2.0% Native American (American Indian) or Alaskan Native

90.6% White, non-hispanic

If none of the above adequately describes your ethnic heritage, please write it in here.

_____

23. Please describe your **residential setting**. (Check one)

12.9% farm
39.5% town under 10,000 people or rural non-farm
21.1% town or city of over 10,000 to 50,000 people
13.1% suburb of city over 50,000 people
8.7% city of over 50,000 people or more

24. What is the **highest** academic degree you have achieved? (Check one)

0.3% Some grade school
0.5% 8th grade
5.0% Some high school
79.5% High school or GE
6.5% Associate degree (community college or university)
3.0% Bachelor's degree or higher
4.2% Other. Please specify: some years in college, vocational training in foods, Master's degree.

25. The following question is **optional**. In what range is your annual household **income**? (Check one)

5.7%	less that $10,000	0.3%	$80,001 to $90,000
11.2%	$10,001 to $20,000	0.5%	$90,001 to $100,000
13.1%	$20,001 to $30,000	0.2%	$100,001 to $110,000
15.6%	$30,001 to $40,000	0.3%	$110,001 to $120,000
12.9%	$40,001 to $50,000	0%	$120,001 to $130,000
6.5%	$50,001 to $60,000	0%	$130,001 to $140,000
3.2%	$60,001 to $70,000	0%	$140,001 to $150,000
1.0%	$70,001 to $80,000	0%	$150,001 or more
16.2%	I do not wish to say or I do not know.		

We would like to hear your comments. Please write any additional comments in the space provided below.

THANK YOU FOR PARTICIPATION IN THE MSU FOOD HANDLING STUDY.

Please return questionnaires to:
Carol A. Sawyer, Ph.D., R.D.
Dept. of Food Science and Human Nutrition
Michigan State University
East Lansing, MI 48824

If you have any questions about this study, please call Dr. Sawyer at 517/353-9663.

APPENDIX 11. COVER LETTER TO SCHOOL FOODSERVICE PERSONNEL

APPENDIX 11. COVER LETTER TO SCHOOL FOODSERVICE PERSONNEL

MICHIGAN STATE UNIVERSITY

DEPARTMENT OF FOOD SCIENCE AND HUMAN NUTRITION
EAST LANSING • MICHIGAN • 48824-1224

(517) 353-8474
FAX: (517) 353-8963

November 18, 1991

Dear :

Your assistance is requested to participate in a Michigan State University study. The study is intended to determine the attitudes, beliefs and knowledge about safe food handling of school foodservice personnel in the state of Michigan.

The occurrence of foodborne illness is a continuing problem in the United States. As the number of cases increase annually, identifying problems leading to foodborne illness becomes critical. To aid in the identification of these problems, food handling practices of food handlers need to be identified.

This MSU Safe Food Handling Project has received the assistance of the Michigan Department of Education (MDE). Your name has been provided to us by MDE, as an employee of a school foodservice organization. To acquire a true picture of food handling practices in school foodservice operations throughout Michigan, you are asked to individually complete a questionnaire. A copy of the questionnaire is enclosed. Please fill out the questionnaire completely and return it in the enclosed, addressed, stamped, envelope by November 27.

The questionnaire will take approximately 15 minutes to complete. Participation is completely voluntary. All of the answers to questions on the survey are confidential. Names are not required on the survey. However, completing and returning the questionnaire would provide information which will be used to help improve the understanding of food handling practices in Michigan schools.

If you have any questions regarding this study at any time, please call Carol Sawyer at MSU (517/353-9663). The return address for the questionnaire is below. Thank you in advance for your assistance.

Sincerely,

Carol Sawyer

Carol Sawyer, Ph.D., R.D.
Associate Professor
139 Food Science Building
Michigan State University
East Lansing, MI 48824-1224

Enclosures: One questionnaire
Addressed, stamped envelope

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List of References

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