

Food Safety Knowledge, Practices, and Educational Needs of Students in Grades 3 to 10

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ABSTRACT

One of the 2000 Priority Research Needs identified by the Food and Drug Administration/Center for Food Safety and Applied Nutrition was to “determine the population trends with respect to food safety knowledge, attitudes, and practices, especially behaviors that may be significant risk factors for foodborne illness (e.g., food consumption, in-home food preparation, and handling)” (Buchanan, 2000). Results from a study of safe food-handling knowledge and practices of 4th- and 5th-grade students in west-central Illinois indicated a need to expand the investigation into their food safety knowledge and practices (Barclay, Greathouse, Swisher, & Cale, 2001). This research examined food safety-handling practices, barriers to safe food practices, and food safety knowledge of 3rd- through 10th-grade students in west-central Illinois.

Two questionnaires were developed for data collection, one for 3rd- and 4th-grade students and one for 5th- through 10th-grade students. Questionnaires were completed and returned by 1,368 students. The Statistical Package for Social Sciences (SPSS), version 10.0 was used for data analysis. Analysis of Variance (ANOVA) was used to determine significant differences (≤ 0.05) in knowledge and practices based on gender and grade.

Food safety practices and knowledge did not improve with grade level. Less than 10% of the students knew: (1) which sources of food were most unsafe; (2) the most common source of botulism; and (3) the most common source of *staphylococcus*. More than 50% of the 5th- through 10th-grade students knew: (1) the correct actions to take after cutting raw meat; (2) the most common source of *salmonella*; and (3) the best choice for a brown bag lunch.

Using gender comparisons, boys appeared less concerned about food safety practices than did girls. Barriers to implementing safe food-handling practices included a lack of information about what practices were unsafe, previous experience by the student with unsafe practices and not getting sick, and observations of family and friends practicing unsafe handling of food and not getting sick. Results of this research indicate a need for food safety educational materials for elementary grades. Food safety information should be reinforced during students' progression through the educational system.

INTRODUCTION

One of the 2000 Priority Research Needs identified by the Food and Drug Administration (FDA)/Center for Food Safety and Applied Nutrition (CFSAN) was to “determine the population

trends with respect to food safety knowledge, attitudes, and practices, especially behaviors that may be significant risk factors for foodborne illness (e.g., food consumption, in-home food preparation, and handling)” (Buchanan, 2000). Results from the 2000 Home Food Safety Study by Audits International revealed that 40% of all food safety errors were attributed to lack of education, another 40% were due to lack of conscious awareness, and the remaining 20% were due to lack of motivation (Daniels, Daniels, Gilmet, & Noonan, 2001).

Very few studies have been conducted on safe food-handling knowledge or practices of youth. In Kansas, a study of 80 9- to 12-year-olds involved in 4-H programs or after-school programs found that 86% of the children reported preparing meals, with 70 percent of those children knowing the meaning of "food safety." However, the majority did not know about foodborne illnesses (59%), cross-contamination (85%), internal temperatures (75%), and proper thermometer usage (70%), and only 45% of them consistently washed their hands before starting food preparation (Bryant & Barrett, 2000).

A study of 305 Detroit schoolchildren, as reported by Reuters News Media, provides an example of the significance of proper handwashing in the reduction of illnesses. Dr. Susan Longe and the teachers under her supervision found that youngsters who washed their hands four times a day at school (on arrival, before lunch, after recess, and before leaving for the day) had 24% fewer sick days due to respiratory illness and 51% fewer days lost because of stomach-related illnesses (FDA/CFSAN, 1998).

Because many parents work outside of the home, 70% of households have no adult supervision of children during the day. It is estimated that more than 50% of the children in these homes shop and prepare their own food (Goldman, 1990), and 65% of teenagers reported going to the supermarket on their own at least once a week (Anonymous, 1990). Such findings conclude that many children may grow into adulthood without learning the basic principles of safe food preparation (Williamson, Gravani, & Lawless, 1992).

It also should be noted that older children’s food safety practices and knowledge are important in preparation of their own food, as well as that of others for whom they may care and prepare food; this could include younger siblings, other children, grandparents, or other adults. Younger children learn by observation of others, and this could lead to the transferal of safe or unsafe food-handling practices and knowledge.

In a previous study of the food-handling practices and food safety knowledge of 4th- and 5th-grade students in west-central Illinois, a need for education in safe food handling in the primary grades was identified (Barclay et al., 2001). These results warranted further research to investigate food-handling practices and food safety knowledge of 3rd- through 10th-grade students in west-central Illinois. This study focused on three main objectives:

- Investigate the safe food-handling practices and barriers to safe food practices of 3rd- and 4th-grade students;
- Investigate the food safety practices and barriers to safe food-handling practices, as well as food safety knowledge, of students in grades 5 to 10; and
- To identify the educational needs of students in the grades under investigation.

METHODOLOGY

This research was conducted with students in grades 3 to 10 who attended schools in west-central Illinois. Two versions of a questionnaire were developed for use in this study to address the differences in reading and comprehension of students in grades 3 and 4 and students in grades 5 to 10.

Questionnaires and an informed consent form for parental signature both were reviewed by the Western Illinois University Human Subjects Committee. The readability and reading level were reviewed and assessed by an educational specialist at Western Illinois University. Modifications recommended by the reviewers were made. Both questionnaires were developed based upon results from a Delphi study of information collected about children's safe food-handling practices, knowledge, and barriers to safe food handling. Data from this Delphi study were collected from five teachers and two dietitians. Eighteen questions were included on the 3rd- and 4th-grade survey, while 25 questions were included on the 5th- through 10th-grade survey.

In the questionnaire for 3rd- and 4th-grade students, two questions were asked about the respondents' demographics and 10 questions about safe food-handling practices. No food safety knowledge questions were included in the 3rd- and 4th-grade surveys. The questionnaire for the 5th- through 10th-grade students included two questions about respondents' demographics, 15 questions about safe food-handling practices, four questions about barriers to practicing safe food handling, and six questions relevant to respondents' knowledge of food safety information.

A pilot test of each questionnaire was conducted for each grade. The pilot test was conducted in one west-central Illinois school, with multiple classes in each elementary grade and multiple sections of health classes in grades 7 to 10. All parents or guardians of students who were participating in the pilot test completed an informed consent form. Students identified safe food-handling practices, barriers to safe food handling, and safe food-handling knowledge. Those students who participated in the pilot test did not participate in data collection for this study.

Data reported in this study were collected in seven west-central Illinois schools. All teachers whose students participated in the data collection phase were provided with informed consent forms and copies of the questionnaire. After the informed consent forms were signed and returned, the teacher administered questionnaires to the class. All data analyses were completed using the Statistical Package for Social Sciences (SPSS), version 10.0. Frequencies were computed for all variables. Analysis of Variance (ANOVA) was used to determine differences among schools. One school was a regional vocational center, which consisted of students from many area high schools. Analysis of covariance was used with the school as the control variable.

RESULTS AND DISCUSSION

The sample of students in west-central Illinois consisted of 1,368 students in grades 3 to 10. Surveys for grades 3 to 8 were administered at all seven schools, while the survey for 9th- and 10th-grade students was conducted at only one school due to its location and accessibility of older students. The total response rate was 100% of the students in grades 3 to 10 who were in attendance the day the survey was administered in each school. Only completed surveys were

included in data analyses. A total of 284 useable surveys were collected from the 3rd- and 4th-grade students and 1,084 useable surveys were collected from the 5th- through 10th-grade students (**Table 1**). The overall student sample (grades 3 to 10) had similar numbers of males (50.5%) and females (49.5%). None of the grades had any prior instruction on safe food-handling practices, knowledge, or barriers.

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Table 1. Mean percentage of students providing positive responses to food safety practice questions by grade and gender

Practice:	Total N=1,369		3rd N=116		4th N= 168		5th N= 109		6th N= 297	
	F	M	F	M	F	M	F	M	F	M
Taste unsafe food	5.1	11.9	6.9	11.1	5.0	7.1	1.9	8.3	7.1*	17.1
Eat non-refrigerated leftovers	33.0	53.0	41.4**	54.8	36.4	50.3	35.7	55.7	27.9*	52.5
Eat food left by family members	46.8	50.8	57.1	47.5	51.4	46.4	45.2	59.3	46.6	50.0
Eat food left by friends	53.5	48.2	47.8	52.3	58.3	47.7	38.1	55.7	56.6	46.8
Wash hands after sneezing	50.3	48.0	52.1	46.7	51.8	33.3	51.2	55.6	48.7	50.8
Wash hands after petting dog or cat	52.5	38.0	54.0	40.0	54.0*	32.4	53.9	41.7	52.7*	34.6
Wash hands after using bathroom	50.0	40.9	51.0	50.0	49.3	33.3	52.6	40.0	49.6	36.4
Wash hands after blowing nose	50.9	45.0	47.9	71.4	51.1	37.9	51.8	53.3	50.7	43.1
Cover mouth at table after sneezing or coughing	50.5	29.5	52.3	42.9	49.7	25.0	53.5	33.3	50.5*	16.7
Know the correct place to keep their lunch	5.4	10.6	—	—	—	—	5.6	8.3	3.6	8.9

N=Number of students

*Indicates a significant difference at $p \leq 0.05$ by gender

**Indicates a significant difference at $p \leq 0.05$ by grade

***Indicates a significant difference at $p \leq 0.05$ by grade and gender

Table 1 (continued): Mean percentage of students providing positive responses to food safety practice questions by grade and gender

Practice: Would	7th N= 313		8th N= 251		9th N= 59		10th N= 55	
	F	M	F	M	F	M	F	M
Taste unsafe food	5.2	8.8	2.6*	9.7	8.0**	26.7	3.8	18.5
Eat non-refrigerated leftovers	34.7*	54.2	31.6*	51.3	31.6**	52.8	23.1***	57.5
Eat food left by family members	49.5	51.0	42.0	52.2	25.9*	64.3	58.6**	39.1
Eat food left by	65.6*	46.8	54.5	45.6	23.8***	58.8	55.6**	44.0

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Wash hands after sneezing	52.6	47.7	46.4	55.6	51.3	31.3	53.1	47.4
Wash hands after petting dog or cat	55.2*	36.2	49.0	44.7	50.0	28.6	45.5	66.7
Wash hands after using bathroom	51.0	55.6	49.3	22.2	49.0	16.7	44.7	83.3
Wash hands after blowing nose	53.3	41.1	48.6	48.1	48.7	37.5	54.3	43.8
Cover mouth at table after sneezing or coughing	52.3*	21.4	48.0	44.4	46.2	50.0	49.0	50.0
Know the correct place to keep their lunch	6.2	8.8	4.9	11.9	45.8	29.6	11.5	31.8

N=Number of students

**Indicates a significant difference at $p \leq 0.05$ by gender*

***Indicates a significant difference at $p \leq 0.05$ by grade*

****Indicates a significant difference at $p \leq 0.05$ by grade and gender*

One food safety practice that was specifically examined was handwashing. One of the most important factors in controlling the spread of bacteria and in preventing infections is handwashing (Guinan, McGuckin-Guinan, & Severeid, 1997). It was found that 50% of female students and 41% of male students reported they would wash their hands after using the bathroom. Similar results were found for washing hands after sneezing, blowing their noses, and petting a dog or cat. Boys reported less-frequent handwashing than did girls; however, only 50% of the girls reported washing their hands. Only 17% of 9th-grade boys, 22% of 8th-grade boys, and 33% of 4th-grade boys reported they would wash their hands after using the bathroom. A

significant difference was found between 4th-, 6th-, and 7th-grade females and males regarding handwashing after petting a dog or cat.

A similar study of 120 middle school and high school students' handwashing habits found that 58% of female students washed their hands after bathroom use, compared with 48% of males (Guinan, McGuckin-Guinan, & Severeid, 1997). The same study also found that female students tended to spend longer washing their hands, using soap, and washing more frequently than male students.

If a student indicated he/she would complete an unsafe food practice, he/she was asked to select a reason for the behavior (**Table 2**). Students could choose only one response per question. They were asked if they would taste a food that smelled bad or looked unsafe, eat non-refrigerated leftovers, or eat food left by family members or friends. Among the most common negative answers were "No one told me I shouldn't," "I have done it before and didn't get sick," and "My family and/or friends do it." No significant difference was found by grade or gender for the causes.

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Table 2. Reasons given for unsafe food practices reported by students in grades 3 to 10

Unsafe food practices	Frequency (%) "No one told me I shouldn't"	Frequency (%) "I have done it before and didn't get sick"	Frequency (%) "My family/friends do it"
Would taste food that smelled bad or looked unsafe	40.0	60.0	NA
Would eat non-refrigerated leftovers	30.5	69.5	NA
Would eat food left by family members	12.9	57.6	29.5
Would eat food left by friends	20.6	59.5	19.5

According to the survey, 56% of students believed they had gotten sick from eating an unsafe food at some time, and 62% of students stated they avoided foods they believed might make them sick; however, students did not identify any examples of unsafe foods. Ninety-one percent of students stated they would not eat food that looked or smelled unsafe. More than 73% of students did not think raw meat that has been left out of the refrigerator for more than two hours is safe to eat after it has been cooked. Ninety-three percent of students claimed the milk in their refrigerators is always cold. More than 88% of the students reported that their mothers purchased

food and more than 87% reported that their mothers cooked their meals. Sixty-eight percent of students stated that they eat dinner as soon as it is ready. Students also reported that they learned the most information about safe ways to handle food from their mothers (78.3%).

Differences in food safety practices were examined by gender and by grade (**Table 1**). In every grade, girls were more likely to avoid foods that might make them sick or that looked or smelled unsafe; and girls in every grade except 9th were more likely to cover their mouths when they sneezed. Furthermore, 9th-grade students were most likely to taste a food item that smelled or appeared unsafe, and 9th- and 10th-grade students were more likely to eat food left out of the refrigerator and food left by friends. Students in 10th grade, followed by 9th-grade students, were most likely to eat food left by family members.

Food safety knowledge was analyzed by gender and grade; however, no knowledge questions were included in the 3rd- and 4th-grade surveys. **Table 3** includes the percentages by grade and gender of students who had correct food safety knowledge responses. Significant differences were identified by gender and grade. More boys correctly answered questions about *botulism*, while more girls answered questions correctly about *salmonella*. Students believed most unsafe food comes from restaurants and markets, with food at home being the least likely source. However, results from Audits International 2000 Home Food Safety study, compared with the FDA Baseline, strongly suggested that homes are not any safer than restaurants (Daniels et al., 2001).

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Table 3. Mean percentage of students in grades 5 to 10 providing positive responses to food safety knowledge questions by grade and gender														
Knowledge	Total		5th		6th		7th		8th		9th		10th	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Where most unsafe food comes from	7.1	7.8	9.3	4.2	5.3	8.5	6.0	5.6	9.4	11.1	8.3	6.9	8.3**	8.0
Most common source of <i>botulism</i>	5.8	8.2*	5.7	2.1	5.1*	11.3	5.2	7.5	9.1	7.3	4.3	17.2	25.0	11.1
What you should do after cutting raw meat	66.0	53.2	75.5	60.4	71.0*	48.3	62.3	57.4	65.5*	56.1	64.0*	26.7	44.0	29.6
Most common source of <i>salmonella</i>	52.1*	49.0	50.0	50.0	45.3*	48.6	56.5	48.3	54.1	48.4	44.0**	30.0	57.7	55.6
Most common source of <i>staphylococcus</i>	6.6	8.5	7.4	8.3	5.8	11.4	5.8	7.5	8.1	4.9	13.0**	20.0	7.7**	14.8
Best choice for brown bag lunch	65.0	56.6	66.7**	56.3	59.7	58.7	61.8	50.0	75.2	63.1	68.0**	43.3	65.4**	52.0

*Indicates a significant difference at $p \leq 0.05$ by gender

**Indicates a significant difference at $p \leq 0.05$ by grade

Based on mean percent, more 8th-, 9th-, and 10th-grade students than 5th-, 6th-, and 7th-grade students gave correct answers regarding sources of unsafe food. More 9th-grade students provided incorrect information about *salmonella* than any other grade; however, more 9th- and

10th-grade students gave correct answers about *staphylococcus* than students in any other grade. Fewer 5th-, 9th-, and 10th-grade students gave correct answers about appropriate foods for a brown bag lunch than any other grade.

In this study, less than 10% of students surveyed knew how most food becomes unsafe, and they did not know the most common source of *botulism* or *staphylococcus*. Approximately 50% of students knew the most common source of salmonella, and approximately 60% knew what to do after cutting raw meat, or which food choices are best for a brown bag lunch. Boys appeared to practice safe food handling less than girls.

CONCLUSIONS AND APPLICATIONS

There are several important implications based on survey results. Food safety knowledge and safe food-handling practices do not appear to increase with age; therefore, materials should be developed that would make an impression in early childhood, with this information being reinforced throughout the educational experience. Students need education to identify the characteristics of dangerous foods and learn how to avoid becoming ill from improper food handling. Depending on the organism, only a few microbes can cause a serious, even deadly, foodborne illnesses. This is of particular importance to populations at high risk, including children, pregnant women, immuno-compromised individuals, and the elderly.

According to the *Healthy People 2010* report, “Foodborne illnesses will continue to be a problem on the rise in the future” (*Healthy People 2010*, 2001). In this survey, one of the most common responses given for unsafe food practices was “I’ve done it before and didn’t get sick.” The most important barrier to safe food practices appeared to be the inconsistency of foodborne illness in which one person will eat an unsafe food and not get sick while the next time the same person might get sick. Foodborne illnesses vary greatly regarding the type of foodborne illness, the method of transmission, and the amount of microorganisms needed to make a person ill. Foodborne illnesses cannot be predicted but can be prevented, and children need to learn this fact.

Educational materials need to emphasize safe food-handling practices to begin in childhood and continue to be refined throughout the lifetime to avoid foodborne illnesses. Beginning with preschool and continuing through high school, food safety information should be age-specific, school-based, and reinforced throughout elementary and secondary education in science and consumer education classes (Wolf, 1995), as well as in health, family and consumer science, or home economics classes (Koeppel & Robey, 1998). Researchers have shown that students at all grade levels perform better academically and have higher aspirations if they have parents who are aware, knowledgeable, encouraging, and involved (MacPherson, Haggans, & Reicks, 2000). For food safety education to be effective, it must be a collaborative effort between children, parents, educators, and food safety professionals.

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REFERENCES

- Anonymous. (1990, December 15). Exploring the children's market. *Food Trends*, 3.
- Barclay, M., Greathouse, K., North, T., Swisher, M., & Cale, L. (2001). Food-handling knowledge and practices of 4th- and 5th-grade students: A key to better sanitation. *The Journal of Child Nutrition & Management*, 25, 72-75.
- Bruhn, C. (1997). Consumer concerns: Motivating to action. *Emerging Infectious Diseases*, 3, 511-515.
- Bryant, T., & Barrett, E. (2000). Determining the food safety and hand washing practices of 4th-, 5th-, and 6th-graders. *Journal of American Dietetic Association*, 100 (Supplement), A-68.
- Buchanan, R. (2000). FDA/CFSAN Priority Research Needs. Retrieved September 21, 2000, from <http://www.cfsan.fda.gov/~dms/resneeds.html>
- Daniels, R., Daniels, B., Gilmet, P., & Noonan, P. (2001). Audits International 2000 Home Food Safety Study Report. Audits International. Retrieved September 21, 2000, from <http://www.audits.com/2000HFS.html>
- FDA Center for Food Safety and Applied Nutrition, (September 1998). Handwashing-related research findings. Retrieved December 13, 2002, from <http://www.foodsafety.gov/~dms/fsehandw.html>
- Goldman, D. (1990, September 17). The new consumer, superbrands. *Advertising Weekly Supplement*, 25-32.
- Guinan, M., McGuckin-Guinan, M., & Sevareid, A. (1997). Who washes hands after using the bathroom? *American Journal of Infection Control*, 25, 424-425.
- Healthy People 2010: Section 10- Food Safety. (2001). FDA and FSIS-USDA. [Online] Available at: <http://www.healthypeople/document/html/volume1/10food.htm>
- Koepl, P., & Robey, E. (1998). USDA/FDA food safety initiative: Evaluating the placement of food safety education in American schools. Retrieved July 7, 2000, from <http://www.foodsafety.gov/~dms/fseduuni.html>
- MacPherson, C., Haggans, C., & Reicks, M. (2000). Interactive homework lessons for elementary students and parents: A pilot study of nutrition expedition. *Journal of Nutrition Education*, 32, 49-55.
- Williamson, D.M., Gravani, R.B., & Lawless, H.T. (1992). Correlating food safety knowledge with home food preparation practices. *Food Technology*, 46, 94-100.

Wolf, I. (1995). Home food handling: A timely scientific status summary. *Food Technology*, 49, 28.

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