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Identifying Food Safety Knowledge Gaps among Restaurant Food Handlers in Bolzano, Italy

ABSTRACT

Between June and November 2010, an oral survey was administered in Italian and German to 100 food handlers in 100 restaurants to determine food safety knowledge gaps among restaurant food handlers in Bolzano, Italy. Based on responses to 40 knowledge questions, the overall knowledge score was 65%. Bivariate analysis revealed race as the only characteristic associated with knowledge score ($P < 0.05$). Food handlers most frequently gave incorrect answers to the questions concerning temperatures for cooking and holding foods, beef, cross-contamination, and hygiene practices. Language-specific differences in knowledge were observed. This study demonstrates the need for ongoing education of restaurant food handlers regarding proper behaviors related to handling of high-risk foods.

INTRODUCTION

Globally, foodborne illnesses pose a significant burden, making food safety an important public health priority. Foodborne and waterborne illnesses combined cause an estimated 2.2 million deaths worldwide annually (21, 22).

In the European Region, campylobacteriosis and salmonellosis are important causes of morbidity and mortality (21). As more people eat outside the home because of rapid urbanization, eating establishments are becoming a major source of foodborne outbreaks. The South Tyrol, one of the 20 regions of Italy, has 4,164 restaurants (2). In addition to cuisine from around the world, they serve local specialties, including speck (a lightly smoked raw ham), rare or medium cooked beef, and roast pork and venison, often served not well-done. Food specialties and preferences for how they are served may vary widely by region as may awareness and adherence to food safety recommendations for restaurants. A query within the Bolzano Health Authority revealed that the Health Authority does not have regulations to dictate compliance with time and temperatures necessary to ensure food safety. However, little is known about the extent of this potential problem. Therefore, it is important to determine whether restaurant food handler food safety knowledge is adequate, as this is a fundamental factor in prevention of foodborne diseases.

An Internet search identified only one published restaurant food handler food safety knowledge study in Italy. Angelillo

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et al. interviewed 411 food handlers in the southern Italian city of Catanzaro. The knowledge questions asked only if the food handlers knew the names of pathogens and foods associated with foodborne diseases in Italy rather than if they had knowledge of critical food safety terms, prevention methods, and practices (1). Other data from Europe support the conclusion that restaurant food handler knowledge of critical concepts is often low. For example, in the United Kingdom, 58% of the food handlers surveyed in Wales knew that food poisoning could be caused by cooked rice (20). A study in Switzerland reported similar findings (14). In addition, none of these food handlers knew the proper temperature at which to hold potentially hazardous hot foods such as cooked rice to prevent the growth of pathogens.

Food handler knowledge may vary from jurisdiction to jurisdiction. Awareness of local or regional knowledge gaps may be helpful to those charged with educating food handlers because targeted educational efforts might be more feasible and effective than a general approach. We sought to determine gaps in food safety knowledge among food handlers in northern Italy (Bolzano) and to identify risk factors associated with their knowledge to identify priorities for food safety education. Because the Bolzano region has historically been a part of Austria, and because many residents speak German as their primary language, we hypothesized that language may also be associated with food handler knowledge.

MATERIALS AND METHODS

Sample

A list of 340 authorized (or registered) restaurants was obtained from the Bolzano Health Authority in Italy. Restaurants from this list were randomly approached until a target of 100 participating restaurants was obtained. This sample size was selected based on feasibility, since the health department staff volunteered their time for the study. The research staff at the Bolzano Health Authority approached restaurant managers either in person or by calling to seek verbal consent to a request to interview food handlers at each restaurant. A signed consent form was obtained from each participant and confidentiality of food handler and restaurant name was assured. For each restaurant, the restaurant owner chose one food handler, usually the main chef, to be interviewed to maximize feasibility of achieving an N of 100 food handlers. The research staff excluded food handlers who did not fluently speak Italian or German or were younger than 18 years of age. The interviews took place at a location suitable for the participating food handlers.

Instrument development and data collection

The survey instrument provided for this study was pilot tested, developed, and employed by the University of Illinois at Chicago School of Public Health (15). Additional questions and edits were made to the instrument to ensure

relevance to the local culture. The edited survey consisted of 57 questions, which obtained information on restaurant and food handler demographics, knowledge, behaviors, and personal hygiene. The response to 40 knowledge questions were in true-false, multiple-choice, and open-ended format.

The primary subject areas in the questionnaire included correct temperatures for cooking and holding foods, hand hygiene, cross contamination, and questions on behavior such as working while ill. The hand hygiene questions determined if the food handlers recognized acceptable and unacceptable hand washing practices, such as washing the hands with soap and rubbing them for approximately 20 seconds. Participants were also asked about their history of food safety training, their preference of learning materials, and their number of years of food handling experience. Data on restaurant characteristics such as type of cuisine, food specialization, and average entrée price were also collected. Restaurants were categorized by size: small (less than 10 tables, or less than 40 seats [covers]), medium (10 to 30 tables, or 40 to 120 seats [covers]), and large (more than 30 tables, or more than 120 seats [covers]). Approval from the University of Illinois at Chicago Institutional Review Board for the Protection of Human Subjects was obtained before the initiation of the study.

Statistical methods

Statistical analysis was performed using SAS 9.2 for Windows (SAS, Chicago, IL). The overall mean knowledge score was the sum of correct answers to 40 knowledge questions. Bivariate analysis was performed to identify potential food handler or restaurant variables that may be associated with the mean knowledge score. T-tests were performed to compare the mean knowledge scores on categorical variables between two groups, such as those based on gender and language. Chi-square tests were performed to compare the number of correct responses between Italian-speaking and German-speaking food handlers. Analysis of Variance (ANOVA) models were performed to compare knowledge scores across categorical variables with more than two groups. We set the significance level at 0.05.

RESULTS

One hundred eighty-two restaurants were approached between June 2010 and November 2010 to achieve a target of 100 restaurants (participation rate = 55%) (Table 1). Reasons for restaurants not participating included refusals (43; 23%), closures (25; 14%), and other exclusion criteria (14; 8%). The largest proportion of participating restaurants had informal dining (52%), served both German and Italian cuisine (51%), and had an average entrée price under 10 Euros (84%).

The mean age of the food handlers was 45 years (range: 20 to 74 years). More participants were male (85%) than female (15%) (Table 2). Of the 100 participating food handlers, 95

TABLE 1. Participating characteristics and knowledge score of Bolzano restaurants (N = 100)

Characteristic	Frequencies		Score (%)	P-value
	N	%		
Restaurant size				0.4171
Small (≤ 10 tables or seating ≤ 40 seats)	9	9.0	27 (68)	
Medium (> 10 tables or seating > 40 seats but < 30 tables or seating < 120 seats)	49	49.0	26 (65)	
Large (≥ 30 tables or seating ≥ 120 seats)	42	42.0	27 (68)	
Food service style				0.6281
Fast food	1	1.0	30 (75)	
Formal	47	47.0	26 (65)	
Informal (diner, delicatessen, other casual)	52	52.0	26 (65)	
Restaurant located inside a hotel?				0.5029
Yes	17	17.0	27 (68)	
No	82	82.0	26 (65)	
Cuisine				0.4487
German only	4	4.0	26 (65)	
Italian only	39	39.0	26 (65)	
German and Italian	51	51.0	27 (68)	
Other (Asian, Chinese, Ethnic, Ethnic and Regional, Kebab and Pizza)	6	6.0	25 (63)	
Food specialization				0.1730
Meat or Poultry	16	16.0	26 (65)	
Seafood	9	9.0	26 (65)	
No specialization but meat, poultry, and/or seafood served	67	67.0	27 (68)	
Vegetarian	8	8.0	23 (58)	
Buffet served at least 2 days per week				0.7292
Yes	11	11.0	26 (65)	
No	89	89.0	26 (65)	

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TABLE 1. Participating characteristics and knowledge score of Bolzano restaurants (N = 100) (continued)

Chain or Independent				0.9539
Chain	5	5.0	26 (65)	
Independent	95	95.0	26 (65)	
Average Entrée Price (Euros) ^a				0.9384
≤ €10	84	84.0	26 (65)	
> €10 but < €20	15	15.0	26 (65)	

^aEntrée price not available for one restaurant

(95%) described themselves as White and 5 (5%) as Asian or Pacific Islander. The primary language was Italian for 47%, German for 41%, and another language for 12%. The largest proportion of participating food handlers were born in Italy (81%), of whom 38 (47%) were German-speaking Italian-born food handlers. Forty-one (41%) German-speaking food handlers and 47 (47%) Italian-speaking food handlers had an educational level no higher than a high school diploma. Sixty-three (63%) food handlers had a history of taking a course on food safety, of whom 54% were Italian-speaking and 46% were German-speaking. Twenty-nine (29%) food handlers had received information on food safety training by their current employer. The mean number of years of handling food was 23 years (range: 0 – 55 years).

Identifying knowledge gaps

The mean knowledge score of the participating food handlers was 26 (65%) out of a possible 40 points (range 16 [40%] to 35 [88%]). Food handlers identifying themselves as White had significantly higher knowledge scores than those who identified themselves as Asian or Pacific Islander (67% vs. 57%, respectively; $P < 0.05$). The scores of male and female food handlers were the same (65%).

Food safety knowledge was substantially low concerning adequate temperatures needed for cooking, cooling and holding foods, cross-contamination, and hygiene. Overall, none of the food handlers knew the correct temperature range at which germs grow, the correct internal temperature to which to cook chicken for at least 15 seconds, and the correct temperature at which hamburgers and other foods containing minced meat, such as meatloaf, should be cooked (Table 3). Only 62% of the food handlers knew that chilled foods should be stored at 55°F (13°C) or lower, and 82% stated that it is true that a metal stem thermometer is most suitable to check the temperature of a chicken breast (Table 3). Only 6% knew that cooked rice may contain germs

causing illness. Fifty-seven percent of the food handlers did not know that consuming minced meat that has not been properly cooked may cause bloody diarrhea, and 40% did not know that raw beef may be contaminated by germs that can cause hospitalization or even death. Only 38% of the food handlers recognized that tasting and smelling normal was not sufficient to ensure that food is perfectly safe.

Low food safety knowledge concerning cross-contamination and hand hygiene was also observed among the food handlers. Only 41% responded that raw meat, even if wrapped in plastic, may not be stored anywhere except on the bottom shelf of a refrigerator. Fifty-six percent knew that if any raw chicken juice drips onto salad greens, the greens must be thrown away. Only 58% of the food handlers said it was true that a person eating a sandwich that had been prepared by a food handler with an infected cut on his or her finger may become sick, with vomiting and diarrhea. Eighty-one percent knew that it is not okay to turn off the water with bare hands after washing them.

Significant differences were observed between Italian-speaking and German-speaking food handlers. Although both groups did poorly when asked if hot roast beef that has been held in a steam table below 135°F (57°C) for over 4 hours should be thrown away ($P < 0.05$), Italian speakers were more knowledgeable than German speakers (38% vs. 24%, respectively). Seventy-nine percent of the Italian-speaking and 95% of the German-speaking food handlers knew that, to check temperatures correctly, a meat thermometer should be inserted in the thickest part of the meat ($P < 0.05$). More German-speaking than Italian-speaking food handlers lacked knowledge that raw meat should not be stored above food that is ready to be served (27% vs. 6%, respectively, $P < 0.05$). Twenty-seven percent of German-speaking and 6% of Italian-speaking food handlers did not recognize that shelled eggs may not be stored in refrigerators above ready-to-eat salads ($P < 0.05$).

TABLE 2. Participating characteristics and knowledge score of Bolzano food handlers (N = 100)

Characteristic	Frequencies		Score (%)	P-value
	N	%		
Age				0.3058
18–29 years	9	9.0	26 (65)	
30–39 years	24	24.0	27 (68)	
40–49 years	29	29.0	25 (63)	
≥ 50 years	38	38.0	27 (68)	
Gender				0.8050
Males	85	85.0	26 (65)	
Females	15	15.0	26 (65)	
Race				0.0162
White	95	95.0	26 (65)	
Asian or Pacific Islander	5	5.0	22 (55)	
Primary Language				0.8657
Italian	47	47.0	26 (65)	
German	41	41.0	26 (65)	
Other	12	12.0	26 (65)	
Education				0.6787
Less than 8th grade	4	4.0	26 (65)	
8–12th grade but no high school diploma	64	64.0	26 (65)	
High school diploma or GED	29	29.0	26 (65)	
Four year college degree or more	3	3.0	29 (73)	
Food safety certification				0.1700
Certified food handlers (managers)	45	45.0	26 (65)	

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TABLE 2. Participating characteristics and knowledge score of Bolzano food handlers (N = 100) (continued)

Certified food handlers (non-managers)	18	18.0	28 (70)	
Food handlers with no certification	37	37.0	26 (65)	
Country of Birth				0.9921
Italy	81	81.0	26 (65)	
Germany	1	1.0	27 (68)	
Austria	2	2.00	27 (68)	
Other (Albania, China, El Salvador, Philippines, Hungary, Maldives, Pakistan, Poland, Romania, Switzerland, and Turkey)	16	16.0	26 (65)	

DISCUSSION

This study demonstrated low food safety knowledge among restaurant food handlers in Bolzano, Italy. The food handlers in this study had an overall mean score of 65%. Knowledge gaps were observed in all the major food safety categories, including temperatures required for cooking, holding, and cooling foods, risk of consuming raw and improperly cooked ground beef, cross-contamination, and hand hygiene. The only characteristic associated with the overall knowledge score was that White food handlers scored higher than Asian or Pacific Islanders (65% v. 55%, respectively).

Inadequate temperature practices have contributed to several foodborne outbreaks (16, 18, 19). In our study, we observed that none of the food handlers knew the safe minimum internal temperature required to cook chicken and the minimum temperature needed to cook hamburgers and minced meat mixes such as meatloaf. In addition, a very low proportion of food handlers correctly identified the temperature range at which germs proliferate. These results are concerning, given that 63% of the food handlers had received training, 45% were managers, and all worked at restaurants where potentially hazardous foods are served. The results, which are similar to data from Neuchâtel, Switzerland and Chicago, Illinois,

and to results of a study in two counties in Oregon, suggest that instruction of food handlers on temperature needs further emphasis (4, 14, 15). The importance of cooking temperatures needs to be emphasized to restaurant managers and food handlers as part of general efforts to reduce the burden of foodborne diseases.

In our study, a low proportion of food handlers knew that consuming raw beef was associated with the potential for significant morbidity and mortality. These results are consistent with similar studies in Neuchâtel, Switzerland, and in Chicago, and the suburbs of Chicago, where a low proportion of food handlers knew that consuming improperly cooked beef may lead to bloody diarrhea (13, 14, 15). Lack of such knowledge may interfere with adherence to proper cooking practices by food handlers in the kitchen, as they may not appreciate why food safety guidelines are critically important. Consuming undercooked ground meat has led to foodborne outbreaks on numerous occasions (5, 7, 10, 11). Given these consistent results in several countries, food safety training for restaurant food handlers needs to emphasize the health implications of non-adherence to safe food practices.

Poor knowledge of hygiene and improper food handling behavior among restaurant food handlers have been cited as contributory factors in several studies and outbreaks (1, 3, 6, 12, 17, 19). Food handlers in our study did not demonstrate a high level of knowledge concerning cross-contamination.

TABLE 3. Frequencies of correct responses to knowledge questions asked of Bolzano restaurant food handlers overall and by primary language (N = 100)

Question (Answer)	Format	Correct Responses		
		Overall N = 100 (%)	German N = 41 (%)	Italian N = 47 (%)
Time and Temperature				
What is the correct internal temperature for cooking chicken? (74°C or 165°F)	Fill-in-the-Blank	0 (0.0)	0 (0.0)	0 (0.0)
What minimum temperature (as measured by a meat thermometer) should hamburgers and other minced meat mixes (such as meatloaf) be cooked? (57°C or 155°F)	Fill-in-the-Blank	0 (0.0)	0 (0.0)	0 (0.0)
Germs that make people sick grow between which temperatures? Minimum. (5°C or 41°F)	Fill-in-the-Blank	9 (9.0)	1 (2.4)	5 (10.6)
Germs that make people sick grow between which temperatures? Maximum. (57°C or 135°F)	Fill-in-the-Blank	8 (8.0)	5 (12.2)	3 (6.4)
If hot, roast beef is placed on a hot plate with a temperature lower than 135°F (57°C) for more than 4 hours, the roast beef must be: (Thrown away)	Multiple Choice	33 (33.0)	10 (24.4)	18 (38.3)
Chilled foods should be stored at 55°F (13°C) or lower. (False)	True/False	62 (62.0)	23 (56.1)	30 (63.8)
In order to check temperatures correctly, where should you insert a meat thermometer? (The thickest part of the meat)	Multiple Choice	84 (84.0)	39 (95.1)	37 (78.7)
What kind of thermometer is most suitable to check the temperature of chicken breast? (A metal stem thermometer)	Multiple Choice	82 (82.0)	35 (85.4)	40 (85.1)
Hand Washing Steps				
Rinse hands under running water. (Okay)	Okay/Not okay	87 (87.0)	39 (95.1)	39 (83.0)
Wash hands with soap and rub for approximately 20 seconds. (Okay)	Okay/Not okay	99 (99.0)	41 (100.0)	46 (97.9)
Dry hands using a kitchen towel or your apron. (Not okay)	Okay/Not okay	92 (92.0)	36 (87.8)	46 (97.9)
Turn off the water using your bare hands. (Not okay)	Okay/Not okay	81 (81.0)	33 (80.5)	41 (87.2)
Hygiene				
Should you put ice in a glass by using tongs*? (Yes)	Yes/No	94 (94.0)	35 (85.4)	47 (100.0)
Should you put ice in a glass by using an ice-scoop? (Yes)	Yes/No	86 (86.0)	35 (85.4)	41 (87.2)
Should you put ice in a glass by scooping the glass into the ice? (No)	Yes/No	81 (81.0)	35 (85.4)	36 (76.6)

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TABLE 3. Frequencies of correct responses to knowledge questions asked of Bolzano restaurant food handlers overall and by primary language (N = 100) (continued)

Should you put ice in a glass by picking up ice with your bare hands? (<i>No</i>)	Yes/No	100 (100.0)	41 (100.0)	47 (100.0)
If a food handler has an infected cut on one of their fingers and then prepares a sandwich which is kept luke warm but not hot, the person eating the sandwich may manifest vomiting or diarrhea. (<i>True</i>)	True/False	58 (58.0)	26 (63.4)	21 (44.7)
While at work, it is not necessary to wash hands if you have urinated without defecating. (<i>False</i>)	True/False	97 (97.0)	41 (100.0)	45 (95.7)
Gloves for handling ready-to-eat food must be disposed of if the food handling process is interrupted. (<i>True</i>)	True/False	99 (99.0)	41 (100.0)	47 (100.0)
If any raw chicken juice drips on to salad greens, washing the greens is not enough. They must be thrown away. (<i>True</i>)	True/False	56 (56.0)	23 (56.1)	25 (53.2)
Should you wash your hands carefully if you use food paper to handle food?* (<i>Yes</i>)	Yes/No	89 (89.0)	40 (97.6)	39 (83.0)
Should you wash your hands carefully if you use a spatula or tongs to handle food? (<i>Yes</i>)	Yes/No	75 (75.0)	33 (80.5)	35 (74.5)
Should you wash your hands carefully if you use single-use gloves to handle food? (<i>Yes</i>)	Yes/No	64 (64.0)	27 (65.9)	29 (61.7)
Cleaning and Sanitizing				
The difference between cleaning and sanitizing is: (<i>Cleaning means removing food or other dirt from a surface, whereas sanitizing means reducing the amount of germs on a clean surface in order to reach the appropriate safety level</i>)*	Multiple Choice	76 (76.0)	36 (87.8)	33 (70.2)
Other				
Cooked rice may contain germs causing indisposition. (<i>True</i>)	True/False	6 (6.0)	2 (4.9)	2 (4.3)
Beef may be left to thaw in cold water. (<i>True</i>)	True/False	26 (26.0)	12 (29.3)	9 (19.2)
It is perfectly safe to consume food that tastes and smells normal. (<i>False</i>)	True/False	38 (38.0)	17 (41.5)	17 (36.2)
Raw meat may be stored below food that is ready to be served. (<i>True</i>)	True/False	39 (39.0)	18 (43.9)	13 (27.7)
As long as it is wrapped in plastic film, raw meat may be stored anywhere inside a refrigerator. (<i>False</i>)	True/False	41 (41.0)	14 (34.2)	22 (46.8)
Microwave ovens may be used to thaw beef. (<i>True</i>)	True/False	43 (43.0)	15 (36.6)	24 (51.1)
Consuming minced meat that has not been properly cooked may cause bloody diarrhea. (<i>True</i>)	True/False	43 (43.0)	16 (39.0)	20 (42.6)

TABLE 3. Frequencies of correct responses to knowledge questions asked of Bolzano restaurant food handlers overall and by primary language (N = 100) (continued)

It is safe to consume fish (such as raw tuna) stored at not sufficiently low temperatures but cooked correctly and at the correct internal temperature. (<i>False</i>)	True/False	51 (51.0)	22 (53.7)	21 (44.7)
Raw beef may be contaminated by germs causing hospitalization or even death. (<i>True</i>)	True/False	60 (60.0)	22 (53.7)	32 (68.1)
Thawing chicken breasts on counters is a safe procedure. (<i>False</i>)	True/False	71 (71.0)	28 (68.3)	36 (76.6)
Shelves covered in aluminum foil may interfere with the circulation of cold air inside a refrigerator. (<i>True</i>)	True/False	73 (73.0)	29 (70.7)	35 (74.5)
Beef may be left to thaw on counters. (<i>False</i>)	True/False	76 (76.0)	33 (80.5)	34 (72.3)
Raw meat may be stored above food that is ready to be served.* (<i>False</i>)	True/False	77 (77.0)	22 (53.7)	44 (93.6)
It is perfectly safe to cool warm food in refrigerators. (<i>False</i>)	True/False	81 (81.0)	30 (73.2)	41 (87.2)
It is safe to store products with closer 'best before' dates in front of those with more distant 'best before' dates. (<i>True</i>)	True/False	84 (84.0)	33 (80.5)	40 (85.1)
Shelled eggs may be stored in refrigerators above ready-to-eat salads.* (<i>False</i>)	True/False	85 (85.0)	30 (73.2)	44 (93.6)
As long as they are labeled correctly, chemical substances may be stored where food is prepared. (<i>False</i>)	True/False	86 (86.0)	34 (82.9)	41 (87.2)
Raw eggs may contain germs causing indisposition. (<i>True</i>)	True/False	87 (87.0)	36 (87.8)	43 (91.5)
Beef may be left to thaw in refrigerators. (<i>True</i>)	True/False	91 (91.0)	38 (92.7)	42 (89.4)
Raw chicken may be contaminated by germs causing serious illness to human beings. (<i>True</i>)	True/False	91 (91.0)	38 (92.7)	44 (93.6)

Although a high proportion of food handlers reported good hygiene practices, all food handlers should report good hygiene behavior practices. Only 81% of the food handlers found it unacceptable to turn off the water using bare hands, and only 89% stated that hands need to be washed carefully even if food paper is used to handle food. It is possible that food handlers may face barriers that prevent them from practicing good hygiene. Past studies have reported that in the restaurant environment, time pressure, high volume of business, stress, type of restaurant, problems with availability of supplies, inadequate food handler training and lack of incentive and desire to perform good food safety practices by managers and food handlers are the most frequently reported barriers (6, 9, 16). Food safety training should acknowledge these barriers when providing training on

cross-contamination and hygiene practice behaviors in the restaurant environment, urge efforts to overcome them, and teach managers to ensure that all food handlers have excellent hygiene knowledge and behavior.

Language may contribute to restaurant-associated foodborne illnesses if it interferes with communication of educational food safety information. A study in Los Angeles County in 2002–2003 revealed that food establishments with higher proportions of Spanish-speaking workers tended to have more violations during restaurant inspection (8). Debess et al. reported that Hispanics in Oregon scored lower on food safety knowledge than non-Hispanic Whites (54% v. 72%, respectively) (4). In Chicago, language-specific differences were observed between English-speaking and Spanish-speaking food handlers in their knowledge of

temperatures for cooking, holding, and refrigerating foods, cross-contamination, and hygiene. Spanish-speaking food handlers also had significantly lower overall knowledge scores than English-speaking food handlers (15). In our Italian study, we found some significant differences in knowledge between Italian-speaking and German-speaking food handlers. Although language was not associated with the overall knowledge score, there was at least a 13% difference in the proportion of food handlers correctly answering questions concerning storage of meat and eggs and temperatures for holding foods. The differences we observed could be related to cultural food practices, as those might affect responses on a food safety survey. For example, in a study of restaurant food handlers in Neuchâtel, Switzerland, few knew that consuming insufficiently cooked raw beef can lead to hospitalization and even death (14). Since raw beef in the form of steak tartare is served in many Neuchâtel restaurants, even food handlers who have heard of such a dramatic association may be reluctant to accept such information. However, the role of cultural differences in food safety knowledge and behavior has not been well studied, so we cannot fully explain this finding. We recommend that training and related educational materials should be sensitive to possible cultural differences.

One limitation of our study is lack of generalizability, because of selection bias. Twenty-three percent of the sampled restaurants refused to participate. The data may not be representative of all Bolzano food handlers or to all food handlers in Italy because, although the restaurants were

chosen randomly, the restaurant owners chose the food handler to be interviewed, on the basis of convenience and feasibility. Additionally, only one food handler per restaurant was interviewed. Thus, this selection bias may have led to an over estimation of food safety knowledge, as more knowledgeable food handlers could have participated in the study. This study was also limited by a small sample size, leading to low statistical power.

CONCLUSION

Data on food safety among restaurant food handlers in Italy are scarce. This study provides the first examination of food safety knowledge in Northern Italy and reveals areas in need of attention, including language-specific differences between Italian-speaking and German-speaking food handlers. These data also provide a foundation for future research and educational intervention to increase food handler food safety knowledge and to guide policies to improve food safety training among food handlers in this region. We recommend that similar food safety knowledge studies be performed in other jurisdictions to determine local educational needs. When feasible, they should include study of behavior to allow for correlation of knowledge and behavioral practices.

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All local environmental health jurisdictions in the U.S. and Canada are encouraged to apply, if they meet the following basic criteria:

- Sustained excellence over the preceding four to six years, as documented by specific outcomes and achievements, and evidenced by continual improvements in the basic components of a comprehensive program;
- Demonstrated improvements in planning, managing and evaluating a comprehensive program;
- Innovative and effective use of program methods and problem solving to identify and reduce risk factors that are known to cause foodborne illness; and

- Providing targeted outreach; forming partnerships; and participating in forums that foster communication and information exchange among the regulators, industry and consumer representatives.

The award is sponsored by the Conference for Food Protection, in cooperation with the American Academy of Sanitarians, American Public Health Association, Association of Food and

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