Research Note

Food Safety Knowledge Retention Study

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MS 08-342: Received 16 July 2008/Accepted 26 September 2008

ABSTRACT

Foodborne illness in Canada is an ongoing burden for public health and the economy. Many foodborne illnesses result from improper food handling practices. If food handlers had a greater knowledge of what causes foodborne illness, perhaps these illnesses would have less of an impact on society. This study gave researchers the opportunity to examine the current food safety knowledge of food handlers by using a standardized questionnaire. Questionnaires were distributed by environmental health officers to food handlers working in the food service industry during on-site inspections, and responses were used to evaluate immediate knowledge of key food safety issues. Both certified and noncertified food handlers were evaluated.

Information also was collected on the number of years since food safety certification was achieved and the number of years experience noncertified food handlers had in the food service industry. Results indicated that certified food handlers had a greater knowledge of food safety information than did noncertified food handlers. The highest failure rates were observed among noncertified food handlers with more than 10 years of experience and less than 1 year of experience. The results support the need for mandatory food safety certification for workers in the food service industry and for recertification at least every 10 years. Although the study was not sufficiently rigorous to evaluate existing food safety courses, data collected provided valuable insight into what issues should be emphasized in existing food safety courses and which should be targeted by future food safety initiatives.

Every year 11 to 13 million Canadians suffer from a foodborne illness, at an estimated annual cost of $12 to 14 billion (CAD) (1). According to a U.S. Food and Drug Administration (FDA) report published in 2000 (15), the most common foodborne illness risk factors in the food service industry are improper holding times and temperatures for potentially hazardous food, contaminated equipment and cross-contamination, and poor employee hygiene.

More recent studies have revealed that food handlers are the most important source of food contamination (14). This finding is highlighted by the large number of foodborne outbreaks in which infected food handlers have been implicated as the likely source (2, 3, 5, 12). Hertzman and Barrash (11) reinforced this idea by observing that food service workers are generally knowledgeable about personal hygiene when questioned but do not necessarily practice proper food handling and personal hygiene when working at catering functions. The FDA (15) reported that food service managers need to reduce the occurrence of foodborne illness risk factors through improved identification and management of problems when they occur. Food safety training provides the necessary skills for food managers to better perform these tasks and has been demonstrated to be an effective approach to controlling risk factors associated with foodborne illness (4). An FDA report released during 2004 (16) suggests that a certified manager present within the food establishment has a positive effect on the personal hygiene practices of food service workers.

In Canada, the requirement for food handler training is regulated by provincial legislation, and only four provinces have made food safety certification mandatory: Alberta, British Columbia, Nova Scotia, and Saskatchewan (6–10). During the past few years, the food safety training requirement in Alberta has become more stringent. With amendments to the Food Regulation in 2003, it is now required that food establishments with five or fewer employees have at least one individual with recognized food safety training. In food establishments with six or more food handlers, one person on the supervisory or management staff on every shift must have taken an approved course (7). There is currently no mandatory requirement for recertification.

In Alberta, the knowledge of a trained food handler is evaluated through a standardized multiple choice exam that is issued immediately after completion of a food safety training course. Successful candidates are issued a provincially recognized certificate. Once certification is achieved, there is no formal reassessment of the food handler’s food safety knowledge to determine how long this information is being retained.

A food handler’s knowledge is the accumulation of the various sources of food safety information to which he or she is exposed. Both certified and noncertified food handlers working in the food service industry may be exposed to food safety information through workplace orientation,
TABLE 1. Number of certified and uncertified food handlers who passed a standardized food safety test in each experience category (n = 630)

<table>
<thead>
<tr>
<th>Handler status</th>
<th>Time (yr)*a</th>
<th>Score higher than 50%</th>
<th>Score higher than 70%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certified</td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Not defined</td>
<td></td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Less than 1</td>
<td></td>
<td>112</td>
<td>1</td>
</tr>
<tr>
<td>Less than 5</td>
<td></td>
<td>157</td>
<td>2</td>
</tr>
<tr>
<td>Less than 10</td>
<td></td>
<td>51</td>
<td>0</td>
</tr>
<tr>
<td>10 or longer</td>
<td></td>
<td>56</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>396</td>
<td>3</td>
</tr>
<tr>
<td>Noncertified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not defined</td>
<td></td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>Less than 1</td>
<td></td>
<td>19</td>
<td>1</td>
</tr>
<tr>
<td>Less than 5</td>
<td></td>
<td>67</td>
<td>1</td>
</tr>
<tr>
<td>Less than 10</td>
<td></td>
<td>45</td>
<td>2</td>
</tr>
<tr>
<td>10 or longer</td>
<td></td>
<td>74</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>222</td>
<td>9</td>
</tr>
</tbody>
</table>

*a For certified food handlers, years since gaining certification. For noncertified food handlers, years working in the food service industry.

information provided by environmental health officers (EHOs) during on-site inspections, printed food safety resources, mass media, and advertisers. Certified food handlers also are exposed to such information through formal food safety training courses. In the present example, researchers sought to evaluate food safety knowledge among current food handlers with and without formal food safety training. These researchers also sought to identify any differences in the food safety knowledge of certified and noncertified food handlers and to establish whether length of time since certification or number of years of experience in the food service industry had any influence on the food safety knowledge of the food handler.

MATERIALS AND METHODS

A standardized multiple choice questionnaire was developed by Environmental Public Health Services (EPHS) to assess a worker’s knowledge of safe food handling practices, including personal hygiene, temperature control, food storage practices, and

TABLE 2. Failure rates for certified and noncertified food handlers in Edmonton (Alberta, Canada) that completed a standardized food safety test

<table>
<thead>
<tr>
<th>Passage criterion</th>
<th>Time (yr)*a</th>
<th>Certified</th>
<th>Noncertified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher than 50%</td>
<td></td>
<td>0.9  5.0</td>
<td>1.3  1.5</td>
</tr>
<tr>
<td></td>
<td>Less than 5</td>
<td>3.1  5.9</td>
<td>3.1  5.9</td>
</tr>
<tr>
<td></td>
<td>Less than 10</td>
<td>1.3  4.3</td>
<td>7.1  12.7</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td>0.8  3.9</td>
<td>3.8  8.2</td>
</tr>
<tr>
<td>Higher than 70%</td>
<td></td>
<td>3.5 10.0</td>
<td>3.1  5.9</td>
</tr>
<tr>
<td></td>
<td>Less than 5</td>
<td>3.1  5.9</td>
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</tr>
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</tr>
</tbody>
</table>

*a For certified food handlers, years since gaining certification. For noncertified food handlers, years working in the food service industry.

other requirements specified under pertinent health legislation. Questionnaires were distributed to food service supervisors in Edmonton (Alberta, Canada) during monitoring inspections of local full-service eateries during 2006. Individuals with and without formal food safety certification were examined. Participants were required to indicate whether they had taken a course, the name of the course, and the length of time since they had successfully completed the course (to the nearest year). Individuals without formal food safety certification (as recognized under the Alberta Food Regulation) were required to indicate the number of years they had worked in the food service industry. Information collected on time frames was recorded as categorical variables for analysis purposes (Table 1). No other personal information or details about the facility were collected to help maintain confidentiality and reduce bias. Correct answers were discussed verbally with participants at the time questionnaires were collected. Data analysis was conducted using SPSS 15.0 statistical software (SPSS Inc., Chicago, IL). A score less than or equal to 50% was considered a failure for analysis purposes. A similar analysis was conducted using 70% as the cutoff for passing because this percentage is the passing grade for the formal food safety course taught by health educators in Edmonton. Test scores were cross referenced with food safety certification, the length of time since certification, and/or the number of years working in the food service industry. No attempt was made to control for confounding created because of carryover effects between different sources of food safety information.

RESULTS

A total of 630 questionnaires were completed during 2006; 63% of respondents were certified in safe food handling (n = 399), and the remaining 37% (n = 231) were not certified. The numbers of years since food safety certification was achieved or the number of years in the food service industry are listed in Table 2. Five percent of certified food handlers failed to properly disclose when they received formal food safety training, and 7% of noncertified food handlers did not disclose the length of time they had worked in the food service industry. The majority of the noncertified food handlers in the study population had more
FIGURE 1. The distribution of test scores for 630 food handlers that completed a standardized food safety questionnaire in Edmonton (Alberta, Canada) during 2006.

than 5 years of experience. Of those who were certified, more than 68% had received training within the last 5 years.

Ninety-eight percent of food handlers participating in the survey scored higher than 50%, and 94% scored higher than 70%. The distribution of scores is presented in Figure 1. The median score on the questionnaire was 18 of 20. Significant differences were observed in passing scores for food handlers with food safety training compared with food handlers without such training. Having food safety certification was significantly associated with a passing grade at both the 50th percentile (\( P = 0.007 \)) and 70th percentile (\( P = 0.015 \)).

At the 50th percentile, the length of time since the food handler had taken food safety training did not significantly influence a passing score (\( \chi^2 = 1.534, \text{df} = 4; P = 0.821 \)). Similarly, the length of time a noncertified food handler had worked in the food industry did not increase the likelihood of achieving a passing grade (\( \chi^2 = 3.088, \text{df} = 4; P = 0.543 \)). Four percent of noncertified food handlers surveyed failed to score higher than 50% on the standardized questionnaire. This failure rate is equivalent to five times that for certified food handlers, of whom less than 1% scored 50% or less.

At the 70th percentile, the length of time since the food handler had taken food safety training also did not significantly influence a passing score (\( \chi^2 = 2.738, \text{df} = 4; P = 0.603 \)). Similarly, the length of time a noncertified food handler had worked in the food industry did not increase the likelihood of achieving a passing grade (\( \chi^2 = 3.739, \text{df} = 4; P = 0.442 \)). Eight percent of food handlers without any formal food safety training failed to achieve a score of 70% or higher on the standardized questionnaire, double the failure rate for certified food handlers.

Significant differences in failure rates were observed between certified and noncertified food handlers. Failure rates for noncertified food handlers were on average two to five times that of certified food handlers surveyed. The highest failure rates were found among noncertified food handlers with more than 10 years of experience in the food service industry. This finding is consistent with incidental reports from EHOs, who often find veteran food handlers most resistant to instruction and least receptive to advice. High failure rates also were found among noncertified food handlers with less than 1 year of experience, which indicates the need for close supervision and mandatory food safety training for all new food service employees.

DISCUSSION

Evaluations of the food safety knowledge of current food handlers provide the EPHS with valuable insight into several aspects of the delivery of food safety initiatives, including formal food safety training. The results of this study validate the need for provincially legislated food safety certification; in the food handlers in this study, food safety training had a positive impact on food safety knowledge.

The results of this study also helped identify the short- and long-term effectiveness of the formal food safety training program; the failure rate among certified food handlers was highest for those for whom more than 10 years had elapsed since certification. This finding supports the idea of mandatory recertification at least every 10 years. Recertification may be a valuable contributing factor to improving the food safety knowledge of veteran food handlers. However, mandatory food safety certification and recertification for food service employees has important implications for course delivery and may place a significant burden on the course provider. Decision makers at the provincial and local levels must be prepared to fund and ensure that enough staff and other resources are available to meet the increased demand for the food safety training courses. Issues regarding the style and format of the courses provided also should be addressed. Equal access to food safety training should be available to all food handlers. Existing food safety courses may require modifications to suit the needs of those workers that face language challenges. English-as-a-second-language (ESL) students and students with literacy issues may have difficulty completing the course. New teaching approaches and changes to both the style and format of the courses provided should be explored to ensure that information is understood and retained by food handlers regardless of background (13). An investment of time and resources will be required to develop new and innovative training courses to meet these demands.

The results of this study should contribute to the improvement of food safety initiatives delivered by the EPHS. For example, the information gathered from standardized questionnaires can be used to identify which food safety concepts EHOs need to stress during monitoring inspections of food establishments. Reinforcement of important food safety concepts can reduce the risk of foodborne illness associated with the factors described by the FDA (15, 16). The information gathered should contribute significantly to the ongoing review and improvement of food safe-
ty information made available by EPHS via the department’s web site, print resources, and media releases.

Although the results of this study provide valuable information that can be used to improve the delivery of food safety training, they do not indicate whether the food safety knowledge of the food handler is actually being used in the workplace. Putting food safety knowledge into practice and the on-going monitoring and evaluation of safe food handling practices is equally (if not more) important, as was demonstrated in a recent study conducted at the University of Nevada, Las Vegas (11). Researchers assessed the food safety knowledge of 81 catering employees based on responses to a standardized questionnaire. These individuals earned a mean score of 71.5%. However, in subsequent evaluations during actual catering functions, researchers found that many of these same employees did not follow many of the safe food handling practices on which they had successfully been examined. The most common food safety violations observed included not wearing gloves when required, inadequate hand washing, failing to check hot and cold temperatures, and not properly protecting foods while on display or in storage. Thus, frequent inspections by qualified EHOs are important to reinforce safe food handling practices with food service managers on a regular basis.

Strengths and limitations. This study had several strengths. First, it provided the opportunity for existing field EHOs to use a standardized questionnaire to educate food service employees about a wide range of important food safety concepts. Another strength of the study was the size of the sample population; 630 food handlers were interviewed. This large sample size increases the likelihood that the study group was representative of the food handler population in Edmonton.

The limitations of this study are extensions of its strengths. Researchers cannot conclude with any certainty that the sample population is representative for areas outside of the metropolitan Edmonton area, and the study was not sufficiently rigorous to evaluate existing food safety courses or any other single source of food safety information. Other limitations of the study include the following.

(i) Illiterate and ESL food handlers may have been underrepresented because the study design favored those who could read and write English.

(ii) The length of time since certification was used as a surrogate to approximate the number of years in the food service industry for certified food handlers, but the actual length of time in the food industry was not recorded for these food handlers. This omission could inadvertently act as a confounder and make differences between the study populations more difficult to assess.

(iii) The sample size was diminished by the division of the original sample into certified and noncertified food handlers. Each of these subgroups was further stratified by length of time since becoming certified or length of time employed in the food industry. This division resulted in a loss of statistical power, which may increase the likelihood of type I or type II error.

Future directions. Further study is warranted to validate these findings. The EPHS in Edmonton is presently completing phase 2 of the study, which was expanded to include rural areas. In phase 2, the number of years in the food service industry was collected for both certified and noncertified food handlers because this lack of data was identified as a shortcoming during phase 1. The addition of these data should allow similarities and differences pertaining to food safety knowledge to be identified in the respective urban and rural areas. This information will be used to improve the scope and focus of existing food safety education materials (in and out of the classroom).

Future studies of this kind could further explore whether ESL food handlers score differently than those who have English as a first language. Such a study would have to control for literacy issues because illiteracy could be an important confounder. In light of the research by Hertzman and Barrash (11), researchers may wish to combine the present study design with on-site evaluations of food handling activities. This approach would allow researchers to ascertain whether certified food handlers were significantly more likely than their noncertified counterparts to incorporate safe food handling techniques into their day-to-day activities.

ACKNOWLEDGMENTS

The authors acknowledge the contributions of the following environmental health officers working in Capital Health (Edmonton, Alberta, Canada) without whom this work would not have been possible: Wing Kang, B.Sc., CPHI(C), Steve Knebel, B.Sc., CPHI(C), Kristen Krywiak, B.Sc., CPHI(C), Pam Wagner, B.Sc., CPHI(C), Gizea Chizik, CPHI(C), Quan Nguyen, M.D., CPHI(C), Samy Tawfik, M.B., Ch.B., CPHI(C), and Rick Dimock, B.Sc., CPHI(C).

REFERENCES


