



# *Measuring Self-efficacy of Food Safety* in Middle School Populations

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## ABSTRACT

Educational interventions seeking to improve food handling behaviors are more likely to be successful when they also increase participants' self-efficacy. However, very little is known about the relationship between self-efficacy and food handling behaviors. For this reason, this study developed and validated an instrument to measure self-efficacy of food safety in adolescent populations for the purpose of further investigating the hypothesis that raising adolescents' food safety self-efficacy can improve their food handling behaviors. A rigorous instrument development protocol, securely grounded in psychometric theory, was implemented, which included special consideration for conducting research in underage populations. The instrument development protocol consisted of four distinct phases: (1) item construction; (2) field testing; (3) instrument refinement; and (4) scale confirmation. The final instrument contained 12 items with coefficient alpha of .90, suggesting the Self-efficacy of Food Safety Scale (SEFSS) has strong internal consistency. The instrument also demonstrates strong test-retest reliability across test administrations ( $r = .78$ ,  $P < .001$ ) and is stable across gender,  $F(1, 68) = .977$ ,  $P = .327$ , and race,  $F(5, 64) = .652$ ,  $P = .661$ . The results of this study suggest that adolescent food safety self-efficacy can be accurately measured by the SEFSS instrument.

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## INTRODUCTION

Foodborne illnesses caused by 31 major pathogens are estimated to affect approximately 9.4 million people in the U.S. every year (16), and the well-documented trends of decline in outbreaks for many microorganisms in the 1990s have stopped and may even be reversing (18, 19). A substantial majority of these cases of foodborne illnesses are preventable with proper food handling techniques in the home (1). However, many people do not believe it is their responsibility to ensure the safety of their food or that their personal food handling behaviors have any impact on their health. In fact, food safety often is considered the responsibility of food producers, manufacturers, and preparers (6, 7, 20). Although these perspectives perpetuate unhealthy food-handling attitudes and behaviors, a properly targeted educational intervention can increase food safety knowledge and improve food handling attitudes and behaviors (13, 15).

The critical years between ages 11 and 17 are an ideal time to teach food safety. At this developmental stage, adolescents are in the formative process of establishing lifelong habits; therefore, they are more likely to synthesize new food safety knowledge in a way that will lead to the development of positive life-long behaviors (15). While educational interventions can increase adolescents' food safety knowledge and improve attitudes and behaviors, some data have shown a significant disparity between an adolescent's food safety knowledge and behaviors. Similar gaps have been found with adult populations (9, 12). The difference suggests that more than knowledge increases are needed to impact long-term behavior change.

Studies have shown that high self-efficacy is a strong indicator for individuals who adopt and sustain positive health behaviors and refrain or abstain from negative health behaviors (4, 9, 13). Additionally, Bandura (2) suggests that developing a greater sense of self-efficacy is a strong predicting factor for change in one's risky behaviors. Thus, the key to sustainable positive food handling behavior change may lie in understanding and improving one's food safety self-efficacy. Self-efficacy is the belief in one's own ability to perform tasks and affect outcomes (3). More specifically, Byrd-Bredbenner (9) suggests that self-efficacy, as it relates to health, is an individual's confidence in his or her ability to perform a particular recommended health behavior or abstain from an unhealthy behavior. This study operationally defines self-efficacy of food safety (SEFS) as the degree to which individuals believe they can affect the safety of their own food.

SEFS is a relatively new concept that integrates theoretical frameworks from the field of food safety education and the psychological construct of self-efficacy; as such, it is an undeveloped area of research with relatively few published articles focusing on its impact on sustainable behavior change. Additionally, no scientifically-validated instrument is available to assess adolescents' food safety self-efficacy. Therefore, this study developed and validated an instrument to measure self-efficacy of food safety in adolescent populations for the purpose of investigating the hypothesis that raising adolescents' food safety self-efficacy can improve their food handling behaviors.

## MATERIALS AND METHODS

A rigorous instrument development protocol, securely grounded in psychometric theory, was implemented, which included special consideration for conducting research in underage populations. The instrument development protocol consisted of four distinct phases: (1) item construction; (2) field testing; (3) instrument refinement; and (4) scale confirmation.

### Item construction

Items included in the self-efficacy of food safety scale (SEFSS) reflect food safety content, the construct of self-efficacy, and principles of adolescent development. Because food safety self-efficacy is a new concept area, expert review was also vital to ensure that items represented the breadth of topics included within food safety, while focus was maintained on the psychological dimension of self-efficacy (10).

Consultation of food safety literature determined the scope of food safety concepts to be included and revealed that food safety is generally comprised of the following six topics: personal hygiene, sanitation, cross-contamination, cooking and cooling temperatures, foodborne illness, and high-risk behaviors (13). A panel of experts in food microbiology, food science, and food safety generated a list of skills relative to each of the six food safety topics, yielding 15 items per topic, for a total of 75 items.

These items were reviewed by a panel of middle school level educators, who were tasked with removing any skill that was not developmentally appropriate for children 11–14 years old. The reading level of the remaining 73 task items were then evaluated and modified, where necessary, to improve comprehension. The revised items were determined to be at a 6.3 grade reading level, established by the Flesch-Kincaid readability test. Experts in psychological measurement then rewrote these task items into question stems, as suggested by the self-efficacy literature, to reflect the degree to which the participant was confident in his or her ability to positively impact the safety of his or her food. Each item included the stem of "I can" and was then followed by a food safety task such as "tell you the difference between cleaning and sanitizing."

While some literature suggests that a 100-point scale is best for measuring self-efficacy (14), there is no consensus on the appropriateness of the scale for use with adolescents. A nested pilot test was conducted by the researchers to compare adolescent participant responses using a 5-, 10-, or 100-point response scale. The results yielded no significant difference ( $P > 0.05$ ) between 5-, 10-, or 100-point scales on any of the items. Therefore, the 5-point Likert scale was used in this study, with response options of 1 = *can't do at all*, 2 = *can do a little*, 3 = *can do some*, 4 = *can do mostly*, and 5 = *can do for sure*.

### Field testing

Field testing is especially important in adolescent populations to reduce the likelihood of including confounding influences (e.g., items that are too difficult or ambiguous). The field tested version of the

**TABLE 1. Example of a review of the response distribution for two tested self-efficacy of food safety items**

Sample Item	M, SD <sup>1</sup>	Response Options				
		Can't do at all	Can do a little	Can do some	Can do mostly	Can do for sure
I CAN TELL YOU WHY I SHOULD CLEAN MY UTENSILS TO REMOVE GERMS	4.56, 0.89	1.1% <sup>2</sup>	3.3%	9.9%	9.9%	75.8%
I CAN TELL YOU HOW TO CLEAN A KITCHEN TO REMOVE GERMS	3.73, 1.30	4.4%	17.6%	20.9%	13.2%	42.9%

<sup>1</sup>M = mean; SD = standard deviation

<sup>2</sup>Percentage of participants who selected response option

SEFSS contained 73 items and was administered within two middle school located in eastern Tennessee, housing grades 6–8. School 1 ( $n = 74$ ) is situated in an urban setting, while school 2 ( $n = 143$ ) is in a rural area. In total, the sample included 217 students: 66% were in seventh grade and 34% in the eighth grade; the median age was 13. The sample was comprised of 45% females and 55% males; 65% white/Caucasian, 13% black/African American, 11% Hispanic, 4% Asian, and 7% “other” ethnic/racial. State achievement data at school 1 indicated that students tested below the state averages in math and reading, while students at school 2 performed at the state average in math and slightly above the state average in reading (17).

One teacher at each school was selected by the school’s principal to administer the SEFSS to students in his/her classes. To establish test-retest reliability items were then administered a second time, with a latency period of three weeks. Each survey was coded to provide student confidentiality and yet enable researchers to pair student responses across administrations.

## RESULTS

### Instrument refinement

The revisions of SEFS items were informed by both statistical analyses and expert review. Statistical analyses included a review by item of descriptive statistics, response distributions, and test-retest reliability. In addition to relying on these data, the test authors relied on an expert panel familiar with the theoretical framework of food safety self-efficacy to maintain content validity.

The mean, standard deviation, skewness, and kurtosis were examined for each item. Means ranged from 1.88 to 4.73, with standard deviations ranging from 0.46 to 1.35. Perceived self-efficacy varied as a function of the item content. Considerable variation was seen within this sample, which is consistent with the view that these adolescents have a wide range of food handling skills and responsibilities. However, items whose responses were significantly skewed or kurtotic (i.e., less than -1.0 or greater than 1.0) were flagged for further review.

A review of the distribution of responses for each item revealed problematic item performance. Items on which the majority of students select any one option do not discriminate as well as items with a broader response pattern across all options. For example, [Table 1](#) includes the item response distribution for two similar items that were field tested. Although both items ask about removing germs in the kitchen, 75.8% of the students responded “Can do for sure” to the item “I can tell you why I should clean my utensils to remove germs,” whereas only 42.9% of students responded “Can do for sure” to the item “I can tell you how to clean a kitchen to remove germs.” This option selection pattern may be related to level of specificity of the item. That is, while the first item asks to rate confidence in one’s ability to explain why he or she should clean a specific utensil, the second item asks to rate confidence in one’s ability to explain how he or she should clean a general space. Both questions focus on self-efficacy related to sanitation, but the wording differences between the two items significantly impacted the response distribution. Therefore, the first item was removed in favor of the second, which demonstrated greater ability to discriminate perceived self-efficacy among participants.

Statistical analysis was used to flag items for revision or removal; however, some items were included despite potential minor statistical indicators, such as a skewed response distribution. For example, personal hygiene items about hand-washing were included, even though responses were not evenly distributed, because the content reflected within these items is an integral component of proper hand washing and a foundational concept of food safety. Higher scores on hand-washing items were anticipated and reflect “overlearning” as a function of the many messages students receive regarding the importance of this behavior.

To determine item stability over time, the SEFSS was administered twice, with approximately three weeks between administrations. The test-retest reliability was examined by use of paired sample t tests and correlation coefficients (11). Items whose mean scores across administrations were significantly different at  $P < .05$  or whose correlations were not strong ( $r > .60$ ) were flagged to be reviewed and revised, or removed. As a result, 22 items were flagged, suggesting that students did not understand these questions or that the questions were poorly worded.

The final SEFSS contained 12 items, whose Flesch-Kincaid reading level was 4.6, and consisted of the six topic areas of personal hygiene, sanitation, cross-contamination, cooking and cooling temperatures, foodborne illness, and high-risk behavior. The panel of food safety experts reviewed the items and confirmed that the 12 SEFS items adequately maintained content validity. However, because the selection of items was dramatically reduced, an independent field test for scale confirmation was conducted to examine item and scale properties when tested within the final instrument format. (See Table 2 for final SEFSS.)

### Scale confirmation

The scale confirmation field test was conducted in an eastern Tennessee middle school housing grades 6–8. The school is situated in a suburban setting and has no affiliation with either school included in the pilot testing phase. The sample ( $n = 70$ ) was comprised of 59% female and 41% male children; 87% were Caucasian, with 7% Asian and 6% African American. State achievement data indicated that students tested above the state averages in both math and reading (17). The procedures of the field test were identical to those described above for the pilot phase.

**TABLE 2. Self-efficacy of Food Safety Scale**

DIRECTIONS: Read each of the following statements or questions below and choose the BEST answer from the choices given.	Can't do at all	Can do a little	Can do some	Can do mostly	Can do for sure
1. I can reduce the risk of food poisoning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I can tell you why food safety is important	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I can tell you the difference between cleaning and sanitizing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I can show you how to prevent cross-contamination	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. I can tell you how to correctly measure the temperature of my food	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I can tell you why washing my hands helps keep me from getting sick	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. I can explain why it is important to reheat food to the right temperature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I can tell you why it is important to keep cooked food and raw food away from each other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. I can tell you how to clean a kitchen to remove germs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. I can show you how to store food properly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. I know how to reduce the amount of germs in my food	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. I can show you how to properly wash my hands	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The final instrument contained 12 items with coefficient alpha of .90, suggesting the SEFSS has strong internal consistency (5). The instrument also demonstrates strong test-retest reliability across test administrations ( $r = .78, P < .001$ ) and is stable across gender,  $F(1, 68) = .977, P = .327$ , and race,  $F(5, 64) = .652, P = .661$ . The results of this study suggest that adolescent food safety self-efficacy can be accurately measured by the SEFSS.

## DISCUSSION

All of the field test sites for this study were located in eastern Tennessee. It is possible that regional food safety practices, coupled with the specific demographic compositions of the area and a common state educational curriculum, may reduce generalizability to other regional demographics. To address limitations associated with generalizability and sample size, the research team will expand the study by engaging the following procedures.

### Establish baseline

Previous research suggests that high levels of self-efficacy are directly tied to meaningful and long-lasting changes in behavior (14). Therefore, it is important to thoroughly understand the baseline of self-efficacy in adolescents, as it pertains to food safety, in order to develop and implement truly effective educational interventions. Without a baseline of knowledge upon which to develop targeted interventions, it is difficult to produce meaningful effects on adolescents' food handling behaviors. To accomplish that objective, the baseline level of adolescents' food safety self-efficacy needs to be defined and better

understood. The validated instrument developed in this study will be administered to a stratified, random sample of adolescents to establish baseline data. The sample size for this administration will also be large enough to provide additional supporting evidence for the reliability and validity of the instrument.

### Improve interventions

The existing behavioral science research demonstrates that affecting behavior change is successful when an individual's self-efficacy in the targeted area is high (14). To effectively apply this concept to affecting sustainable behavioral change in food handling, it is critical to understand the relationships that exist between knowledge, behaviors, and self-efficacy. Understanding the unique influence of food safety knowledge and self-efficacy on food-handling behavior change in adolescents, can help to ensure that educational and behavioral interventions can be better designed to target elements directly related to maximizing SEFS, and therefore sustainable positive behavior changes. To this end, the researchers will examine SEFS within the context of an existing, validated food safety education intervention for adolescent populations, using the instrument developed in this study.

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