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2900 100th Street, Suite 309, Des Moines, IA 50322-3855, USA

Jenna D. Anding,[1*] Rebecca Dittmar,[2] Dean McCorkle,[3] and Daniel Hanselka[4]

[1]Dept. of Nutrition, Texas A&M AgriLife Extension Service, 119 Cater-Mattil, College Station, TX 77843, USA

[2]Dept. of Nutrition, Texas A&M AgriLife Extension Service, 700 Main St. CB 103, Kerrville, TX 78028, USA

[3]Dept. of Agricultural Economics, Texas A&M AgriLife Extension Service, AGLS 319, College Station, TX 77843, USA

[4]Dept. of Agricultural Economics, Texas A&M AgriLife Extension Service, AGLS 321, College Station, TX 77843, USA

Impact of a Food Handler's Course on Targeted Behaviors among Foodservice Employees in Texas

ABSTRACT

Food handler (FH) programs can improve knowledge among foodservice workers. Currently eight states require these programs for front-line foodservice workers. Although FH programs increase knowledge, their impact on the adoption of food safety behaviors within the United States is limited. This study was conducted using a retrospective post-then-pre approach to survey how often 141 foodservice employees in Texas were adhering to targeted food safety behaviors before and after completing an online FH program. Ten behaviors in the areas of temperature control, cleaning and sanitizing, and personal hygiene were assessed on a Likert scale (1 = always to 4 = never) before and after the foodservice employees completed the FH program. Change in behaviors was calculated with paired *t* tests, and effect size was measured with Cohen's *d*. Significant improvement in all but one behavior was observed, with a small to medium effect size. The one behavior that did not significantly change was coming to work with vomiting and/or diarrhea; however, the frequency of that behavior was close to "never" (mean = 3.9) before and after completing the program. Results suggest that the knowledge obtained from an online FH program may be helpful for improving targeted food safety behaviors that can reduce the risk for foodborne illness.

INTRODUCTION

Foodborne illness (FBI) is a major public health concern in the United States. Not only are these illnesses common, they also have a large economic impact on the affected population. The Centers for Disease Control and Prevention estimates that each year, one in six Americans fall ill from contaminated food or beverages, with 3,000 cases of FBI resulting in mortality *(16, 17)*. The U.S. Department of Agriculture *(21)* estimates that foodborne illnesses cost the United States more than $17.6 billion annually, and an estimated 64% of foodborne disease outbreaks have been linked to restaurants *(3)*. With more than 15.5 million employees in the restaurant industry *(10)*, food safety education is a key component in the prevention of FBI.

*Author for correspondence: Phone:+1 979.321.7075; Email: j-anding@tamu.edu

Both the National Environmental Health Association (NEHA) and the National Restaurant Association (NRA) offer a professional certificate for food handlers (FHs) preparing to work in the food industry, meeting the requirements for employee training (FH) by state and/or local jurisdictions across the nation. State agencies and education companies offer similar FH certification programs that focus on basic food safety principles and practices that are necessary to ensure that food is handled safely. All FH programs cover good hygienic practices, cross-contamination, and time and temperature principles. An exam to test the understanding of those basic food safety principles is required by the NEHA and the NRA FH programs. Other FH programs require completion of the program but may not include an exam or minimum score necessary to receive the certificate.

Food safety education programs, including FH programs, have improved knowledge in the restaurant industry *(13)*. However, the extent to which that education leads to adoption of targeted food safety behaviors in the United States is limited. Rajagopal and Strohbehn *(12)* reported that education on glove use among student workers employed in a university dining hall reduced noncompliance with targeted behaviors compared with employees who did not receive this education. Smith et al. *(19)* found that foodservice volunteers at a Ronald McDonald House in Houston who received FH training increased their knowledge in areas such as hand washing and temperature control. These participants also self-reported improvement in targeted behaviors both at home and where they volunteered. However, Robertson et al. *(15)* reported that food safety knowledge among grocery store deli and bakery employees did not lead to compliance with recommended hand washing guidelines or handling of ready-to-eat foods. In a recent systematic review that included studies outside of the United States, Insfran-Rivarola et al. *(9)* concluded that food safety and hygiene programs can improve the knowledge, attitudes, and practices of FHs who are employed across different aspects of the food chain, including schools, restaurants, hospitals, and farms.

As of June 2024, the NRA reported that eight states (Alaska, California, Florida, Illinois, Oregon, Texas, Utah, and Washington) required an FH certification for designated employees working in the foodservice industry *(18)*. These employees include front-line foodservice workers, childcare providers, cottage food operators, and others involved in the foodservice industry. Fifteen additional states require an FH certificate on a county-by-county basis *(18)*. For states that require an FH certificate, employees are not required to have the certificate on the first day of their employment. Those states allow a grace period of an average of 32 days from the date their employment begins to earn the FH certificate. The grace period ranges from 14 days (Washington) to 60 days (Florida).

The Texas A&M AgriLife Extension Service has developed a FH course that is accredited by the state's health department. Offered both in person and online, the 2-h program "Food Safety: It's in Your Hands" has been shown to increase overall knowledge of safe food handling practices *(6)*. Because Texas allows foodservice employees to work up to 30 days before obtaining an FH certificate, the purpose of this study was to investigate the extent that an FH course can lead to changes in self-reported behaviors among program participants, specifically among those who were employed in foodservice at the time of their FH course completion.

MATERIALS AND METHODS

Participant recruitment

Individuals that completed the AgriLife online FH program between January 1 and December 31, 2021, who were at least 18 years of age, and were employed in foodservice at the time the program was completed were invited to participate in a posttraining survey that explored the impacts of FH training on the adoption of targeted food protection behaviors. We surveyed participants who had completed the online FH program because their contact information (email address) was more complete than that for the 2,634 individuals who attended the program in person. Because the online course was delivered consistently, fidelity to the curriculum was insured.

Survey development and administration

We used a retrospective post-then-pre survey approach *(8, 11, 20)* to assess the participants' self-reported changes in 10 targeted food safety behaviors emphasized in the FH program. These behaviors follow the U.S. Food and Drug Administration Food Code *(22)* and are centered around temperature control, cleaning and sanitizing, and personal hygiene. In addition to employment history and basic demographic questions, participants were asked to self-assess the extent to which they were following the behaviors before and since completing online FH program. Response choices were presented as "before the program" and "currently" for each question in a 4-point Likert scale format, where 1 = always, 2 = almost always, 3 = sometimes, 4 = never, and N/A = not applicable. The behavior questions, which were reviewed by three food safety educators for content and face validity, were previously utilized to evaluate the AgriLife Extension Certified Food Manager Program *(1)*.

Surveys were administered through Qualtrics (Provo, UT) and closely mirrored the procedure outlined in Dillman's tailored design method *(5)*. In March 2022, an email was sent to individuals from the FH program to inform them that they would be receiving an invitation to participate in a survey about the program. One week later, the invitation and a link to the survey was emailed to these individuals. The following week, a second email was sent to recipients who had not completed the survey. Two weeks later, a final reminder email was sent to the remaining recipients who had not completed the survey. Of the 2,578 invitations sent, 91 emails were

returned as undeliverable, resulting in 2,487 individuals who received the invitation to participate. Of those, 276 identified themselves as eligible and enrolled in the study; however, 57 were excluded because they were not currently employed in foodservice and/or were less than 18 years of age. Among the 219 individuals who were eligible, 141 completed the survey (135 in English and 6 in Spanish) sufficiently to be included for statistical analysis.

Data analysis was conducted with SPSS version 27 (IBM, Armonk, NY) and included Student's *t* tests and Cohen's *d* to calculate effect size. Study protocol was approved by the Institutional Review Board at Texas A&M University (IRB2022-0105M).

RESULTS

Participant characteristics

On average, the 141 participants were 45 years of age (range, 18 to 78; SD = 14.0) and female (83%) and most were white or Hispanic *(Table 1)*. Twenty-nine percent (n = 41) had a high school diploma, GED, or less, and 62.4% (n = 88) had completed some college or earned a college degree. A majority (68.8%, n = 97) of the participants worked in a school, Head Start program, or early childcare setting. The length of foodservice experience varied but most had been employed for at least 1 year. Ten individuals reported that they were not employed in foodservice; among those, six were employed in a childcare setting, one owned a cottage food business, one was a culinary arts teacher, and another was a volunteer. Because of the high likelihood that these 10 individuals were handling food, their survey results were included in the study.

On average, 253 days (range, 97 to 435) separated the time between completing the online FH course and completing the follow-up survey. Other than the FH course, more than half (55%, n = 77) of the participants had not received any food safety education in the previous year.

Change in self-reported behaviors

The frequencies of participants' reported adherence to targeted behaviors before and since completing the FH training are presented in *Table 2*. For the five behaviors related to temperature control, the average reported frequencies with which the participants measured the internal temperature of foods being held at least every 2 h and used the two-stage cooling method for cooling foods to ≤41°F (5°C) were close to "sometimes" before completing the FH program (mean ± standard error of the mean): 2.8 ± 0.13 and 2.9 ± 0.14, respectively. Maintaining proper temperatures (≤41°F for cold foods and ≥135°F [57°C] for hot foods) was closer to "almost always." Use of a food thermometer to determine the doneness of food had an average response of 2.5 ± 0.14, which was midway between "almost always" and "sometimes." All of the targeted behaviors except maintaining the temperature of hot foods improved significantly (P < 0.000) at follow-up, with a medium effect size.

With respect to the two behaviors in the cleaning and sanitizing area, before completing the online FH course, participants reported they were cleaning and sanitizing cutting boards and equipment at a rate that was close to "almost always" (1.6 ± 0.106); since completing the course the frequency improved significantly (1.3 ± 0.099) but with a small effect size. The rate at which equipment, utensils, and food-contact surfaces were cleaned significantly increased as well but with a small effect size.

Improvements were also noted in two of the three behaviors related to personal hygiene. Self-reported hand washing frequency, although high, increased significantly (P < 0.001), although the effect size was small. The frequency with which participants reported handling ready-to-eat foods with bare hands was closer to "never" before taking the course and moved even closer to the "never" category (P < 0.001; d = 0.325) at the time the survey was completed. The one behavior that did not significantly change was the frequency with which participants came to work sick with vomiting and/or diarrhea. Before completing the course, the extent to which the participants were engaged in this behavior leaned toward "never." However, 21 participants reported coming to work sick with vomiting and/or diarrhea "almost always," "always," or "sometimes." Since completing the course, the frequency of coming to work sick with vomiting and/or diarrhea continued to trend toward "never" category, and number of participants reporting doing this at any frequency fell from 21 to 8.

DISCUSSION

The results of the survey suggest that the knowledge obtained from completing an online FH program may have influenced improvements in 9 of 10 targeted behaviors that can reduce the risk of FBI. This improvement is important because a majority (69%) of the participants in this study were employed in schools, Head Start centers, or childcare settings with children under the age of 5 years. The Centers for Disease Control and Prevention *(4)* has identified children under 5 as a population at increased risk for a FBI because their immune systems are not fully developed. Reynolds and Rajagopal *(14)* previously reported that lack of temperature controls and improper cleaning and sanitizing were some of the most common violations noted in inspection reports from childcare facilities in South Carolina. These behaviors are just two of those emphasized in FH programs.

In a systematic review and analysis of the effect of food safety education on behaviors of FHs, Insfran-Rivarola et al. *(9)* reported that training leads to improved self-reported and observed behaviors, although the overall effect of training on self-reported behaviors was 0.80, higher than what we observed in the present study.

TABLE 1. Participant characteristics

Characteristic	*N*	%[a]
Gender		
Male	12	8.5
Female	117	83.0
No response	12	8.5
Race or ethnicity		
Black	26	18.4
Hispanic	35	24.8
White	56	39.7
Asian	7	5.0
Multiracial	3	2.1
No response	14	9.9
Highest level of education		
Less than high school	4	2.8
High school graduate or GED	37	26.2
Some college or technical school	43	30.5
College graduate	29	20.6
Graduate degree	16	11.3
No response	12	8.5
Length of foodservice experience		
Have not worked in foodservice	10	7.1
1 year	24	17.0
1–3 years	35	24.8
4–6 years	20	14.2
7–9 years	9	6.4
≥10 years	31	22.0
No response	12	8.5
Where employed (type of foodservice)		
Hospital, nursing home, or assisted living	2	1.4
School, head start, or childcare	97	68.8
Grocery store	2	1.4
Restaurant (including fast food)	8	5.7
Other	32	22.7
Food safety training in previous 12 months?		
Yes	34	24.1
No	77	54.6
Not sure	18	12.8
No response	12	8.5

[a]Rounded to the nearest 10th.

TABLE 2. Self-reported frequency of behaviors prior to and since completing the food handler's course

Behavior	No. responding	Mean (SEM) frequency[a]		*P*-value[b]	Effect size[c]
		Precourse	Currently		
Temperature control					
Use a thermometer to determine the doneness of food	112	2.5 (0.142)	1.8 (0.140)	0.000	0.637
Maintain food temperatures ≤41°F for cold holding	113	2.1 (0.129)	1.5 (0.117)	0.000	0.562
Maintain food temperature at ≥135°F for hot holding	107	2.3 (0.142)	1.9 (0.147)	0.000	0.527
Measure the internal temperatures of hot/cold foods being held at least every 2 h	110	2.8 (0.139)	2.1 (0.150)	0.000	0.649
Use the two-stage cooling method to cool foods to ≤41°F	109	2.9 (0.143)	2.2 (0.160)	0.000	0.706
Cleaning and sanitizing					
Clean and sanitize cutting boards between uses	111	1.6 (0.106)	1.3 (0.099)	0.000	0.461
Clean equipment, utensils, and any food-contact surfaces used for preparing potentially hazardous foods at least every 4 h	112	1.8 (0.115)	1.4 (0.101)	0.000	0.499
Personal hygiene					
Wash hands for 20 sec using soap and hot water	112	1.3 (0.061)	1.1 (0.043)	0.000	0.369
Touch ready-to-eat foods with bare hands	110	3.6 (0.093)	3.8 (0.085)	0.001	0.325
Come to work with vomiting and/or diarrhea	111	3.9 (0.057)	3.9 (0.064)	Not significant	Not applicable

[a]Responses were recorded using a Likert scale, where 1 = always, 2 = almost always, 3 = sometimes, and 4 = never. Participants who answered "not applicable" to the behavior were not included in the analysis. Comparison of precourse and current frequency of behavior was conducted using a two-sided paired samples *t* test.

[b]Differences were considered significant at $P < 0.05$.

[c]Effect size was measured with Cohen's *d*.

This study has several limitations. First, our sample size was small. Although >2,500 adults completed our online FH program, our data analysis focused on comparing the frequency of practicing the targeted behaviors before versus after completion of the FH course. This limited our subject pool to those who had been employed in foodservice at the time they completed their FH certificate. In Texas, foodservice employees must complete their FH training within 30 days of employment and renew the certification every 2 years. We did not ask whether participants had previously completed an FH program, so some of the respondents may have been in the process of renewing their FH certificate. It is also possible that individuals had been working in a foodservice setting before obtaining the FH certificate.

The frequency with which participants were engaged in the targeted behaviors (before and since completing the course) was self-reported rather than observed. As with most surveys that include self-reported behaviors, especially those behaviors that are viewed as socially desirable (e.g., washing hands and not coming to work when sick), response bias must be considered. Because this survey was a statewide assessment of behaviors of online program participants, it was not possible to observe the participants in real time.

However, the finding that even a small number of participants self-reported engaging in behaviors that can increase the risk of FBI is concerning because poor employee hygiene and health is a risk factor for FBI *(7)*. Future observational studies examining FH behavior may help determine the impact of education on adherence to targeted behaviors.

Participants in our study had a higher level of education compared with national statistics. Approximately 62% had completed some college or had a college degree, which is much larger than the 43% reported by the NRA *(10)* and suggests that our study participants may not be representative of all foodservice employees.

Nearly one-quarter of our participants reported that they had received food safety training in the previous 12 months in addition to completing the FH program. Because we did not ask about the type of training received, we cannot assess the impact it might have had on behavior adoption. Future evaluations of these programs should include identifying outside trainings to assess their impact. Because of these limitations, caution should be used when trying to generalize our results to all FH program participants.

Requiring an FH certification can be a positive step in preventing or reducing the scope and scale of an FBI outbreak risk. Brown et al. *(2)* reported an increase in food safety knowledge when workers received food safety certifications compared with those workers who were not certified. Assuming that an FH certificate program can provide knowledge that encourages improved targeted behaviors linked to food safety protection, should more states consider adopting the FH certificate as a requirement for employment? Given the ease with which an FH program can be completed (i.e., online), it might be time to require the completion of the FH certification program before the start of employment instead of allowing a grace period.

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