Journal of Health Sciences

RESEARCH ARTICLE Open Access

Public health challenges in households - Food safety

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ABSTRACT

Introduction: Most foodborne illnesses can be prevented by proper food preparation. The estimated prevalence of these diseases is 300-350 times higher than the data available today, which represents only the "tip of the iceberg." Although restaurants are cited as the most common sites for food poisoning, these cases are three times more likely to occur in households. Therefore, assessing food consumer knowledge and practices provides a basis for formulating and designing programs to promote food safety in households.

Methods: Representatives of 384 households in six urban and rural municipalities in Sarajevo Canton participated in the survey. A previously designed and validated household food safety questionnaire was used to explore the knowledge and practices of the population regarding household food safety. Respondents' knowledge and practices were assessed by the score they achieved, with one point awarded for each correct answer. The range of scores for knowledge and practices was divided into quartiles. The Chi-square test was used to examine whether there was a difference between expected and observed scores in one or more categories in contingency tables.

Results: In the assessment of food safety knowledge, 62% of the respondents had good knowledge, 33.1% had average knowledge, and 4.9% had poor knowledge. The results showed that 59.4% of the respondents had average practices and 22.4% had poor practices regarding food safety in their households. It was confirmed that various socioeconomic factors had a significant influence on consumers' knowledge and practice regarding food safety in their households ($p < 0.05$).

Conclusions: Nowadays, the topic of food safety is rarely discussed in households, and the public is not aware of the risks they face. Urgent action should be taken to raise collective awareness of the importance of household food safety to public health.

Keywords: Food safety; households; knowledge; practices

INTRODUCTION

Most foodborne illnesses occur after consuming food or drink contaminated with various pathogens, microbes, or toxins. Symptoms vary depending on the underlying cause and usually include vomiting, fever, pain, and occasionally diarrhea. According to the World Health Organization, 1.8 million people die each year from diarrheal diseases caused by contaminated food or water. It is estimated that the prevalence of these diseases is 300-350 times higher than the available data (1). While it is known that food poisoning occurs most frequently in restaurants, it is less well known that these cases occur three times more frequently in private kitchens (2). In addition, foodborne illnesses tend to be sporadic and affect small groups or individuals, making identification difficult for health authorities (3,4). However, the problem has been recognized, and prevention programs, along with control measures, have been identified as an essential part of protecting public health from food safety problems (1). It is widely recognized that proper food preparation is the key to prevention. Therefore, authorities are increasingly emphasizing the importance of hygienic hand washing and home food handling, preparation, and storage, in addition to a continued focus on manufacturers and legislation (5). Their goal is to develop effective strategies to encourage desirable behaviors and discourage inappropriate ones. However, formulating and designing successful food safety promotion and education programs is only possible by assessing the knowledge and practices of food consumers (6,7). The scientific community now agrees that more research should be conducted on this topic (2,8). To our knowledge, no studies on this topic have been conducted in our region. This view formed the basis for the research objective, which aimed to investigate the level of knowledge and consumer behavior regarding food safety in Sarajevo Canton, Bosnia and Herzegovina.

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Submitted: 19 October 2023/Accepted: 08 December 2023

DOI: https://doi.org/10.17532/jhs.2023.2591

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METHODS

This cross-sectional study was conducted between November 2020 and July 2021. Representatives of 384 households in six urban and rural municipalities in Sarajevo Canton took part in the survey. This corresponds to a sample size of 112,630 households with a confidence interval of 95 and a confidence level of 5 (9). The snowball method was used, which is best suited for studying the lifestyles of different population groups (10). The respondents representing the households were familiarized with the procedure and objectives of the study prior to participation and provided written informed consent. Their personal data were encrypted and permanently protected in accordance with legal requirements and the principles of the Declaration of Helsinki. The results of this study are part of a larger study on public health significance and risk assessment of food safety in households (11), which was approved by the Ethics Committee of the University of Sarajevo, Faculty of Health Studies.

A previously developed and validated household food safety questionnaire was used as a tool to assess respondents' knowledge and practices regarding household food safety. The overall Cronbach's alpha index and content validity of the questionnaire were 0.842 and 0.95, respectively (12). The instrument consists of three sections: 18 general/demographic and socioeconomic questions, 11 knowledge questions, and 10 practice questions. Most of the answers were formulated on a four-point Likert scale (strongly agree, agree, disagree, and do not know). In addition, the questionnaire contains several closed questions.

The respondents' knowledge and practice were assessed based on the number of points achieved, with one point being awarded for each correct answer. The range of scores for knowledge and practice was divided into quartiles. Excellence was awarded for more than 75% correct answers per segment, 50-75% good, and <50% unsatisfactory or poor.

A database was created using Microsoft Office Excel 2016 to store the collected data. Absolute numbers and percentages were used for categorical variables. The Chi-square test was applied to examine the differences between expected and observed values in one or more categories in contingency tables. IBM SPSS Statistics 26.00 (IBM Corporation, Armonk, New York, USA) was used for statistical data analysis. Statistical significance was defined as $p \leq 0.05$.

RESULTS

Of the 384 respondents, the majority were female (93.5%), lived in urban areas (67.2%), were married with children (65.4%), and had a monthly income of between EUR 500 and EUR 1000 (60.7%) (Table 1). More than half of the respondents (51.1%) were in the age group of 36-51 years, while the lowest participation was in the age group of 18-25 years (5.5%). A total of 49.7% of respondents had a high school diploma, followed by 36.7% with a university education and 3.4% with a primary school diploma. People from vulnerable groups (pregnant women or people with chronic diseases) lived in a quarter of households (25.5%).

Knowledge was assessed based on 11 questions (Table 2). For eight questions, more than three-quarters of the respondents gave correct answers (75%), while the answers to three questions ranged between 67.4% and 72.4%. Most respondents knew that direct contact between unwashed hands and ready-to-eat food can lead to bacterial contamination (89.6%). Overall, 88.5% of respondents were very knowledgeable about hygiene practices and their association

TABLE 1. Sample description (n=384)

Demographic and socioeconomic characteristics	Category	Percent
Gender	Male	6.5
	Female	93.5
Residence	Urban	67.2
	Rural	32.8
Age	18-25	5.5
	26-35	23.2
	36-51	51.0
	51-65	16.2
	≥65	4.1
Per household monthly income (EUR)	<250	2.1
	251-500	11.5
	501-1,000	60.7
	>1,000	25.8
Marital status	Single	12.0
	Married without children	18.8
	Married with children	65.4
	Others	3.9
Educational level	Elementary school	3.4
	High school	49.7
	University and above	36.7
	Unknown	10.2
Vulnerable groups in households	Yes	25.5
	No	74.5

TABLE 2. Respondent's knowledge of food safety in households

Questions	Correct (%)	Incorrect (%)
1. Microbes invisible to the naked eye can cause food poisoning.	88.5	11.5
2. When eating raw or undercooked meat, there is a high risk of food poisoning.	84.1	15.9
3. Unhygienic practices are a source of microorganisms that can contaminate food.	89.1	10.9
4. If we eat cooked food kept at room temperature for more than 4 h, there is a high risk of food poisoning.	72.4	27.6
5. Direct contact between unwashed hands and ready-to-eat foods results in bacterial contamination of the food.	89.6	10.4
6. Defrosting frozen meat on the lowest shelf of the refrigerator is the correct method.	67.4	32.6
7. Eating undercooked eggs (soft yolks) can cause food poisoning, often resulting in hospitalization.	67.4	32.6
8. Insects, such as cockroaches and flies, can transmit bacteria that lead to food poisoning.	88.5	11.5
9. Leftover-cooked foods should be thoroughly warmed and cooked before consumption.	78.4	21.6
10. Besides bacteria, fungi and viruses can also cause foodborne illnesses.	79.9	20.1
11. Do you think it is appropriate to refreeze thawed meat?	89.1	10.9

with microorganisms, as well as the correct defrosting procedure for meat (89.1%). The percentage of correct answers was lower for the questions on the correct defrosting of meat on the bottom shelf of the fridge (67.4%) and on the link between eating undercooked eggs and food poisoning and hospitalization.

The respondents' knowledge regarding socioeconomic characteristics is shown in Table 3. Suburban respondents had poorer knowledge (57.9%) than urban respondents (42.1%). The Chi-square showed significant differences in respondents' knowledge at the 0.010 level. In terms of age, 6.1% of respondents between 36 and 50-years-old and 3.8% of those over 51-years-old had poor knowledge overall (p = 0.017). The differences in marital status were also statistically significant (p = 0.004). About 6.4% of respondents who were married and had children had poor knowledge. In terms of monthly income, respondents with an income of over EUR 1000 had the best knowledge (73.7%). Poor knowledge was reported by 6.8% of respondents with an income between EUR 500 and EUR 1000 and 68.4% of respondents with secondary education (p < 0.001). In households with three or four family members, 68.4% of respondents had poor knowledge of food safety (p = 0.032).

TABLE 3. Knowledge of respondents in relation to socioeconomic characteristics

Variable	Evaluation			χ2	p
	Good (%)	Average (%)	Poor (%)		
Gender					
Male	5.9	8.7	0.0	2.443	0.295
Female	94.1	91.3	100.0		
Age					
18-25	4.2	8.7	0.0	15.456	0.017
26-35	25.2	19.7	21.1		
36-50	54.6	42.5	63.2		
>51	16.0	29.1	15.8		
Educational level					
Elementary school	1.3	6.3	10.5	26.684	<0.001
High school	43.7	58.3	68.4		
University and above	44.5	24.4	21.1		
Unknown	10.5	11.0	0.0		
Residence					
Urban	71.8	62.2	42.1	9.198	0.010
Rural	28.2	3.8	57.9		
Martial status					
Single	7.6	20.5	10.5	19.391	0.004
Married without children	18.5	21.3	5.3		
Married with children	70.2	53.5	84.2		
Others	3.8	4.7	0.0		
Number of household members					
1	7.6	17.3	5.3	13.801	0.032
2	19.3	23.6	10.5		
3-4	65.1	52.8	68.4		
≥5	8.0	6.3	15.8		
Per household monthly income (EUR)					
<250	0.4	5.5	0.0	32.213	<0.001
251-500	6.3	20.5	15.8		
501-1,000	62.6	55.9	68.4		
>1,000	30.7	18.2	15.8		

Table 4 shows the respondents' assessment of the practices in their households. The best hygiene practice of the respondents was cleaning food contact surfaces before and after preparing meals. About 88% of respondents stated that they do this constantly or frequently. About 84.6% of respondents wash their hands with soap and warm water before they start preparing food, while the majority (73.4%) avoid cooking and preparing food with open sores on their hands. More than half of respondents (55.2%) regularly disinfect their kitchen sink. Around a third (32.3%) use inadequate chopping boards for raw meat and vegetables, while half of respondents (50.5%) defrost meat improperly. Overall, 99.7% of households surveyed do not use a thermometer to check the thermal processing of food.

The practice of the respondents in relation to their socio-economic characteristics is shown in Table 5. The Chi-square test revealed statistically significant differences in respondents' practices in relation to their level of education (p < 0.001). More than half of the respondents with university education (51.4%) have adequate household practices, while 59.3% of the respondents with secondary education have poor practices (p < 0.001). Overall, 34.8% of single respondents (p = 0.227) and 33.3% of respondents in the 18-25 age group have poor hygiene practices (p = 0.051). In terms of monthly income, 31.8% of respondents with an income between 500 and 1000 EUR have poor practices (p = 0.338).

Based on the thresholds set, the general knowledge and practices of the households surveyed were assessed (Figure 1). More than half of the respondents (62.0%) had good knowledge, one-third (33.1%) had average knowledge, and 4.9% had poor knowledge. The lowest percentage of households surveyed (18.2%) had good practices, while 59.4% had average hygiene practices. Poor practices were found in 22.4% of respondents.

DISCUSSION

According to the results presented in Table 1, of the 384 households that participated in the survey, most responses were given by women (93.5% of the sample). We believe that the higher representation of female respondents in surveys of this type is a consequence of established traditional

TABLE 4. Respondents' practices regarding food safety in households

Questions	Correct (%)	Incorrect (%)
1. Would you avoid cooking and preparing food if you have open sores in your hands?	73.4	26.6
2. Do you clean food contact surfaces before and after food preparation?	88.0	12.0
3. Do you use different cutting boards to cut raw meat and vegetables?	67.6	32.3
4. Do you wash your hands with soap and warm water before you start preparing your food?	84.6	15.4
5. Do you defrost the meat on the lowest shelf of the refrigerator?	49.5	50.5
6. Do you separate raw and cooked food in a refrigerator?	61.5	38.5
7. Do you use a food thermometer to check if the food is sufficiently cooked?	0.3	99.7
8. How often do you disinfect your kitchen sink?	55.2	44.8

TABLE 5. Respondent's practice in relation to socioeconomic characteristics

Variable	Evaluation			χ2	p
	Good (%)	Average (%)	Poor (%)		
Gender					
Male	4.3	6.6	8.1	0.946	0.623
Female	95.7	93.4	91.9		
Age					
18-25	0.0	6.1	8.1	12.537	0.051
26-35	24.3	26.8	12.8		
36-50	57.1	46.9	57.0		
>51	18.6	20.2	22.1		
Educational level					
Elementary school	1.4	2.6	7.0	28.934	<0.001
High school	27.1	53.1	59.3		
University and above	51.4	36.4	25.6		
Unknown	20.0	7.9	8.1		
Place of residence					
Urban	74.3	67.1	61.6	2.806	0.246
Rural	25.7	32.9	38.4		
Marital status					
Single	7.1	11.0	18.6	8.160	0.227
Married without children	14.3	20.6	17.4		
Married with children	72.9	65.4	59.3		
Others	5.7	3.1	4.7		
Number of household members					
1	8.6	9.6	15.1	6.752	0.344
2	12.9	21.9	22.1		
3-4	67.1	61.0	57.0		
≥5	11.4	7.5	5.8		
Per household monthly income (EUR)					
<250	1.4	2.2	2.3	6.818	0.338
251-500	4.3	11.8	16.3		
501-1000	62.9	60.1	60.5		
>1000	31.4	25.9	20.9		

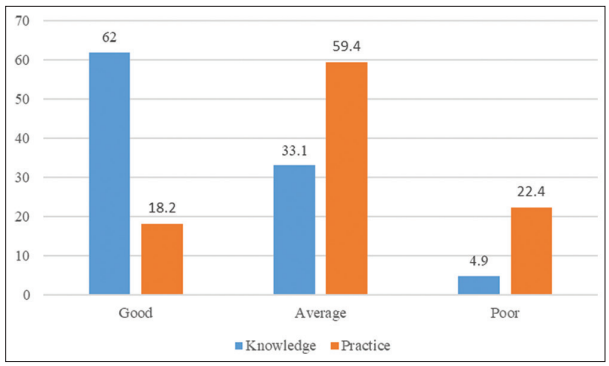

FIGURE 1. Comparison of knowledge and practice of the respondents (%).

and cultural habits in which the role of women in the household plays a crucial role, not only on the territory of Bosnia and Herzegovina but also on a global level. Most of the respondents lived in urban areas in Sarajevo Canton (67.2%). More than half of the respondents (51%) belonged to the age group between 36 and 50 years, while the smallest number of participants was over 65-years-old (4.1%). A quarter of households (25.5%) had a monthly income of more than 1,000 euros, more than half (65.4%) were married with children, and two-thirds (74.5%) had a member of the household belonging to one of the vulnerable groups (pregnant women or people with chronic diseases). About half (49.7%) had completed secondary school, 36.7% had a university degree, and 3.4% had completed elementary school.

Consumers' food safety knowledge is defined as their contact with sources and their personal involvement in obtaining relevant and verified information (13). In our survey, respondents were most knowledgeable about hygienic practices and the meat preparation process. Of the respondents, 89.1% knew that unhygienic practices at home are the source of microorganisms, and 89.6% knew that direct contact between unwashed hands and ready-to-eat food can lead to bacterial contamination of food (Table 2). However, as noted in the study by Jianu and Goleț (14), knowledge of hand hygiene and compliance with it do not necessarily coincide; therefore, more attention should be paid to it and its importance emphasized. A total of 67.4% of respondents confirmed that eating undercooked eggs can lead to food poisoning, which can result in hospitalization. In Ireland, 74.5% of respondents (15) had a higher level of knowledge on this topic, while studies from Jordan (52.9%), Saudi Arabia (43.9%), Portugal (19%), and China (8.9%) showed a lower level of knowledge (16-19). In our study, 84.1% of respondents were aware of the link between the risk of food poisoning and the consumption of raw or undercooked meat. Our results are consistent with those of a study conducted in Saudi Arabia by Sharif and Al-Malki (18) and differ markedly from those of studies conducted in China (25.3%) and Portugal (12.5%) (16,19). Considering that in the European Union, information on cooking raw meat or raw eggs is mandatory on product packaging (20,21), it can be concluded that the population in certain European countries (Portugal and Greece) is not sufficiently informed on the subject in question and that education in this area needs to be intensified. Our respondents (88.5%) showed an enviable level of knowledge about the possibility of pest transmission. A study conducted in Italy (22) showed a poor level of knowledge (39.9%) about the role of pests in food contamination. In addition, our respondents (89.1%) knew how to freeze meat properly, which is not significantly different from the results (93%) of Mkhungo et al. (23). The correct way to defrost meat on the bottom shelf of the refrigerator was known by 67.4% of respondents in our study, which is significantly more than the results of studies conducted in Ireland (43.5%), China (38.2%), and Greece (24.1%) (15,16,24). Our results are not consistent with those of a study conducted in the United States of America (USA), in which 79.2% of respondent's thawed meat appropriately (25). Reheating food is the last line of defense to prevent food poisoning. If bacteria survive heat treatment or become contaminated after preparation, improper refrigeration, or prolonged storage at room temperature, they can be destroyed during reheating (4). Of the respondents, 72.4% knew that there is a high risk of food poisoning when we prepare food that has been stored at room temperature for more than four hours. Compared to our results, the percentage of respondents (17.4%) in a survey conducted in China (15) who had sufficient knowledge in this area was very low. A similar study conducted

in the United States found an excellent level of knowledge among the population surveyed (82%); however, only 17% of respondents knew what temperature was appropriate for reheating food (26). Although our respondents showed a satisfactory level of knowledge compared to other countries, we believe that additional efforts are needed to improve food safety knowledge in households. Knowledge alone does not always lead to positive practices, as the relationship between knowledge and practice has been shown to be mediated by numerous variables (27). However, there is a consensus that anyone who handles and prepares food must acquire the appropriate knowledge to prevent microbiological contamination of food in the home.

The respondents' knowledge of socio-economic characteristics is shown in Table 3. The results of the survey show that people living in rural areas have less knowledge (57.9%). The Chi-square test revealed statistically significant differences in respondents' knowledge ($p < 0.010$). Regarding the differences between age and gender, respondents in the age group between 36 and 50 years (54.6%) and women (94.1%) showed the best level of knowledge. The differences in marital status were also statistically significant ($p = 0.004$), so respondents in marriages with children had the best level of knowledge (70.2%, $p = 0.004$). In terms of monthly income, respondents with an income between EUR 501 and 1,000 had the best level of knowledge (62.6%, $p < 0.001$). Statistically significant differences ($p = 0.032$) were also found in groups with different numbers of household members, with respondents with up to 3-4 members (65.1%) having the best level of knowledge.

Proper hygiene practices in food preparation and handling have a significant impact on food safety at home (28). In our survey, 84.6% of respondents reported washing their hands with soap and water before preparing food. This result is in line with a survey conducted in Turkey (82%) (29). Similarly, Mahmood et al. (30) found in a study conducted in Malaysia that more than 75% of respondents washed their hands before starting to cook, but taking off watches and jewelry before cooking was not a common practice. The authors of a study conducted in Brazil reported that 65% of respondents usually washed their hands after handling raw chicken or meat, but only 18% did so properly, mainly due to insufficient washing time and improper hand drying methods (31). Our results are not consistent with those of a Malaysian survey in the Sibu region, which found that 56.5% of respondents washed their hands with soap and water before cooking or eating. Wearing jewelry that comes into contact with unwashed hands, long and unclean nails, and exposed hair during food preparation can contribute significantly to microbiological hazards in food, especially *Staphylococcus aureus* (32). A high percentage of our respondents avoided cooking and food preparation when they had open sores on their hands (73.4%) and cleaned food contact surfaces constantly or frequently before and after food preparation (88%). Our results are not consistent with those of Naeem et al. (33), where 35.4% and 52.5% of respondents had good practices in this regard. The results differed in the segments of separation of raw and cooked foods in the refrigerator. In our study, correct practice was found in 61.5%, compared to 51.3% of Malaysian respondents (33). Using a food thermometer is the most reliable method to check if the food is properly prepared and does not contain pathogenic microorganisms. In our survey, the worst results were recorded for thermometers. Overall, 94.3% of respondents did not use thermometers in their households. A similar result was reported by Ruby et al. (32) in a study conducted in Malaysia (94.4%).

The practices of the respondents in relation to their socio-economic characteristics are shown in Table 5. The Chi-square test revealed statistically significant differences in respondents' practices in relation to their level of education ($p < 0.001$). More than half of respondents with higher education (51.4%) had appropriate practices in their households, while 59.3% of respondents with higher education rated them as poor. Overall, 34.8% of single respondents ($p = 0.227$) and 33.3% of respondents in the 18-25 age group had poor hygiene practices ($p = 0.051$). In terms of monthly income, 31.8% of respondents with an income between 501 and 1,000 EUR had poor practices ($p = 0.338$).

In the assessment of general knowledge and practices (Figure 1), 62% of our respondents had good knowledge, 33.1% had average knowledge, and 4.9% had poor knowledge. Our results are not consistent with studies in Pakistan, where the authors reported that only 8.9% of respondents had adequate knowledge of food safety (34). Cheng et al. (35) reported a better level of knowledge in a Chinese study where 42% of respondents had good knowledge; Moreb et al. (15) in a study conducted in Ireland (67%); and El Haddad et al. (36) where 74.8% of respondents in Lebanon had good knowledge overall.

Our results differ from those of a study conducted in Turkey, in which 69.5% of respondents reported poor food preparation and storage practices (29). A similar result to ours was presented in a Chinese study in which 18.5% of respondents reported poor hygiene practices in food preparation (37).

According to our study, women have a better knowledge of food safety than men, and their food preparation and storage practices are better. Lin's study emphasized that gender plays an important role in risk perception (38). Our results are consistent with studies from Ireland, Turkey, and Canada (39-41), which emphasize the role of women in the household, which is a traditional and cultural value, regardless of geographical location.

In terms of age group, respondents between the ages of 36 and 50 had the best knowledge and practices, and those between the ages of 18 and 25 had the worst. De Boer et al. (42) found that age is one of the most important factors in understanding the importance of good food safety practices. Our findings are consistent with numerous studies showing that older people are more concerned about food safety hazards and cook more safely than younger people (39,43). Sanlier (29) found that young consumers have less knowledge about food safety and that their practices urgently need to be improved. Fischer et al. (5) apostrophize that older people have always cooked in school as part of the educational program and therefore have a much better appreciation of the importance of good practices than new generations. According to Hudson and Hartwell (44), older people are the least affected by food poisoning. Klontz

et al. (45) believe that young people (18-29 years old) are the most susceptible to food poisoning.

CONCLUSIONS

The data obtained in this study can serve as a starting point for raising awareness and creating education programs for a wider population. In this way, consumer knowledge can be further improved, leading to better and safer food handling practices in households. Statistical analysis has shown that the population in Sarajevo Canton has a good knowledge of food safety, while hygiene practices in food preparation and storage are average or unsatisfactory. In our region, food safety is rarely discussed in households, and the population is not aware of the risks they are exposed to. Our findings suggest that urgent action should be taken to raise collective awareness of the importance of household food safety for public health.

Study limitations

Although this research fills important gaps in the literature, it is not without limitations. First, the collected answers are the subjective attitude of the respondents and therefore susceptible to bias. In addition, this study was cross-sectional, which implies that the findings are limited.

DECLARATION OF INTERESTS

Authors declare no conflict of interests.

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