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Examining the Exam: Implications for Participants and Policy Makers of the Food Manager Certification Exam

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ABSTRACT

Foodborne illness continues to plague U.S. consumers, with children being one of the most vulnerable populations to suffer severe consequences of unsafe food. Federal agencies as well as public and private entities have instituted comprehensive food safety education and regulatory programs such as the food manager credentialing exam to address critical food safety issues in foodservice operations. The University of Massachusetts and Department of Nutrition collaborated with state and national partners on a four-year, three-phase study to examine barriers to successful exam completion by child nutrition personnel. This unique multi-disciplinary investigation provides the first baseline information needed to address key barriers to successful food safety education and certification. Qualitative and quantitative methods were used to examine learners' needs, exam items, and educational materials. Participant interviews revealed language and comprehension difficulties as well as potential concerns regarding relevance of exams to food service personnel in school settings. Results of this study indicate the need for revision of current exam policies, exam construction, and item testing.

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INTRODUCTION

The Centers for Disease Control and Prevention (CDC) estimates that foodborne diseases cause approximately 48 million illnesses and 3,000 deaths each year *(19, 20)*, with children identified as especially vulnerable to severe illness and death *(15)*. Federal agencies such as the US Department of Agriculture (USDA), US Food and Drug Administration (FDA), and CDC have responded to this public health issue by developing and implementing interventions for all constituents in the food chain, from producers to food service personnel to consumers. These strategies include policies and recommended or required food safety procedures, such as good agricultural and manufacturing practices *(29, 30)*. Food safety programs such as Hazard Analysis Critical Control Points *(31)* have been designed to improve food handler practices in food processing and service, with specific guidance for developing safety plans in schools *(26)*. Education initiatives such as FightBac!® *(16)*, Be Food Safe *(25)* and food manager certification *(28)* have been created and expanded for

consumers and food service personnel to increase knowledge about the risks of foodborne disease and about food handling practices that can reduce risk of illness. While these initiatives reflect the critical importance of food safety knowledge through education and training (28), little is known about implications and consequences of training and testing programs on participants.

Demonstration of knowledge as a preventive strategy for reducing foodborne illness risk is fundamental to the FDA Food Code (28). Since 1997, the FDA Food Code has required demonstration of knowledge of foodborne disease along with food handling procedures that reduce the risk of food-related illnesses. The first of two options necessitates successful completion of a food manager certification exam. The experience of University of Massachusetts (UMass) Extension food safety educators has indicated that, while the people and responsibilities needed in food service operations may vary, the existing exam did not appear to adequately measure the range of food safety responsibilities, knowledge and practices of those who are required to take the exam. Despite a comprehensive process for developing certification policies and procedures, there is a lack of evidence explaining the extent to which changes in the population targeted for the exam might contribute to poor policy outcomes as evidenced by declining test scores and passing rates.

In Massachusetts, the food manager certification policy appeared to be successful in the early stages of policy planning and implementation. Even before the formal adoption of the 1999 Food Code by the Massachusetts Department of Public Health, Food Protection Program (6), many food establishments, including industry and school food service operations, voluntarily used the food manager certification exam to address their concern for preventing foodborne illness. Since 1989, UMass Extension Nutrition Education Program has designed and conducted food safety education programs primarily for personnel and volunteers working with high risk populations in food service operations in schools, and in child and elder care programs. Between 1989 and 1998, UMass Extension, through its Food Safety Education Program, utilized the National Restaurant Association Education Foundation ServSafe® (21) course materials and administered the corresponding exam to over 2,000 food service and regulatory personnel. High passing rates and exam scores from 1992 through 1998 appeared to reflect a successful policy outcome for these agencies and institutions. Prior to the statute becoming mandatory, the passing rate followed national norms, which ranged from 80% to 100%, with an average successful certification rate of 85–88% statewide (35). However, following the adoption of Section 2-102.11 of the federal statute requiring food manager certification by the Massachusetts Department of Public Health in 2000, passing rates and scores began to decline dramatically (36). For example, in 2001 a review of ten food manager certification classes for school food service employees conducted in four Massachusetts cities (n=267) revealed an average passing rate of 59%, with some rates as low as 13%. Data collected as part of program evaluations from October 1999 to September 2001 also revealed a decline in individuals completing or attending some college or post-secondary education and an increasing number of participants with high school education or less (35). In response to these findings, UMass food safety educators modified teaching tools and strategies by simplifying terminology in instruction and activities, as well as by designing and incorporating interactive types of learning experiences. However, test scores continued to decline.

Because of this trend in declining test scores and passing rates, the authors obtained funding from USDA Cooperative State Research, Education and Extension Service (CSREES) for a four-year, three-state study entitled *Examining the Food Certification Exam — Food Safety Training and Certification for Under-educated, Limited English Proficient School Food Service Personnel (ETE) (37)*. Little is known about characteristics of food service personnel who participate in food manager certification programs and the extent to which changes in these characteristics might be related to exam outcomes. Therefore, the purpose of this study was to assess barriers to the successful completion of the food manager certification exam, particularly in school nutrition personnel.

The ETE study is unique in exploring exam participant characteristic profiles beyond standard demographic parameters. Qualitative methods, such as cognitive interviews, helped address the need for a greater understanding of food service personnel, particularly those in school nutrition settings who are required to participate in food manager certification exams. This study also examined policy and exam planning and implementation protocols and procedures that may predispose poor exam outcomes, particularly in school nutrition program personnel.

MATERIALS AND METHODS

The ETE study was conducted in two phases. Phase I determined barriers to successful completion of food manager certification. Both qualitative and quantitative measures were used to collect and analyze data, including participants' feelings about exam items and course materials as well as demographic information and exam outcomes. Participants' literacy levels as well as demographic characteristics were assessed. Cognitive evaluations of selected exam items and instructional materials were also conducted at this time. Data collected in Phase I were used to revise selected examination questions and responses that were pilot tested in Phase II. Supplemental instructional materials were also developed and evaluated. Unless otherwise specified, methods are identical in Phases I and II.

Subject selection

Participants included food service personnel in child nutrition programs who participated in food manager certification courses in Massachusetts, Connecticut and Rhode Island. Participants had to be at least 18 years of age and able to read, speak and understand English. This purposeful sample of adult learners primarily represented urban areas with historically low test scores. English language learners and school nutrition personnel who had already participated in a certification course or exam were excluded from the study. This study was approved by the Human Subjects Committee of the UMass Institutional Review Board.

Advisory committees

In Phase I, national and regional advisory committees were convened, and continued to meet and receive reports from the research team throughout the study. The national advisory committee, which included University of Massachusetts, Rhode Island and Connecticut collaborators as well as representatives of the Conference on Food Protection (CFP) Manager Training Testing and Certification Committee, federal and state regulatory agencies and associations, and national exam providers, as well as other education and training entities, helped identify issues and content areas that needed to be addressed in test questions and instructional materials. Based upon recommendations from this advisory group, all nationally accredited exam providers were invited to submit a proposal to work with the ETE research team to provide exams, modify selected exam questions for Phase II and assist with analysis of exam scores in Phase I and Phase II. One provider was selected, and a memorandum of understanding (MOU) was developed to insure adherence to all required exam procedures for confidentiality and security, and use of retired exam questions. In addition, the MOU respected the proprietary nature of the credentialing exam and anonymity of the exam provider. During Phase II, the national advisory group provided input and assisted with review and revisions of selected examination questions and supplemental educational materials.

On a regional level, a nine-member New England Assessment and Training Team (NEATT), which included state coordinators, research assistants, Extension educators, and certification instructors from the three collaborating states, reviewed study protocols for project assessments and surveys developed by the UMass research team to insure consistency in the study administration and implementation, as well as data collection, throughout the study. The NEATT also provided input on design of supplemental instructional materials. Members of this team were responsible for promotion and completion of certification courses in their respective states. In Phase II, the regional team met to ensure successful coordination and implementation of pilot testing revised exams and materials.

Qualitative measures

Cognitive interviews were conducted with a sub-sample of participants selected from those with the lowest Test for Adult Basic Education (TABE) scores. These hour-long interviews took place within two weeks of completing the exam at a site convenient to the participants, such as the school at which they worked. Two research assistants, trained by the lead investigator (E. Carbone) in cognitive interview techniques, conducted the interviews, using ten exam items identified by the exam provider as those with the lowest correct response rates. During the cognitive interview, participants were asked to paraphrase exam items (questions and responses) and discuss thoughts, feelings, and ideas that came to mind as they viewed the information (39). Two cognitive interview techniques were used to assess participants' responses to questions and materials. First, concurrent probing questions asked participants to clarify answers and express thoughts *while* reading the information. These were followed by retrospective clarification questions, which were asked *after* participants read the information (11). Participants were also asked to suggest alternative wording to increase understandability and relevance of activities. This approach has been highly informative in previous research to assess participants' understanding of exam items and answers or content of educational materials (1, 2, 11, 14, 17).

A semi-structured interview guide and materials for the qualitative assessments were developed by the project team. Development of the interview guide was iterative. After each session, data were reviewed and the interview questions were clarified on the basis of participant responses. All interviews were audio-taped with permission of the participant.

In Phase I and II, qualitative measures consisted of open-ended questions included in Surey II. In Phase II, a separate survey provided additional information on the usefulness, understandability, and relevance of the modified instructional materials.

Quantitative measures

Four quantitative measures were used in both Phase I and II. First, a pre-survey (Survey I) was used to collect de-mographic information on age, gender, education, ethnicity, primary language spoken at home, and position in the child nutrition program or other food service operations. Second, the TABE was used to determine grade equivalent reading levels of participants (5). These norm-referenced tests are designed to measure achievement of fundamental skills in adult basic education curricula, including seven content areas such as mathematics, social studies, reading, language arts and geography, in order to place or advance students in adult learning programs. This study was interested in reading levels; therefore, only the reading section was administered to study participants. Based on recommendations from CTB McGraw Hill, two levels of the TABE Form 10, M (Medium) and D (Difficult), were used (personal telephone communication with CTB representative, December, 2003). Following TABE administration protocol, a Locator Test, which is part of the TABE testing package, was administered to determine which of the two levels of the test (D or M) would best assess the grade equivalent for each participant (5). Since this timed assessment was restricted to the reading section only, UMass created a single 12-item answer sheet to replace the standard 40-item answer sheet. The third measure was exam scores, which were derived from a nationally accredited food manager certification exam that required the use of two parallel test booklets containing 80 multiple-choice questions. In Phase I, exam booklets coded UMA and UMB as unique identification numbers represented different versions of the examination. Answers were entered on a separate answer sheet along with coded identification of the participant, class and exam form. In Phase II, four forms of the food manager certification exam were administered, using 80 questions in forms UMA and UMB, along with forms UXA and UXB, which included ten revised questions.

Data collection

In order to collect all data in each phase of this study, an exam training course format with a minimum of four sessions was required, with an additional 30 to 60 minutes added beyond the usual instructional time at each session. Standardized protocols were developed

TABLE 1. Data collection plan

Timing	Phase I	Phase II
Session I	Informed Consent	Informed Consent
	Survey I	Survey I
	(Participant Demographics)	(Participant Demographics)
	TABE Locator Test	TABE Locator Test
	TABE pre-test	TABE pre-test
Session II	No data were collected.	No data were collected.
Session III	TABE D or M Reading Test	TABE D or M Reading Test
	(Grade Equivalent Reading Level)	(Grade Equivalent Reading Level)
Session IV	Certification Exam	Certification Exam
	(UMA/UMB)	(UMA/UMB or UXA/UXB)
	Survey II (Qualitative Assessment	Survey II (Qualitative Assessment
	of Instructional Materials	of Instructional Materials
	and Instructor)	and Instructor)
After the Course	Cognitive Interviews on Exam Items and Instructional Materials	

to outline the materials needed, directions and timeframe for administering specific assessment instruments, and directions for returning items to state coordinators, UMass project staff or the exam provider. Detailed scripts for each session provided course instructors with consistent language for introducing the different components of the study and explaining each of the data collection measures and procedures. The instructions and procedures were reviewed by the NEATT.

While the number of sessions varied from state to state, all data were collected in a standard manner. The Data Collection Plan for Phase I and Phase II of the study shown in Table 1 illustrates the sequence.

All project measures, with the exception of the exams, were returned in prepared envelopes to UMass for analysis. Instructors followed exam protocols for collecting and returning exams and answer sheets to the exam provider for scoring.

Course administration

Each state's project coordinator scheduled, promoted and managed registration and logistics for the food manager certification courses and exams. Prior to each certification course, detailed project materials were mailed to each state. A separate envelope was coded for each participant and contained data collection instruments for each of the sessions.

All instructors were experienced trainers and were approved exam administrators. Instructors in each state followed the cooperating institution's certification course procedures. In Massachusetts, food manager certification training consisted of 10 hours of instruction over four sessions, with the exam administered at the end of the fourth session. Rhode Island classes included 18 hours of instruction over two to five days, with the exam given on a separate, last day. In Connecticut, courses consisted of 10 to 12 hours of instruction over two to four days, with the exam administered at the end of the final session.

At each session, instructors followed prepared protocols and scripts incorporating the selected study text, activities, materials and assessment measures. At the first session, instructors introduced participants to the study, explained the objectives, and reviewed the course outline with planned assessments. The Informed Consent statement was read aloud, and participants were invited to sign the consent form. Participants received an "Examining the Exam" tote bag and a set of ETE refrigerator and bimetallic stemmed thermometers as incentives. At the conclusion of the course, participants were mailed a letter with their exam results, accompanying certification or certificate of attendance, and a note of appreciation for taking part in the study.

Analysis

In Phase I, qualitative data from cognitive interviews were transcribed verbatim by a professional transcriptionist. Data were coded; a content analysis was performed by the lead investigator (E. Carbone) and trained research assistants. Emerging themes, concepts and issues were identified regarding barriers to comprehension and effectiveness of selected test questions and training materials. Qualitative data were then summarized to provide information on understandability and relevance of language, as well as participants' overall reactions to content, structure and for-

mat. Quantitative analyses provided descriptive data of demographics, reading levels and test scores. CTB scoring charts from the TABE Administration Manual for the Locator Test and Reading sections were used to determine grade level reading equivalents *(5)*. The exam provider analyzed test scores, with a passing score on the exam set as 75%.

In Phase II, qualitative data were summarized as key emergent themes regarding participants' perceptions of the understandability and relevance of the language, as well as overall reactions to content, structure and format of the new or modified instructional materials. Descriptive data were analyzed for means and frequencies of demographics, reading levels and test scores. In this phase, the exam provider analyzed test scores and provided the authors with an item analysis of the revised questions.

Chi-square tests, Fisher's Exact tests, and regression analyses were used to compare characteristics of school nutrition personnel who passed the certification exam with those of personnel who did not pass the exam (using overall test score as the dependent variable). A significance level of $P \leq 0.05$ was set for all analyses. Data were analyzed by use of SPSS® software *(22)*.

RESULTS

In Phase I, a total of 12 training sites participated in the study in the three-state area. In Phase II, courses were held in four locations in each of the three states (Massachusetts, Rhode Island, and Connecticut). A total of 172 and 214 child nutrition program (CNP) personnel participated in food manager certification training in Phase I and Phase II, respectively.

Qualitative results

In Phase I, transcripts of 37 taped cognitive interviews were analyzed for consistent themes and issues. Two key themes emerged regarding participants' understanding of the ten selected exam questions and response options: (1) confusion with language, and (2) construction of exam questions and responses. Specifically, participants talked about use of unfamiliar words, the lack of consistency and accuracy of words, and complex question or response options.

For example, participants were confused by unfamiliar phrasing and scenarios such as "container size" and "a hose in the mop sink." Several words were specifically identified as difficult to understand in questions or response options, including "neutral," "microorganism" and "toxin." Participants identified the word "*agitate*" as particularly confusing. During cognitive interviews, when asked what came to mind when seeing the word "agitate", respondents said:

> "…it's when you take a box, and you agitate it, or when I take you, and I agitate you…"
> "… I know it is digesting the food, but using the word this way is like how fast are they eating the food? How fast are they digesting it?"
> "…I am thinking of a washing machine, and how it agitates, so that has nothing really to do with food except to keep your uniform clean."

In addition, participants noted that the use of "not" in the construction of exam questions and response options was confusing. Others had difficulty with the conjunction "or" in response options, such as "agitating or stirring of the food" as a factor to consider when chilling food.

> "And the ones that when they say 'which is NOT a factor,' those always confuse you too."
> "They [agitate and stir] mean the same thing but actually it is like they are saying the same thing twice. They could just go with like 'stirring of the food'."
> "This word, or that word. …you have a hard time to decide. We gotta know what we're talking about…what we need to use."

In addition to language and structure issues, participants also identified items or situations that were not relevant to their school settings. Feelings of marginalization and poor self-concept were revealed. Specifically, participants challenged the relevance of certain questions in relation to their job responsibilities or work environment in schools that added to their confusion. For example, when asked about procedures for cleaning floor spills, preventing backflow in a mop sink, or maintaining a salad bar, participants had this to say:

> "See this is… mostly the custodians do all this. So I really wouldn't even…I don't have a really good answer about this…I mean, if we have a big spill we'll call a custodian to come do it… As long as they get it done, I don't know where the mop sink hose is. It doesn't matter to me."
> "You know what the whole thing is…I don't understand what a hose would be doing in a mop sink to start with. I mean I don't see it in my school, you know?...If this is, this is a good custodian question not someone that works…because we don't have one, a mop sink."
> "I feel like I'm being set up because I don't have a regular cafeteria so some of the questions is like asking me what the temperature is of a salad bar. How am I supposed to know that? I don't work at a salad bar."

Furthermore, a number of comments underscored participants' feelings about their lack of education and poor reading ability:

> "You know, I'm not good at vocab. I'm not good at reading...It's about education and how people read and how high their IQ is…If I took an IQ test, I probably, in some areas, may be a little below. And in some areas, if you ask, I could be higher… Because my vocabulary is not high, you know what I mean? My vocabulary might be like a ten-year old… I barely got out of high school."
> "I have a difficult time reading … That is why if there was an oral test I would probably pass it no problem as compared to me being over there by myself trying to read these. It is tough."
> "I never went to college and I wasn't a good reader...people show me and I know. I'm gonna say, out of eighty of those questions, I probably got maybe thirty wrong. Not because, I mean, if somebody was standing by me, watching me in the kitchen, I would probably get a hundred on that test."

Modifying exam items

As illustrated in Table 2, the research team utilized a process to modify the language and phrasing of selected examination items and to inform the development of new instructional materials for use in Phase II. The ten revised ques-

TABLE 2. Original and revised question and response items

Theme	Issues	Original	Revised
Language	Consistency/accuracy of terms	Which of the following is NOT a factor to consider when **chilling** food?	Which of the following is NOT a factor to consider when **cooling** food?
Construction	Uncommon or unfamiliar phrasing Use of "or" in exam items	**a.** the **container size** the food is in c. the thickness **or density** of the food **d. agitation or** stirring of the food	a. the **size** of **container** the food is in c. the thickness of the food **d.** stirring of the food

TABLE 3. Description of ETE participants

	Phase I n = 172	Phase II n = 214
Demographics		
Gender (female)	88.9%	92.1%
Age (30–49 yrs)	60.5%	56.2%
Race (white)	61.4%	65.2%
Language (English)	79.1%	90.8%
Position		
Food Worker	82.2%	73.3%
Manager/Supervisor	8.9%	19.1%
Highest Level of Education		
Less than Grade 12	28.6%	7.6%
High School, technical school or GED	42.9%	48.7%
Some college or degree	28.6%	43.7%
Average Reading level (Grade Equivalent)	7.6	8.5

tions and response items were submitted to the exam provider for inclusion in ETE exam forms, UXA and UXB, which were tested in Phase II of this study.

Quantitative results

As shown in Table 3, in both Phase I and II of this study, most of the CNP personnel surveyed were female (88.9%; 92.1%); between 30 and 49 years old (60.5%; 56.2%); white (61.4%; 65.2%) and English-speaking (79.1%; 90.8%).

In Phase I, 28.6% of participants reported completing less than grade twelve as their highest level of education, 42.9% of participants reported graduating from high school, earning a GED or completing post-secondary education, including trade or technical school. Fewer than one-third (28.6%) had attended or completed some college. The average reading level of participants in Phase I was then 7.6 grade-level equivalent. In Phase II, 7.6% reported completing less than grade twelve as their highest level of education; 48.7% had graduated from
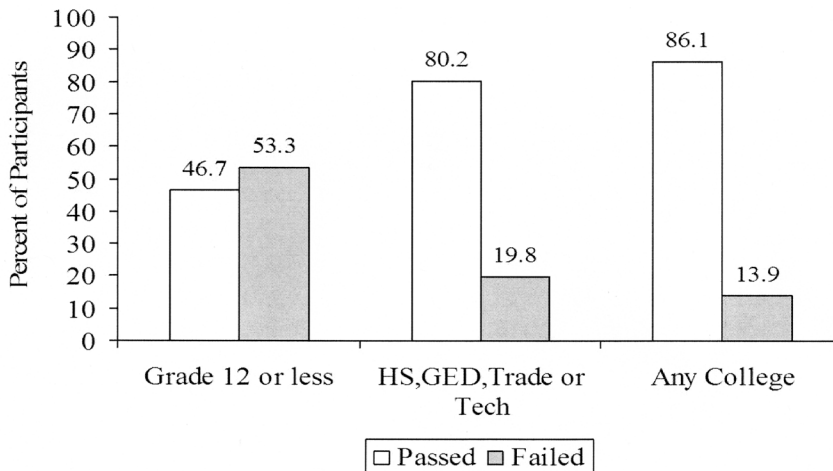
FIGURE 1. Exam outcomes Phase I (n = 156) and Phase II (n = 200)
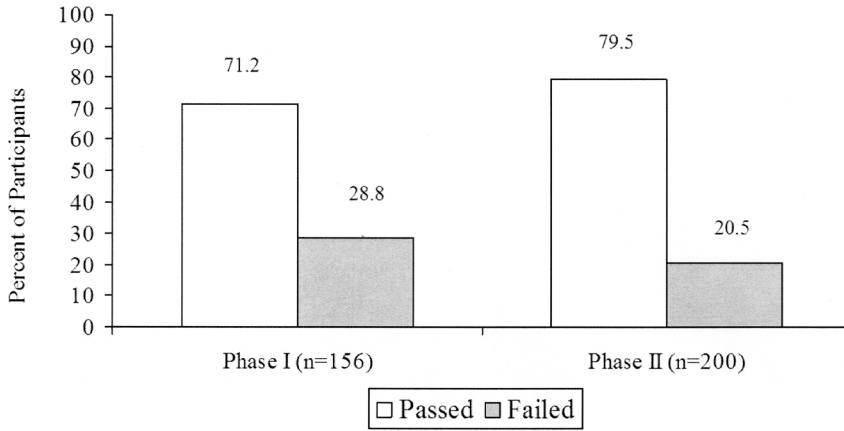
FIGURE 2. Exam outcomes by education levels in Phase II (n = 147)
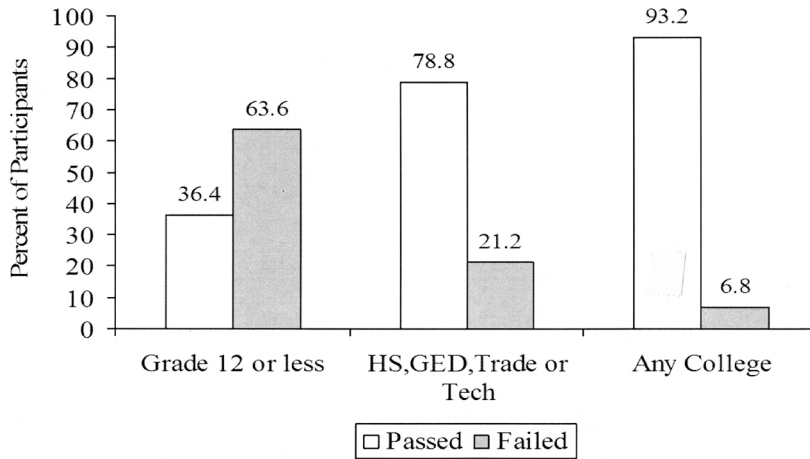
FIGURE 3. Exam outcomes by education levels in Phase II (n = 190)

high school or earned a GED, and 43.7% had attended or completed some college-level education. In this phase, the average reading level of participants was 8.5 grade-level equivalent.

When asked to describe their position, most participants identified themselves as food workers. In Phase I, 82.2% described themselves as food workers; 8.9% considered themselves managers or supervisors. In Phase II, 73.3% identified themselves as food workers and 19.1% reported being managers or supervisors.

Food manager certification exam outcomes

In Phase I, 71.2% of participants passed the exam (Fig. 1). Exam scores ranged from 20 to 89 out of a possible 100. Of the participants who did not pass the exam, 28% failed by more than five points. In Phase II, in which two versions of the certification exam were administered, approximately half (47.5%) received an exam with ten revised questions. Nearly 80% of participants passed the exam. Results of exam outcomes indicated a slightly higher pass rate with the revised exam, than with the standard certification exam (84.2% vs. 75.2%, respectively). This difference was not statistically significant.

Exam outcomes by education and reading level

Figures 2 and 3 present data on exam outcomes by education. In Phase I, statistically significant positive associations were found with exam success when high school, GED, trade or technical school education was compared with completion of grade 12 or less ($P < 0.0001$) and when any college was compared with grade 12 or less ($P < 0.0001$). No statistically significant association was found when any college was compared with high school or the equivalent. This pattern was similar for Phase II, with values of $P < 0.012$ (high school or the equivalent versus grade 12 or less) and $P < 0.003$ (any college versus grade 12 or less).

TABE data revealed that the mean reading level of those who failed the exam was a grade equivalent of 4.3 in Phase I and 5.0 in Phase II, compared with grade equivalent of 9.6 and 9.7 for those who passed the exam in Phase I and Phase II, respectively (Fig. 4).

FIGURE 4. Comparison of exam outcomes by reading levels in Phase I and Phase II
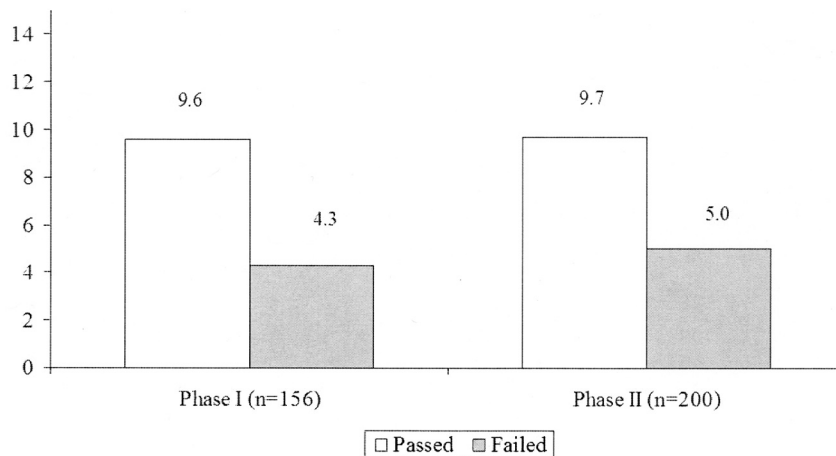
DISCUSSION

Knowledge about foodborne disease prevention, as demonstrated by successful completion of the food manager certification exam, is recognized as an essential intervention strategy to reduce the risk of food related illnesses *(28)*. Despite efforts of national food regulatory agencies and industry associations to insure optimum knowledge of food safety, foodborne disease persists *(19, 20, 38)*. Cates *(4)* and others *(10, 12)* acknowledge that changing characteristics of the food service workforce can present challenges to successfully achieving a decrease in foodborne illness — the intended outcome of food manager certification policy. The diverse learning needs and profiles of food service personnel who are required to take part in manager certification exams have not been prioritized and are consequently not well understood.

The intent of this study was to identify barriers to successful completion of the food manager certification exam and thus gain insight into the learning needs of food service personnel to better ensure knowledge gain and concomitant practice change. By examining differences in demographic characteristics and diversity of language use and information processing styles, this study demonstrated that certification training programs and exam participants, particularly child nutrition program personnel, differ from the population for which the exam and accompanying education were intended.

Through further examination, this study also revealed weaknesses in the planning stages of the food manager certification statute that may predispose school nutrition personnel to poor exam outcomes.

Data from this study revealed several striking differences between the people who participated in this study and the population for which the exam and accompanying education were intended. First, ETE results indicated that more than three-quarters of the study participants did not identify themselves as managers, but instead, as food workers. The US Department of Labor describes a food service manager/supervisor as the individual who "supervises workers engaged in preparing and serving food" and further distinguishes the supervisor from the manager; the manager has more decision making and standard-setting authority, and the supervisor has more direct responsibilities for carrying out and overseeing employees *(32, 33)*. The Food Code further differentiates between the person in charge as the individual present at a food establishment "who is responsible for the operation at the time of inspection" as compared to a food employee whose responsibilities include working with food, food equipment or utensils, or food-contact surfaces *(28)*. Additionally, the CFP Committee defines the Certified Food Protection Manager as a person in a particular food establishment who is responsible for a number of managerial level tasks, from developing policies or procedures

to coordinating training, supervision or direction of food preparation tasks and monitoring in-house self-inspections *(8)*. School nutrition managers must also prioritize sanitation standards *(3)* and must comply with specific USDA food safety standards *(26)*. However, while many child nutrition personnel who serve as managers in a school may be responsible for the operation at the time of inspection, as indicated in the Food Code, the supervisory or managerial tasks and responsibilities defined by these national entities may not accurately reflect the responsibilities of school nutrition personnel in a variety of settings.

Second, while test providers may construct test items at a sixth to eighth grade reading level, lack of education and reading ability of ETE study participants contributed significantly to poor performance on the food manager certification exam. Although the average reading level of study participants fell within this range, as education level and reading ability declined, passing rates decreased. Of those who failed the exam in Phase I, 63.6% had not graduated from high school, and only 6.8% had completed some type of post-secondary education. While exam outcomes improved slightly in Phase II, passing rates increased with education level. Reading levels of those who did not pass the exam in Phase I and Phase II (4.3 and 5.0 grade equivalents) were about half of the grade level of those who passed the exam (9.6 and 9.7 grade equivalent), respectively. Furthermore construction of examination items appeared to be inappropriate for a portion of food service personnel participating in this study. Interviews with ETE participants revealed confusion over terminology and complex structures such as those used in responses. As a result of findings from Phase I of this study, exam items and responses were changed to shorten word length, simplify language, eliminate the word "or" from response options, and use terms consistently with their use in instructional materials. In Phase II, these modest changes to ten questions resulted in a slightly higher pass rate with the revised exam (84.2%) than with the standard exam (75.2%)

Exam items used by the food manager certification providers are often designed by means of standardized

review methods that include quantitative measures such as reading level formula programs that rely more heavily on word or syllable counts instead of comprehension and clarity. Exam items were also problematic to ETE study participants because of lack of job relevance. For example, maintaining a salad bar or preventing backflow in a mop sink would be foreign to even the "person in charge" of a school cafeteria or food service operation such as satellite feeding sites, at which food service operations are limited to heating and serving frozen meals. As the cognitive interviews revealed, in many schools custodial or janitorial staff are assigned duties for cleaning up spills and maintaining basic plumbing. In other schools, salad bars would not be part of the operation. Therefore, greater effort is needed to construct and test exam items that are clear and relevant to the range of responsibilities, experiences and settings of the diverse food service populations being assessed.

In addition to examining the food manager certification exam in relation to participant characteristics, this study evaluated learning needs and instructional materials. Until recently, regulatory, industry and educational entities have depended on traditional programs to train food service employees at a variety of levels and institutional settings. Instructional materials have been developed and revised over time to meet the needs of an increasingly diverse population of food service personnel participating in the certification courses and examination. However, it is important to note that traditional education, including food service education, relies heavily on print materials and may be written at levels that are too high for under-educated individuals. As a result of this study, researchers collaborated with literacy specialists to develop instructional materials to help under-educated food service personnel understand important food safety terms and concepts (34). More recently, the FDA has supported efforts such as the Oral Culture Learners project to explore and test instructional materials that address the learning needs of food workers who have difficulty reading and understanding traditional text-laden food safety materials or who prefer a visual medium, set in a real-life context (23). Initiatives such as these must be expanded to ensure that multiple learning styles and relevant instructional experiences are addressed in the context of the food safety education, and intended knowledge gain, that policies such as food manager certification promote.

The results of this study not only draw attention to education and assessment tools that are the cornerstone of this food safety policy, but may also suggest implications to the policy planning and implementation processes employed in this statute. In planning the food manager certification policy, the FDA and CFP have addressed one of the essential components of successful public policy by designating a small definable target group (18) as the "person in charge". Additionally, CFP standards require exam providers to define the target population to an even greater extent by incorporating a job task analysis as the foundation for writing exam questions. This feature of the exam development requires a description of the knowledge, skills, and abilities required to carry out the tasks of this position. The job task analysis also includes "information and other attributes that the worker must possess in order to perform effectively and safely" (8). Toward this particular goal, the standards of the food manager certification exam require that each provider assemble an advisory group for the purpose of developing the job analysis; this job analysis document may be sent for additional review by other industry members. In recent years, the committees and reviewers have included restaurant owners and operators, food safety trainers, supermarket personnel and regulators, but not personnel from school or other child nutrition programs (9). Because child nutrition programs are not included in this phase of policy planning and development, the job task analysis is irrelevant and inappropriate, particularly with respect to the context and language of certain exam items, as evidenced in cognitive interviews conducted with study participants.

In limiting the target group for this policy, food manager certification courses and examinations have been designed for managerial personnel with an assumption of a certain level of education and ability to read. However, the construction of exam items and instructional materials may not be appropriate for the different language abilities and learning styles of the exam participants and trainees. Indeed, while Americans in general are reportedly more educated than ever before, approximately one-fifth of the U.S. adult population has low literacy skills, reading at or below the fifth-grade level (13), and an estimated 40% of food service managers have only a high school education or less (24). For this reason, this study focused on under-educated English speaking food service personnel who may have limited proficiency in their native language.

Another weakness in the policy planning process may be the composition of the committees responsible for developing guidelines and procedures for education and certification as well as the exam itself. The CFP Food Protection Manager Certification Committee serves a coalition of interested agency and industry representatives to contribute to the design of food safety policies and to ensure application and practice of the statute's various components. Through this CFP Committee, issues and needs of implementing agencies and target groups are deliberated and acted upon to improve impacts (7). This committee, with a membership that varies over time, can include representatives from state, local and federal regulatory agencies such as the FDA and USDA, academia, and consumer groups, as well as food industry designees from food processing, food service, retail food stores and food vending. Various industry and health-related professional and trade groups are represented on this committee; at-large representatives have included restaurants, supermarkets, convenience stores, and psychometricians from accredited exam providers (9). However, gaps are evident among those who were invited to represent the constituent groups affected by this policy. It appears that representatives from child nutrition programs have not been involved in any aspect of developing the standards for this policy. Excluding school nutrition programs from critical planning and implementation stages of the certification process may have contributed to poor exam outcomes for people who work in various school settings.

This study provides critical insight into barriers to the successful comple-

tion of the food manager certification exam. However, it is important to note the limitations of the study. First, each phase of the study included a relatively small number of food service personnel from child nutrition programs in three New England states and may not reflect the increasing diversity in the food service workforce. Second, limited time and resources prohibited random sampling of participants. Third, the number of exam questions that could be modified and tested may have diminished the possible impact of changes in language and item construction.

CONCLUSIONS AND RECOMMENDATIONS

Using a unique analysis of participants' demographic, literacy and information processing characteristics, this study identified barriers to successful completion of the food manager certification examination and suggested remedies to improve the certification policy planning and implementation process.

In order for such tests as the food manager certification exam to truly assess the knowledge of people who practice food safety, a more comprehensive approach for the development and pilot testing of exam items and educational materials is needed to ensure that each is relevant to food safety risks and responsibilities of food service personnel in a variety of settings, such as school nutrition programs. Toward that end, public and private entities such as FDA, the Conference on Food Protection and exam providers must expand the list of constituents to include representatives from federal, state, and local child nutrition programs. Exam providers in particular must engage members from school nutrition as well as child and adult care food programs in job task analyses and exam construction and testing. Finally, continued research is needed to further examine the learning needs and information processing styles of an increasingly diverse food service workforce to ensure improved food safety knowledge and practices, especially among individuals with a high school education or less.

Child nutrition program personnel are responsible for preparing and serving food to millions of children each day (27) and therefore represent a particularly critical target population for the food manager certification policy. By removing obstacles to success, such as education level or place of employment, and expanding the coalition of food service entities who participate in the food manager certification policy to include those in child nutrition programs, this policy will be better able to achieve the ultimate goal of reducing foodborne illness, especially in vulnerable populations.
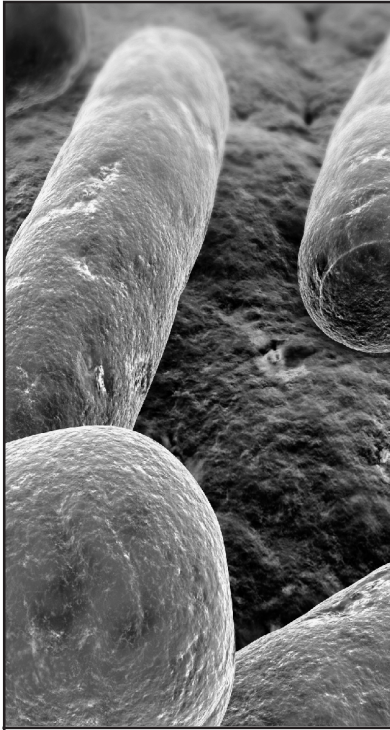
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