ABSTRACT

Objective: To assess the level of food safety knowledge, perceptions, and self-reported food-handling behaviors among middle school students.

Design: Baseline questionnaire administered in class that assessed background characteristics, knowledge, behaviors, and perceptions related to food safety.

Participants: 178 seventh and eighth grade students from 4 schools in central Pennsylvania.

Main Outcome Measures: Food safety knowledge, perceptions, and self-reported food-handling behaviors.

Analysis: Independent samples t test tested differences between genders and bivariate correlation analysis explored associations among knowledge, perceptions, and behavior (P < .05).

Results: Food safety knowledge score was 7.2 ± 1.6 of a maximum of 10 points. Perceived self-efficacy and severity of a foodborne illness were high, but perceived susceptibility was low. Girls scored higher on the self-efficacy and severity scale (P < .01). Self-efficacy correlated positively with knowledge and behavior (P < .0001) and severity with knowledge (P < .01). One fifth reported taking risks in food handling and one fifth reported having been sick because of something they ate.

Conclusions and Implications: There is a disconnection between middle school students’ food safety knowledge, perceptions, and behaviors. A need for relevant and motivating food safety education exists in this group.

KEY WORDS: food safety, knowledge, behavior, perception, adolescent

(int/nutr educ behav. 2004;36:71-76.)

INTRODUCTION

The need for enhanced food safety education has been recognized in the United States1-4 and in Europe5 with the launch of national initiatives to find ways to effectively educate consumers, especially the young, who are the food preparers of the future. The changing demographics and lifestyles, as well as the emergence of resistant and exceptionally hazardous strains of foodborne microorganisms, create a situation that could lead to major outbreaks of life-threatening foodborne illness.6 The Centers for Disease Control and Prevention’s most recent estimates state that foodborne diseases cause 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths in the United States each year.7

It has been reported that of the foodborne illness outbreaks in the United States in which the site of mishandling has been reported, 79% implicated food from commercial or institutional establishments and 20% from homes.8 An estimated 25% of these could have been avoided by safe food-handling practices.8 As recently suggested by Medeiros and colleagues,9 to reach the Healthy People 201010 goal to reduce the incidence of foodborne illness by half from 1997 to 2010, all home food preparers must understand and practice safe food-handling techniques 100% of the time to ensure that safe foods are served in all settings and to recognize and protect themselves against risky food practices by others.

Mastering all of the basic food safety rules2,4,9,11,12 is critical to avoiding potentially widespread morbidity and mortality owing to foodborne illness. Foodborne illnesses have always been a major threat to vulnerable groups such as the young, the aged, and the immunocompromised. The growing number of virulent strains of microorganisms, such as the...
enterovirulent *Escherichia coli* O157:H7, put even more people at increased risk for permanent health consequences and death from food safety errors. Unfortunately, this phenomenon is occurring at a time when there are even fewer experienced adults in the household to teach food safety lessons to young people at home.

People of all ages seem to think that they know how to handle food safely, but their self-reported food-handling behaviors do not support this confidence. \(^{12-16}\) Studies in adults and children conducted mostly in the late 1990s have revealed gaps in food safety knowledge \(^{12,13,17-22}\) and a disconnection between food safety knowledge and the reported food-handling practices. \(^{16,18,19,25}\) In the US studies, the percentage of people who report taking deliberate risks in handling food has varied between 10% and 50%, \(^{13,16}\) whereas 20% to 50% of households have reported having experienced physical symptoms associated with foodborne illness. \(^{13}\) The proportion of people reporting the use of safe food-handling procedures has been shown to be much larger than the observed proportion. \(^{16}\) These numbers correspond to the statistics from the 1980s that over 10% of the US population experienced a foodborne illness each year, at an annual cost of $10 billion to the national economy. \(^{24}\)

Earlier studies in adults have indicated that food safety knowledge tends to increase with age and practice: females have higher scores than males, and respondents under the age of 35 have shown the greatest need for additional food safety education. \(^{12,13,16-22}\) Furthermore, respondents from urban areas tend to have lower scores than those from rural areas, \(^{18,22}\) and the “occasional cooks” (often men and young adults) or well-educated people and those with a high income tend to report more unsafe food-handling behaviors. \(^{19,22,25,26}\) However, only a handful of studies have been conducted to explore the food safety knowledge, perceptions, and practices among younger populations, children and college students. \(^{38,29}\)

Little is also known about consumer perceptions of personal threat and coping abilities related to food safety, the central constructs in the Protection Motivation Theory, \(^{30}\) which can be used to explain why people would engage in preventive behaviors. Threat appraisal entails an assessment of the individual’s personal risk of harm (susceptibility) and an assessment of the severity of the harm. Coping appraisal is composed of individuals’ perceptions of the recommended response efficacy and an assessment of their ability to carry out this response (response efficacy and self-efficacy). A low perception of threat would not be expected to motivate people to take action. However, a high threat combined with a high coping ability should result in a positive response. Conversely, a high threat combined with a low coping ability would be expected to result in a small effect: if people were threatened but had no effective means of protecting themselves, persuasion and intentions to change behaviors would be expected to be very low. \(^{30,31}\)

Knowing the baseline knowledge, perceptions, and rates of high-risk behaviors in a target group is essential for the development of effective educational interventions in food safety. This study explored the current level of food safety knowledge, perceptions, and safety of food-handling behaviors among middle school students.

**DESCRIPTION OF THE EVALUATION**

**Design**

Baseline food safety knowledge, perceptions, and food-handling behaviors were assessed as part of a 5-week educational intervention to integrate computer-assisted food safety instruction into middle school family and consumer science and life sciences curricula in the spring of 2000. In this article, the baseline results are presented. The study was approved by the Office of Regulatory Compliance of The Pennsylvania State University and the districts and principals of the participating schools.

**Subjects**

A total of 178 middle school students (90 girls and 88 boys) from 12 classrooms in 4 schools in central Pennsylvania provided signed parental consent forms and gave informed assent in class to participate in the study. Schools, which were located within a 2-hour drive from the research center, were recruited via fax and telephone.

**Evaluation Tools**

All evaluation tools were developed for this study in cooperation with university experts in nutrition and food safety and the family and consumer sciences teachers involved with the study. Questions were related to the key issues identified by authorities to be important in food safety: check foods, cook to proper temperatures, chill promptly, separate raw and cooked foods, and wash your hands. The concepts of safe and unsafe foods were explained on the questionnaire: “safe food” means food that does not make you sick; “unsafe food” can make you sick. All instruments were pilot-tested for understandability and validity in a classroom of 20 students in one of the participating schools, resulting in minor changes in wording and layout. Internal consistency reliability coefficients were calculated using the Cronbach α method for constructs with Likert-type scales (perceptions and food-handling behavior) and the Kuder–Richardson method for the 10 true and false questions on the food safety knowledge questionnaire. The questionnaire had a weak internal consistency reliability coefficient (Kuder–Richardson estimate = .40). However, because none of the individual questions had a negative effect on their own, all items remained in the final measure of the students’ mastery of key issues in food safety.

The food-handling behavior questionnaire consisted of 15 questions: 12 itemized behaviors that measured the 5 key issues with 2 to 3 items per issue and 3 items to indicate if
students had not handled raw meat, chicken, or fish or had not eaten eggs or steak during the past month, allowing them the option to skip 3 questions pertaining to these foods. The behavior items had a scale from 1 to 5, with 1 indicating “not once,” 3 indicating “sometimes,” and 5 indicating “every time,” professing safe food handling. The internal consistency reliability coefficient was acceptable (Cronbach $\alpha = .73$). For the food-handling behavior index, the sum of scores for the itemized behaviors was divided by the number of behaviors reported by each student. The number of reported behaviors varied from 8 to 12, with a mean of 11.5 ± 0.7.

Constructs from the Protection Motivation Theory were used to assess students’ perceptions related to food safety: students’ appraisal of self-efficacy in safe food handling was assessed with 3 items (“I know how to handle food safely,” “I can personally do a lot to prevent bacteria from getting into my food,” “I believe I can learn how to handle food safely”; Cronbach $\alpha = .61$), personal susceptibility with 4 items, (“Because I live in the United States, my risk of getting sick from unsafe food is very small”; “I think food and water in the United States are safe to eat and drink”; “Because my food is prepared by my parents [or other safe food preparers], my risk of getting sick from unsafe food is very small”; “I think my risk of getting sick from eating unsafe food is low”; Cronbach $\alpha = .48$), and the perceived severity of foodborne illness with 2 items (“I think unsafe food can make people really sick,” “I think unsafe food can be life threatening”; Cronbach $\alpha = .71$). In this study, measures of response efficacy, the fourth factor in Protection Motivation Theory, were included only in the postintervention questionnaire because the students had not received instruction in food safety and, therefore, were not to be expected to know what the proper safe food-handling behaviors were. Their answers could have been biased and uninformed.

Statistical Analyses

The SPSS 10.0 statistical package was used for all analyses, except for the Kuder–Richardson estimate of internal consistency, which was hand-calculated. Independent samples $t$ test was used to assess the difference between genders. Bivariate correlation analysis with Pearson product moment correlation coefficients was conducted to explore the associations among knowledge, perceptions, and behaviors.

FINDINGS

Background Information

Most of the students participated in meal or snack preparation at home, and a few reported having worked in food service, whereas one fifth reported having been sick because of something they had eaten (Table 1). No significant difference was detected between genders in these background characteristics. However, girls reported more agreement than boys with the statement, “I am interested in studying food safety” (with average scores on a scale from 1 to 4: 3.1 ± 0.9 vs 2.5 ± 1.1, $t = 3.6, P = .0001$). Percentages of agreement with the statement by gender are shown in Table 1.

Food Safety Knowledge and Self-Reported Food-Handling Behaviors

The mean score on food safety knowledge was 7.2 ± 1.6, with a scale from 0 to 10 indicating the number of correct answers (Table 2). Students’ self-reported food-handling behaviors (see Table 2) reached a mean of 3.9 ± 0.6 on a scale with 4 indicating “almost every time,” professing safe food handling. No significant difference was detected between genders in either measure.

Distribution of correct answers on the knowledge pretest (Table 3) indicated that the students had the most difficulties with items that dealt with cooking and cleaning, whereas items such as washing hands or checking foods before eating or chilling foods were mastered by most of the students. However, as indicated in Table 4, the most frequently reported risky food-handling behaviors were “seldom” washing hands before eating at a school cafeteria or restaurant, “often” tasting foods to check if they were still safe to eat, and eating raw eggs or foods that contained raw eggs.

Perceptions about Food Safety

Mean scores for student perceptions of self-efficacy and the severity of foodborne illness were high, whereas the score for perceived personal susceptibility was low (see Table 2). Girls scored higher than boys on the perceived self-efficacy and the perceived severity scale ($P > .01$). Self-efficacy correlated with knowledge ($r = .32, P = .0001$) and behavior ($r = .36, P = .0001$) and severity with knowledge ($r = .21, P = .01$).

<table>
<thead>
<tr>
<th>Table 1. Food Safety–Related Characteristics by Gender (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food Safety–Related Variable</strong></td>
</tr>
<tr>
<td>---------------------------------</td>
</tr>
<tr>
<td>Prepare meals or snacks at home</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Work in food service</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Have been sick because of something they ate</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Interested in studying food safety (scale 1–4)</td>
</tr>
<tr>
<td>Slightly agree–agree = yes</td>
</tr>
<tr>
<td>Slightly disagree–disagree = no</td>
</tr>
</tbody>
</table>

***$P = .0001$.****
A weaker correlation was indicated between knowledge and behavior (\(r = .18, P = .05\)). Interest in studying food safety correlated with perceived severity (\(r = .25, P = .001\)) and self-efficacy (\(r = .365, P = .0001\)).

**DISCUSSION**

Middle school students in this study had only a fair level of food safety knowledge on the key food safety issues tested, scoring, on average, 72% correct on a food-handling knowledge test, with no difference indicated between genders. The lack of gender differences may be consistent with the finding that boys and girls in this study participated equally in meal and snack preparation at home. However, studies of adult Americans have indicated that females score higher than males.17,22,26 With increasing age, females tend to get more practice with food handling and food safety issues and may therefore score higher than males in studies of adults.

On the knowledge questionnaire, the students had the most difficulties with items relating to cooking and cleaning responsibilities, perhaps tasks for which they have not yet assumed responsibility. Items concerned with students’ daily and more habitual food handling, such as washing hands, checking foods before eating, or chilling foods, were more likely to be answered correctly. One positive finding of this study was that students (69%) indicated an interest in studying food safety. However, few school curricula include food safety on a routine basis. It is uncertain where young people will acquire the information needed to fill the gaps in knowledge found in this study.

One fifth of the students surveyed reported frequently taking risks in personal food handling, in spite of the fact that they considered foodborne illness to be fairly severe. With low perceived susceptibility, high perceived severity seems to be insufficient to prompt action in this group of young students. In fact, although one fifth reported having been sick because of something they ate, students still considered their susceptibility to be fairly low. Similar studies in adults have indicated that 10% to 50% of respondents report high-risk food-handling behaviors,10,16-19,22,28 and over 10% are reported to have experienced a foodborne illness.24 Students in this study, as well as adults in earlier studies,14-16 to a certain extent, seem to have an irrational optimism about avoiding foodborne illness. Low perceived susceptibility to a health risk may make people less likely to take precautions.

### Table 2. Mean Scores and Standard Deviations on Food Safety Knowledge, Self-Reported Food-Handling Behavior, and Perceptions Related to Food Safety by Gender

<table>
<thead>
<tr>
<th>Variable</th>
<th>Girls (n = 89)</th>
<th>Boys (n = 88)</th>
<th>All (n = 177)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Food safety knowledge</td>
<td>7.3 (1.5)</td>
<td>7.1 (1.7)</td>
<td>7.2 (1.6)</td>
</tr>
<tr>
<td>Self-reported food-handling behavior</td>
<td>4.0 (0.5)</td>
<td>3.9 (0.6)</td>
<td>4.0 (0.6)</td>
</tr>
<tr>
<td>Perceived severity</td>
<td>3.8 (0.4)</td>
<td>3.5 (0.8**)</td>
<td>3.6 (0.6)</td>
</tr>
<tr>
<td>Perceived susceptibility</td>
<td>2.3 (0.7)</td>
<td>2.2 (0.7)</td>
<td>2.2 (0.7)</td>
</tr>
<tr>
<td>Perceived self-efficacy</td>
<td>3.6 (0.4)</td>
<td>3.3 (0.6**)</td>
<td>3.4 (0.6)</td>
</tr>
</tbody>
</table>

†10 items, true and false questions; maximum score = 10.
‡12 items; scale: 1 = not once; 2 = almost not once; 3 = sometimes; 4 = almost every time; 5 = every time professing the safe behavior.
§Scale: 1 = disagree; 2 = somewhat disagree; 3 = slightly agree; 4 = agree with high level
**P < .01, girls vs boys.

### Table 3. Distribution of Correct Answers on the Knowledge Questionnaire (n = 176)

<table>
<thead>
<tr>
<th>Rule of Prevention</th>
<th>Test Item</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check foods</td>
<td>To make sure that the milk is SAFE to drink, you should taste it instead of checking the expiration date. (False)*</td>
<td>156 (88)</td>
</tr>
<tr>
<td></td>
<td>The canned tomatoes are no longer SAFE to eat if the can is bulging out. (True)*</td>
<td>141 (79)</td>
</tr>
<tr>
<td>Cook to proper temperatures</td>
<td>The safest way to make sure meat is well done (thoroughly cooked) is to check its inner temperature with a meat thermometer. (True)*</td>
<td>112 (63)</td>
</tr>
<tr>
<td></td>
<td>To be sure that the chicken wings are SAFE to eat, they should be cooked to an inner temperature of 100°F. (False)*</td>
<td>85 (48)</td>
</tr>
<tr>
<td>Chill promptly</td>
<td>Milk and cheese should be chilled (refrigerated) within 2 hours to keep them safe. (True)*</td>
<td>158 (89)</td>
</tr>
<tr>
<td></td>
<td>The best temperature for most harmful bacteria to multiply is in the refrigerator, below 40°F. (False)*</td>
<td>105 (59)</td>
</tr>
<tr>
<td>Separate raw and cooked foods</td>
<td>Wiping off the cutting board with a clean paper towel between food items (raw meat and bread) will prevent harmful bacteria from spreading. (False)*</td>
<td>66 (37)</td>
</tr>
<tr>
<td></td>
<td>To avoid cross-contamination, you should separate raw chicken, meat, and fish from ready-to-eat foods. (True)*</td>
<td>162 (91)</td>
</tr>
<tr>
<td>Wash your hands</td>
<td>Harmless bacteria from our hands can produce harmful toxins in foods. (True)*</td>
<td>128 (72)</td>
</tr>
<tr>
<td></td>
<td>Before handling food, rinsing your hands under cold running water is enough to get rid of bacteria on your hands. (False)*</td>
<td>152 (85)</td>
</tr>
</tbody>
</table>

*Correct choice between true and false answers.
ventive action.30,31 These findings present challenges in education about food safety equal to teaching topics of other health risks to adolescents. Although some gender differences were noted, in general, these results indicate that similar food safety education should be offered in classes attended by both males and females.

The findings in this study support the national initiatives1-4 for broad-based food safety education among consumers and especially the young, who are the food handlers of the future. However, the results of this study indicate a similar disconnection between behavior and expectation of consequences that is seen in other health practices, especially in the young, thereby increasing the need for effective, theory-based educational strategies that reinforce the connection.

Limitations of the Study

Because the population of this study consisted of middle school students in central Pennsylvania, the results should not be generalized to all children or all ages. Furthermore, although the reliability coefficient for the behavior questionnaire was high, this study measured self-reported behaviors, which are prone to response variation (bias) by the subjects.16 We also acknowledge the need for instrument validation through more testing and observational studies, as suggested in recent work by Redmond and Griffith16 and Medeiros and colleagues.9 Although the knowledge questionnaire served its purpose to assess the mastery of basic food safety rules in this age group and in this study, questionnaires with stronger reliability coefficients, applicable and relevant to specific target groups, should be developed in the future, as suggested by Medeiros and colleagues.32

### IMPLICATIONS FOR RESEARCH AND PRACTICE

Although we recognize the need for further study to assess the food safety knowledge, perceptions, and behaviors among school-aged children using more comprehensive assessment tools and more representative samples, the results from this study indicate that there is a need for food safety education in this target group. The school setting would be an effective place to reach the young with food safety education, which should attempt to affect the students’ perceived susceptibility to foodborne illness. With the current low perceived susceptibility, students are unlikely to adopt safer practices in their food handling.

### ACKNOWLEDGMENT

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Strategies for Nutrition Education and Behavior Change

The 6-step procedural model proposed by Isobel Contento and described in “Using a Theory-Driven Approach to Design a Professional Development Workshop,” J Nutr Educ Behav. 2003;35:312-318, is from a forthcoming textbook by Contento titled “Strategies for Nutrition Education and Behavior Change.”