Food Handlers and Foodborne Diseases: Knowledge, Attitudes, and Reported Behavior in Italy

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ABSTRACT

The purpose of this study was to evaluate knowledge, attitudes, and behavior concerning foodborne diseases and food safety issues among food handlers in Italy. Face-to-face interviews were conducted within a random sample using a structured questionnaire. Of the 411 food handlers responding, 48.7% knew the main foodborne pathogens (*Salmonella* spp., *Staphylococcus aureus, Vibrio cholerae* or other *Vibrio* spp., *Clostridium botulinum,* hepatitis A virus), and this knowledge was significantly greater among those with a higher education level, in practice from a longer period of time, and who had attended education courses ($P < 0.05$). A vast majority (90.4%) correctly indicated those foods classified as common vehicles for foodborne diseases, and only 7.1% of food handlers were able to name five different food vehicles, each of which transmit one of the five pathogens. The proportion of those who were able to specify a food vehicle that transmitted hepatitis A virus was significantly higher for those with a higher educational level and with a longer food-handling activity. A positive attitude toward foodborne diseases control and preventive measures was reported by the great majority of food handlers, and it was more likely achieved by those who had attended education courses. This attitude was not supported by some of the self-reported safe practices observed for hygienic principles, because only 20.8% used gloves when touching unwrapped raw food, and predictors of their use were educational level and attending education courses. Results strongly emphasize the need for educational programs for improving knowledge and control foodborne diseases.

Diseases caused by contaminated food or drink are still one of the leading causes of morbidity in several countries and under certain circumstances they can lead to serious consequences. In Italy, in 1996 over 26,000 foodborne illness were reported, and *Salmonella* spp. and hepatitis A accounted for over 90% of all cases *(18).* In the past decades the epidemiology of foodborne diseases is changing with several new important microorganisms and reemerging pathogens, and some of them present few risks for most individuals but life-threatening risks to others *(5, 7, 9, 13, 19).* These changes may be attributed to several factors including, for example, demographic and lifestyle of consumers, developments in food processing, preparation and handling practices, and perception and awareness of food hazards.

Despite continuing progress made in food quality and safety, several foodborne disease outbreaks have been reported in the literature, and the most frequently identified factors were cross-contamination, improper cooling, improper storage or holding foods at room temperature for long duration, contaminated raw food/ingredient, and poor personal hygiene by persons who handle foods *(3, 6, 15, 16, 21).* Indeed, most outbreaks of staphylococcal food poisoning follow the handling of cooked foods by persons who carry enterotoxigenic staphylococcal in their nares or skin and outbreaks of foodborne salmonellosis from raw to

cooked foods or to foods not subjected to further cooking via hands. In particular, food handlers play an important role in food safety and in the transmission of food poisoning, because they may introduce pathogens into foods during production, processing, distribution, and preparation.

Therefore, because this topic merits particular attention and information is strongly needed, a survey was designed to obtain data about knowledge, attitudes, and behavior concerning foodborne diseases and food safety issues among food handlers in Italy.

MATERIALS AND METHODS

From May to June 1999, a random sample of food handlers in the area of Catanzaro, Italy, was invited to participate in the study. Informed consent was obtained, and confidentiality of response was assured.

Face-to-face interviews were conducted within the whole target sample using a structured questionnaire (a copy is available upon request from the corresponding author) covering aspects on food handlers' demographics, practice characteristics, knowledge about foodborne diseases that more frequently occur in Italy, knowledge about food hygiene, attitudes about foodborne diseases control and prevention, behaviors regarding use of preventive cross-contamination of foods measures, and food-handling practices. All interviews were conducted in the respondent's own work place by previously trained and standardized interviewers *(1).* The sociodemographic variables were sex, age, and education level; the practice variables were work activity, duration, temporariness, and whether it involved touching unwrapped food to be consumed raw or without further cooking; the routine food contamination

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control procedure variables were washing of hands before and after touching unwrapped food and use of protective gloves.

All the questions about attitudes were scored on a three-point Likert scale with options for agree, uncertain, and disagree; the questions about knowledge on foodborne diseases were in a three-answer format of yes, no, and do not know. One of the education questions was of the yes/no format. Responses regarding use of preventive cross-contamination of food measures were in a five-answer format of never, rarely, sometimes, often, and always.

The questions concerning the level of knowledge about the most frequently foodborne diseases that occur in Italy asked to name pathogens that were associated with foods and to name foods that were associated with the transmission of foodborne pathogens. Respondents who named a probable food vehicle for the transmission of a foodborne pathogen were classified as knowing a food vehicle for that pathogen. The foods classified as common vehicles for the transmission of *Salmonella* spp. were beef, pork, lamb, poultry, milk, eggs, and mayonnaise; *Clostridium botulinum,* fish and canned foods; *Staphylococcus aureus,* eggs, fish, meat, reheated leftovers, stews, homemade soups, milk, and improperly handled foods; *Vibrio cholerae* or other *Vibrio* spp., shellfish, raw or undercooked fish, and water; and hepatitis A virus, shellfish, shellfish eaten raw, improperly handled food, and water.

Statistical analysis. Multiple logistic regression analysis was performed. Four models were developed to identify the variables that affect the following outcomes of interest: knowledge about the pathogens that were associated with food that more frequently occurs in Italy (*Salmonella* spp., *S. aureus, V. cholerae* or other *Vibrio* spp., *C. botulinum,* hepatitis A virus) (model 1); knowledge about foods that were associated with the transmission of hepatitis A virus (model 2); use of gloves (model 3); attitudes about foodborne diseases prevention and control measures (model 4). For purposes of analysis, outcome variables originally consisting of multiple categories were reduced to two levels. In model 1, food handlers were classified as those who knew all the pathogens associated with foods and all others; in model 2, they were classified as those who knew foods that were associated with the transmission of hepatitis A virus and all others; in model 3, those involved in touching unwrapped raw or cooked food to be consumed without further cooking were grouped according to whether they reported use of gloves and all others; in model 4, those who agreed with the statements that foodborne disease prevention and control measures are necessary versus all others. In all models the explanatory variables included were the following: age (continuous, in years), sex (male = 0, female = 1), education level (≤5 years of schooling = 1, 8 years = 2, 13 years or college degree = 3), duration of work activity (continuous, in years), and having attended continuing education courses (no = 0, yes = 1). The model-building strategy suggested by Hosmer and Lemeshow *(10)* was used and included the following steps: (i) univariate analysis of each variable considered using the appropriate test statistic (chi-square test or *t* test); (ii) inclusion of any variable whose univariate test has a *P*-value lower than 0.25; (iii) backward elimination of any variable that does not contribute to the model on the ground of the likelihood ratio test, using a cutoff of 0.05 level significance; variables whose exclusion alter the coefficient of the remaining variables are kept in the model; (iv) testing of interaction terms using a cutoff of 0.15 level significance. Adjusted odds ratio and 95% confidence intervals were calculated. The data were analyzed using the Stata software program *(17)*.

TABLE 1. *Selected characteristics of the study population*

Variables	n	%
Sex (411)[a]		
Male	276	67.2
Female	135	32.8
Age group, years (410)[a]		
15–20	39	9.5
21–25	71	17.3
26–30	67	16.3
31–35	70	17.1
36–40	51	12.5
41–45	39	9.5
46–50	24	5.9
>50	49	11.9
Mean ± SD	34.4 ± 11.9	
Education, years (407)[a]		
≤5	53	13
8	208	51.1
13 or college degree	146	35.9
Duration of work activity, years (411)[a]		
≤1	59	14.4
2–5	97	23.6
6–10	70	17
11–15	60	14.6
16–20	55	13.4
>20	70	17
Mean ± SD	12.1 ± 10.7	
Temporary work activity (411)[a]		
Yes	75	18.2
No	336	81.8

[a] The number of participants responding to the questions is indicated in parentheses.

RESULTS

From a total of 429 respondents approached to take part in the study, a total of 411 agreed to participate for a response rate of 95.9%. The principal characteristics of the study population of food handlers are summarized in Table 1. The mean age was 34.4 years (range 15 to 77 years), two-thirds were males, more than one-third had attained a middle- or higher-school education level, and the mean duration of work activity was 12.1 years.

The respondent's knowledge about diseases associated with foods and about food vehicle for the transmission of a foodborne pathogen are presented in Table 2. Food handlers did not know most of the foodborne pathogens, because 86.3% and 79.3% have heard, respectively, of *Salmonella* spp. and *S. aureus* as associated with foods; a much smaller proportion of respondents recognized the other pathogens. Overall, only 48.7% of survey participants knew about all of the five foodborne pathogens, and the results of multiple logistic regression analysis showed a significant association in the knowledge level according to education level, years of work activity, and attending a continuing education courses, because it was greater among food handlers with a higher rather than lower education

TABLE 2. *Respondents' knowledge about foodborne pathogen and food vehicle for their transmission*

Pathogen	Aware of pathogen		Aware of food vehicle	
	n	%	*n*	%
Salmonella spp. (409)[a]	353	86.3	206	50.4
S. aureus (411)[a]	326	79.3	123	29.9
V. cholerae or other *Vibrio* spp. (411)[a]	234	56.9	84	20.4
Hepatitis A virus (411)[a]	216	52.6	88	21.4
C. botulinum (411)[a]	212	51.6	89	21.7

[a] The number of participants responding to the questions is indicated in parentheses.

level, among those in practice from a longer period of time compared to those subjects with a lower period of work activity, and those who had attended education courses (model 1 in Table 3).

A vast majority of food handlers (90.4%) correctly indicated those foods classified as common vehicles for foodborne diseases, when respondents were asked what food(s) they associated with the transmission of each pathogen, the proportion of those who were able to name a food vehicle that transmitted diseases was not satisfactory. Indeed, overall only a very small percentage, 7.1%, of food handlers were able to name five different food vehicles, each of which transmit one of the five pathogens, and the highest value was reported for *Salmonella* spp. (50.4%); whereas,

lower percentages for *S. aureus* (29.9%), *C. botulinum* (21.7%), hepatitis A virus (21.4%), and *V. cholerae* or other *Vibrio* spp. (20.4%). Respondents' attributions of the food items suggested as infection vehicles showed that beef was the most frequently named food (88%), followed by dairy products (87.1%), eggs (86.8%), and shellfish and finfish (79.1%). Results of multiple logistic regression analysis indicated that the proportion of those who were able to specify a food vehicle that transmitted hepatitis A virus was significantly higher for food handlers with a higher educational level and it increased with increasing years of food-handling activity (model 2 in Table 3).

Table 4 shows the food handlers attitudes toward foodborne diseases prevention and control. A positive attitude was reported by the great majority of food handlers who agreed that a correct application of routine food contamination control procedures provide adequate protection against transmission of infections either for food handlers or for consumers (92.9%), and that washing hands before preparing food reduces the risk of food poisoning (97.3%). More than two-thirds believed that the use of gloves for those involved in touching unwrapped food reduces the risk of foodborne diseases for food handlers (74.4%) and consumers (80.5%), and 69.1% agreed that it was necessary to wear protective gloves while handling unwrapped raw or cooked foods. This positive attitude was not supported by some of the self-reported safe practice observed for hygienic principles, because of those involved in touching unwrapped raw food only 20.8% claimed that they use pro-

TABLE 3. *Results of the logistic regression models*

Variable	OR[a]	SE[b]	95% CI	*P*-value
Model 1: Knowledge about the pathogens that were associated with food				
Log-likelihood = −258.05, chi-square = 41.18 (5 d.f.), *P* < 0.0001				
Education level	1.83	0.32	1.30–2.57	<0.0001
Duration of work activity, years	1.03	0.02	1.01–1.06	0.038
Attending continuing education course	1.78	0.51	1.01–3.12	0.045
Sex	0.82	0.19	0.51–1.30	0.39
Age	1.02	0.01	0.99–1.05	0.079
Model 2: Knowledge about the transmission of hepatitis A virus				
Log-likelihood = −203.88, chi-square = 16.23 (3 d.f.), *P* = 0.0010				
Duration of work activity, years	1.03	0.01	1.01–1.06	0.009
Education level	1.63	0.33	1.10–2.43	0.016
Attending continuing education course	1.73	0.51	0.97–3.08	0.07
Model 3: Use of gloves				
Log-likelihood = −154.82, chi-square = 18.83 (3 d.f.), *P* = 0.0003				
Attending continuing education course	2.85	0.90	1.53–5.30	0.001
Education level	1.64	0.40	1.02–2.64	0.039
Duration of work activity, years	1.02	0.01	0.99–1.05	0.15
Model 4: Attitudes about foodborne diseases prevention and control measures				
Log-likelihood = −271.19, chi-square = 9.33 (3 d.f.), *P* = 0.025				
Attending continuing education course	1.73	0.46	1.03–2.92	0.04
Age	1.02	0.01	0.99–1.03	0.08
Education level	1.20	0.19	0.87–1.65	0.26

[a] Odds ratio.
[b] Standard error.

TABLE 4. *Attitudes of respondents toward foodborne disease prevention and control*

Statement	% agree	% uncertain	% disagree
Use of gloves is required for those involved in touching unwrapped raw foods	77.1	2.4	20.5
Use of gloves is required for those involved in touching unwrapped cooked foods	60.6	7.5	31.9
Correct application of routine food contamination control procedure provides adequate protection against infection transmission for food handlers	93.9	2	4.1
Correct application of routine food contamination control procedure provides adequate protection against infection transmission for consumers	96.8	1.7	1.5
Washing hands before handling unwrapped raw or cooked foods reduces the risk of food poisoning	97.3	0.7	2
Use of gloves when handling unwrapped raw or cooked foods provides adequate protection against infection transmission for food handlers	74.4	5.6	20
Use of gloves when handling unwrapped raw or cooked foods provides adequate protection against infection transmission for consumers	80.5	3.9	15.6

tective gloves. Their use was more likely by food handlers with a higher level of education and by those who have attended continuing education courses, because food handlers who did not attend courses had an adjusted odds ratio of 2.85 (95% confidence interval = 1.53 to 5.30) compared to those who have attended education courses (model 3 in Table 3). This disparity between attitudes and behaviors was not observed for hand washing, because, respectively, 68.7% and 66.2% routinely washed their hands before and after handling any food. Results of the regression analysis indicated that the positive attitude toward foodborne disease control and preventive measures was significantly higher in those respondents who had attended continuing education courses (model 4 in Table 3). In all models, no significant interactions among the variables were detected.

The respondents learned about foodborne diseases primarily from mass media (37.2%) and education courses (17.5%); however, more than two-thirds wanted to learn more (74.1%).

DISCUSSION

Few studies have analyzed in the past decade the food hygiene and foodborne diseases knowledge, attitudes, and behaviors within specific populations. In particular, these surveys have investigated food hygiene behavior among hospital food handlers *(14)*, foodborne illness knowledge *(2, 8, 24)*, and preventive behaviors *(8)* in consumers, food safety knowledge, and practice among elderly people living at home *(11)*, and college students' attitudes, practices, and knowledge of food safety *(20)*. To our knowledge, none of these previous studies have profiled the food handlers knowledge, attitudes, and behaviors toward foodborne diseases and whether or not they are adequately and properly protecting themselves and the consumers from the transmission of diseases. The results of this investigation, which represent the first opportunity to evaluate all of these issues of Italian food handlers toward foodborne diseases and food hygiene, provide detailed information.

Our study results demonstrate a limited level of knowledge of food handlers, because less than half (48.7%) knew all the foodborne pathogens investigated, and the proportion of those who identified the pathogens that were asso-

ciated with foods ranged from 86.3% for *Salmonella* spp. to 51.6% for *C. botulinum.* A lower degree of knowledge was reported in a previous U.S. national telephone survey on consumers, because the values reported ranged from 80.2% for *Salmonella* spp. to 25.1% for *V. cholerae* or other *Vibrio* spp. *(2).* Moreover, only 7.1% knew common food vehicles for transmission of foodborne diseases, and beef and dairy products were the most frequently named food; whereas, only about two-thirds identified finfish and shellfish. The results regarding shellfish and finfish are not very encouraging, because a large percentage of foodborne disease outbreaks have been reported to be associated with consumption of those foods *(2, 12, 22, 25).* Knowledge about foods associated with the transmission of pathogens ranged from 50.4% for *Salmonella* spp. to 20.4% for *V. cholerae* or other *Vibrio* spp., and these values were considerably higher than those reported by Altekruse et al. *(2),* in the already mentioned U.S. survey, for all pathogens considered, except for *Salmonella* spp. (25.6%) and *C. botulinum* (23.1%). Of concern is that only 21.4% of respondents identified a food vehicle that transmitted hepatitis A virus, because the results reported in a previous study by one of us on anti-hepatitis A virus prevalence among food handlers showed a seropositivity of 68.7% and almost two-thirds of the younger population have no antibodies yet and are at risk of infection *(4).* Therefore, our results suggest that this lack of knowledge limits Italian food handlers and may contribute to the transmission of the virus to a large number of people during food manipulation. Findings regarding the effect of different variables on knowledge indicate that lower duration of food-handling activity, even after making adjustment for age, lower educational level, and not attending education courses were significantly more likely in those with lower levels of knowledge about pathogens associated with foods and about foods that were associated with the transmission of hepatitis A virus.

Survey participants showed a positive attitude, because a vast majority (92.9%) agreed that the correct application of routine food contamination control procedures provide adequate protection against infection transmission either for food handlers or for consumers. However, it should be pointed out that these findings were not supported by food

handlers' practices. Indeed, because food products consumed raw or without further cooking may become infected during harvesting and processing and that outbreak investigations indicate that food may also become contaminated by the unwashed hands of an infected food handler, the fact that only 20.8% used gloves and approximately two-thirds washed their hands before (68.7%) and after (66.2%) handling either unwrapped cooked or uncooked food revealed an unacceptable behavior *(23)*. This last percentage was similar to the value of 66% reported by Altekruse et al. *(2),* and it was considerably lower than the 100% found by Oteri and Ekanem *(14),* who surveyed food handlers in hospital settings in Nigeria. In reading the results of the Nigerian study, however, it should be stressed that of the employees observed, only a very small proportion of them, 28.6%, were seen to have actually washed hands between handling food. Although this was not an aim of the study, the survey team frequently reported correspondence between the procedures claimed and those observed. Furthermore, we found that attending continuing education courses was significantly associated with use of gloves and sample's attitudes, because those who have attended courses had a higher use of gloves and demonstrated a better attitude.

In conclusion, data from this survey provide some insights into inadequacies in knowledge and practices of food handlers and considering the extreme importance of safe practice in their activity, they strongly emphasize the need for further educational programs in order to control these diseases and prevent consequent outbreaks among consumers in the food service industry.

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