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# FOOD SAFETY KNOWLEDGE AMONG CADETS OF MILITARY ACADEMY IN REPUBLIC OF SERBIA

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*The purpose of this study was to evaluate the level of food safety knowledge among cadets of Military Academy in the Republic of Serbia. For that purpose, a structured, self-administrative questionnaire was designed and used to assess the level of food handling practices and food safety knowledge. In total, 120 cadets were involved in the study. For each participating cadet, the food handling practice score (FHPS) and food safety knowledge score (FSKS) was calculated by dividing the sum of correct answers by the total number of correct responses. Additionally, knowledge gaps were identified for each question.*

*Our results indicated that on the average FHPS among Serbian cadets was 44.5%, while FSKS was 50.5%. Female cadets showed better scores compared to males, although this was not statistically significant. Better FHPS scores were determined among cadets living with parents (48.7%), compared to cadets living with roommates (43.6%, $p \leq 0.05$), while an opposite was determined for FSKS. In total, 95.8% of cadets apply good practice of hand hygiene before preparing food, 90.8% of them knew that is not safe to consume food when the shelf-life is expired, and 89.2% knew that the opened sterilized milk should not be stored outside the refrigerator. Also, 91.7% of cadets knew that content of blown can is not safe for the consumption. Almost 64.2% of all cadets could successfully make association between meat and Trichinella, while merely 27.5% of them knew that Escherichia coli O157 is the most important pathogen for raw minced meat, and only 13.3% of cadets knew that Listeria monocytogenes is associated with ready-to-eat meat products. Finally, only 10% of cadets knew that Campylobacter is food-borne pathogen mostly associated with raw and undercooked chicken meat. Also, our cadets were not aware that color, smell or appearance of food would not give any indication of food contamination, as only 6.7% of cadets knew this. Results obtained in this study pointed out some food safety areas which need further improvement via educational program, but also via media and internet courses, material or short clips.*

**Keywords:** Cadets, Military Academy, food handling practices, food safety knowledge.

## INTRODUCTION

Food-borne diseases include a number of illnesses ranging from mild gastrointestinal issues to life threatening illnesses such as botulism, hemolytic–uremic syndrome, Guillain-Barre syndrome, etc. (1). Despite numerous projects and studies performed in the field of food safety and various preventive and control measures defined for the food industry, the number of reported food-borne cases remains at an unacceptable high level (2–4). World

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Health Organization (WHO) has estimated the burden of food-borne diseases, with more than 420 000 millions of people fall ill, and 230 000 dies every year from diarrheal diseases, caused by consumption of contaminated food and/or water (5). Although the majority of cases occurs in developing countries, a great number of people in developed countries still experience some food-borne diseases (6, 7). In the European Union (EU), more than 43 000 cases of food-borne illnesses, with 4 541 hospitalizations and 33 deaths occurred only in 2017. Among these cases, almost 34.2% occurred at home, 30% cases occurred at restaurants, pubs, street vendors and take away places and 16% of them took place in different institutions, such as canteen or catering, school, hospital, residential institutions (nursing home or prison or boarding school) where food was prepared and/or served by catering services (6).

Institutional food services include entities that serve food to people who are members of particular institution such as hospital, schools, nursing homes, prisons, military or industry (8). Mostly, army and military establishments have their own food procurement systems which are dedicated to the prevention of both unintentional and intentional contamination of food. Nevertheless, foods consumed at military institutions have been also identified as an important source of food-borne outbreaks (9), including outbreaks caused by viruses, such as Norovirus or Hepatitis A (10–13), bacteria, such as *Salmonella* spp., *Staphylococcus aureus* (14–17), but also toxins such as histamine (18) or scromboine (19) associated with eating yellow fin tuna (*Thunnus albacares*). Despite the fact that military staff usually includes health people in good physical condition, they still constitute a high risk group for food poisoning due to the community kitchen practice and common meals (20–22). Great number of preventive and control measures have been identified for military food services, including the application of adequate sanitary procedures during food processing and preparation, personal hygiene practices, prevention of cross contamination, adequate time-temperature control, etc. (23). Along with these pre-requisite programs, the food safety management system should be also implemented to ensure that safe food is being manufactured, distributed, and consumed in military food services.

The great number of food-borne outbreaks occurs due to bad food handling practices (24, 25), and it is assumed that this is also the case in military food services. The knowledge and practices of food handlers are essential, either when food handlers are professionals working in the food industry or institutional food services, such as military establishments, or when they are casually preparing food at home environments (26, 27). Food handlers may contaminate food due to hand contact with food (by bear hands or gloves), improper hand hygiene, inadequate cleaning of processing or preparation equipment, inadequate food preparation, etc. (6, 28). Many authors have investigated the level of food safety knowledge and self-reporting food handling practices among students of different background (29–37). Nevertheless, only one study has investigated these issues among military students (23) and to our best knowledge no study has been performed among Serbian cadets. Therefore, it was the aim of this study to evaluate food safety knowledge and handling practices among cadets of the final year of Military Academy, in the Republic of Serbia.

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## MATERIAL AND METHODS

### SELECTION OF STUDENTS

This study involved 120 cadets from the Military Academy in the Republic of Serbia. Cadets that participated in this study were inscribed in different modules in the Military Academy and they have participated on voluntary and anonymous basis. Cadets were asked to fill the questionnaire during class, and it took approximately 15 min to finalize it.

### QUESTIONNAIRE

For the purpose of this study, a structured questionnaire was designed based on the previously published articled (30, 31, 34, 36, 37). The questionnaire consisted of different types of questions such as true/false, yes/no and multiple choice answers. Additionally, cadets had the possibility to circle "I don't know" for each question, to minimize the possibility to select the correct answer randomly.

The questionnaire consisted of three separate parts; first one consisted of questions related to demographic characteristics of cadets, such as gender, age, residential area, and involvement in cooking, information on food safety issues, estimated food safety knowledge and previous experience with food borne illnesses. Second part of the questionnaire was related to food handling practices and it included 13 questions, covering those related to cross-contamination (3), temperature regime (2), food preparation and manipulation (8). Finally the third section focused on food safety knowledge and included 28 different questions, comprising of questions related to cross-contamination (7), temperature regime (8), food handling (9), and food poisoning (4).

### DATA ANALYSIS

For each cadet, the food handling practice score (FHPS) and food safety knowledge score (FSKS) was calculated as a percentage of correct answers for a given section. Each multiple-choice question had only one correct answer. Calculated scores were analyzed using an independent sample t-test (for two groups, such as gender, age, previous food poisonings) or analysis of variance (ANOVA) with post-hoc Tukey test (for more than two groups, such as type of faculty, living, eating, information of food safety issues, estimated food safety knowledge, etc. (SPSS Statistics 17.0)). Values with a $p<0.05$ were considered statistically significant.

## RESULTS AND DISCUSSION

### SAMPLE CHARACTERISTICS

For the purpose of this study, 120 cadets studying at the Military Academy have been interviewed. In total, 19.2% females and 80.8% males participated (Table 1). The majority of cadets declared that they were living with roommates 97 (80.8%), while 23 (19.2%) of them were living with their parents. Again, majority of them were eating in the canteen 107 (89.2%), only 6 (5.0%) of them were preparing food by themselves, while 7 (5.8%) cadets

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were eating with their parents. Only 54 (15%) cadets stated that they experienced a personal food poisoning incident in the past. The major source of food safety information for 19 cadets (40.8%) was Internet, for 25 cadets (20.8%) it was family/friends, while only 19 cadets (15.8%) declared that the major source of food safety information was education and faculty. It is of note that 11 cadets (9.2%) indicated that they did not inform themselves on food safety at all.

**Table 1.** Demographic characteristics of cadets participating in this study and their food hygiene practices (FHPS) and food safety knowledge (FSKS) (n=120)

| | | N (%) | FHPS (%)[x] | Within[y] p-value | FSKS (%)[x] | Within[y] p-value |
|---|---|---|---|---|---|---|
| Gender | Female | 23 (19.2%) | 47.83 | 0.13 | 54.19 | 0.06 |
| | Male | 97 (80.8%) | 43.81 | | 49.63 | |
| Living | With roommate | 97 (80.8%) | 43.59 | 0.05* | 50.99 | 0.18 |
| | With parents | 23 (19.2%) | 48.76 | | 48.45 | |
| Eating | Preparing food alone | 6 (5.0%) | 41.67 | 0.68 | 48.81 | 0.35 |
| | In the canteen | 107 (89.2%) | 44.46 | | 50.71 | |
| | At home with parents | 7 (5.8%) | 48.98 | | 57.14 | |
| Information on food safety issues | Via friends/family | 25 (20.8%) | 45.14 | 0.32 | $46.71^{a,b}$ | 0.005* |
| | Via education/faculty | 19 (15.8%) | 47.74 | | $55.82^{b,c}$ | |
| | Via public media | 16 (13.3%) | 46.87 | | $56.02^{b,c}$ | |
| | Via internet | 49 (40.8%) | 44.31 | | $50.65^{a,b}$ | |
| | I do not inform myself | 11 (9.2%) | 35.7 | | $41.23^{a}$ | |
| Estimated food safety knowledge | Excellent | 25 (20.8%) | 39.85 | 0.423 | $46.05^{a,b}$ | 0.016* |
| | Very good | 47 (39.2%) | 42.28 | | $53.57^{a,b}$ | |
| | Good | 22 (18.3%) | 46.80 | | $49.84^{a,b}$ | |
| | Satisfactory | 7 (5.8%) | 47.07 | | $55.52^{b}$ | |
| | Sufficient | 19 (15.8%) | 42.85 | | $40.30^{a}$ | |
| Previous food safety poisoning | Yes | 12 (10.0%) | 42.85 | 0.343 | 55.35 | 0.08 |
| | No | 108 (90.0%) | 44.77 | | 49.96 | |

*statistical significance $p < 0.05$
[x] knowledge score, relative percentage which is based on valid values
[y] differences within the characteristics of cadets
Items denoted with the same small letter are not significantly different within the group

### FOOD HYGIENE PRACTICES AND FOOD SAFETY KNOWLEDGE SCORES

The average value for food handling practice score (FHPS) was 44.5% and for food safety knowledge score (FSKS), was 50.5% (Table 1). As expected, cadets who were informed about food safety issues via classical education and courses obtained better FHPS scores (47.74%) compared to other cadets that were getting information thought public media (46.87%), family/friends (45.14%), and internet (44.31%), although this was not statistically significant ($p>0.05$, Table 1). Results on FSKS scores showed higher values for cadets who were informed via classical education (55.82%) and via public media (56.02%), compared to their colleges that were informed via internet (50.65%) and friends and family (46.71%, $p<0.05$, Table 1) Surprisingly, cadets who experienced some previous food poiso-

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ning obtained lower FHPS than their colleagues without that experience, although it may be expected that they are more careful and interested in food safety.

It is of note that 11 participating cadets (9.2%) indicated that they do not inform themselves on food safety issues at all, and these cadets presented the lowest FHPS and FSKS scores (35.7% and 41.2%, respectively). Most of them are aware of this, as they estimated their overall food safety knowledge as poor or only sufficient (data not shown). This is very worrying, as these young people might be still involved in food preparations in their private lives or professional activities. Cadets studying at the module Defence Logistics, might be also responsible for different operations related to food services, logistics, and organization, both in the canteen level or at the terrain exercises. They might be involved in creating diet plans based on the scientific, medical, nutritional and culinary bases, for all military staff, taking into account the diversity of tasks they perform. As persons in charge of nutrition, they are responsible for the application of all sanitary and hygienic measures during the reception of food, storage, preparation and distribution of food. In addition, they hold trainings for people who are preparing and distributing food.

## KNOWLEDGE GAPS

To identify the major gaps in cadets' practices and knowledge, percentage of correct answer for each question was calculated, and obtained results for food handling practices and food safety knowledge were presented in Table 2 and Table 3, respectively.

**Table 2.** Frequencies of correct answers to food hygiene practices for cadets participating in this study (n=120).

| Question | % correct answers |
|---|---|
| Using the same cutting board for raw and ready-to-eat food. | 60.8 |
| Using knife for vegetables, after it was used for raw meat. | 63.3 |
| Storage of raw and ready-to-eat food in cooling units. | 22.5 |
| Cut on the hand and food preparation. | 14.2 |
| Habit of checking temperature in the fridge. | 47.5 |
| Keeping cooked meal at room temperature. | 53.3 |
| Checking when the chicken is cooked. | 5.8 |
| Duration of the reheating bolognaise spaghetti, prepared the day before. | 19.2 |
| Habit of eating/preparing cakes with raw egg white. | 37.5 |
| Habit of washing cabbage used for salad preparation. | 84.2 |
| Defrosting food. | 6.7 |
| Hand washing practice. | 95.8 |
| Duration of hand washing. | 47.5 |
| Jewelry and food preparation. | 65.8 |

Majority of cadets involved in this study knew how to correctly handle cutting board or knife, to avoid cross contamination (Table 2). Similarly, 61.6% of students from Jordan

correctly handle cutting board (31), and 74.3% of Lebanese students correctly handle cutting knife, when used for fresh produce and raw meat (36). The good practice of thawing food includes leaving frozen foods overnight in the refrigerator, and only 6.7% of all Serbian cadets perform this in everyday life, which is lower than reported in Lebanon, being 28.1% (36). Serbian cadets usually defrost food by keeping it at room temperature (Table 2), which is the least safe way of doing this. In line with this, only 25.8% of cadets knew this fact (Table 3).

Cold storage of food should be organized in a way to prevent cross contamination between ready-to-eat and raw foods, to keep fridge hygiene and to assure that fridge is operating at correct temperature (38, 39). Almost 70% of participating cadets knew that ready-to-eat and raw food should be kept separately in the fridge, to avoid possible cross-contamination (Table 3). Nevertheless, questions on food handling practices showed that only 22.5 % of cadets participating in this study would place potato salad (ready-to-eat food) above the raw meat in the fridge (Table 2). In addition, half of all participants (50.0 %) indicated that they would leave prepared food, where there is available place in the fridge, showing insufficient awareness for the proper food arrangements. These results suggest that the knowledge itself is not a sufficient guarantee for food safety, and it should be complemented with adequate food handling practices, which are often driven by other determinants (40–42).

What seems to be important is the fact that 65 % of participating cadets knew what is the required temperature for the cold storage of food, which is greater than 56 % reported for consumers in Belgrade (43). Additionally, 47.5 % of all cadets had a habit of checking the temperature in the refrigerator (Table 2), while Janjic et al. (2016) reported that only 25% of all Belgrade consumers knew, or regularly measured the temperature of their refrigerators. The great number of domestic refrigerators operate at approx. 9-10 °C (39, 43), which is capable of supporting the growth of some food-borne pathogens including *Staphylococcus aureus, Bacillus cereus, Escherichia coli* O157, *Salmonella* spp. Our results indicated that only 47.5 % of cadets knew that some microorganisms might slowly grow in the fridge, while 18.3 % of them thought that microorganisms could not initiate growth under refrigerator conditions. Even correctly adjusted refrigerator temperature of 4 °C, might support the growth of pathogens such as *Listeria monocytogenes* and *Yersinia enterocolitica,* in foods stored for the extended period of time (38). Almost 60 % of our participants knew that most food-borne pathogens would optimally grow at room temperature. Still, our cadets were not aware that color, smell or appearance of food would not give any indication of food contamination, as only 6.7% of cadets knew this (Table 3). Similar was reported elsewhere (44–47). When foods have bad smell, taste or appearance, it is mostly contaminated with spoilage microorganisms, while the presence of food-borne pathogens would leave no obvious sign of contamination. Therefore, the knowledge of the temperature profile, cross-contamination, growth characteristics of important food-borne pathogens and good handling habits are of ultimate importance for managing food safety risks.

According to data obtained through the official Serbian reporting system, the most frequently identified causative agent of food-borne outbreaks in Serbia has been *Salmonella* spp. (48). In line with this official report, this pathogen is the most often seen in media, as usually great number of mostly vulnerable people, such as kids in the kindergarten and elderly in orderly homes, is involved in *Salmonella* outbreak. However, it seems that this food safety risk is not completely acknowledged by Serbian cadets, as almost 62.5% of them said that they consume cakes prepared with raw egg white.

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**Table 3.** Frequencies of correct food safety answers for all cadets participating in this study (n=120)

| Question | % correct answers |
|---|---|
| Optimal temperatures for bacterial multiplication. | 60.8 |
| Identification of food contaminated with pathogens. | 6.7 |
| Identification of most common cause of food-borne illness. | 1.7 |
| Food often associated with *Listeria monocytogenes.* | 13.3 |
| Food often associated with *Campylobacter spp.* | 10.0 |
| Food often associated with *Trichinella* | 64.2 |
| Consequences of eating meat contaminated with *Escherichia coli* O157 | 27.5 |
| Common symptoms of food-borne diseases. | 52.5 |
| Association between abortion and mental disorders in newborn and food-borne disease | 24.2 |
| The least risky group of people for the food poisoning | 51.7 |
| Identification of diseases that can be transmitted by food. | 34.2 |
| Required temperature inside refrigerator. | 65.0 |
| Required temperature inside freezer | 54.2 |
| Bacterial behavior at chilled temperatures. | 47.5 |
| Separation of cooked and raw food. | 70.0 |
| The least safe practice of food thawing. | 25.8 |
| Is it safe to eat food with expired used by date? | 90.8 |
| Is it safe to keep open sterile milk outside of fridge? | 89.2 |
| Is it safe to consume content of the blown can? | 91.7 |
| Minimal required temperature for cooking poultry meat? | 20.8 |
| Degustation of food during preparation is the best way to check if the food is done? | 52.5 |
| The same cutting board can be used for different meats (red, poultry, fish). | 54.2 |
| Washing hands is mandatory after… | |
| ...touching face | 63.3 |
| ...potteries washed in the machine | 76.7 |
| …fresh fruits | 54.2 |
| ...cloths | 85.8 |
| …potteries used for food preparation | 54.2 |
| Washing hands with soap may decrease chances of food poisoning. | 71.7 |

Our results showed that 95.8% of all respondents report washing hands with water and soap (Table 2), while only 2.5% of all respondents report washing their hands only with water. Similar was also reported by other researchers. A total of 96.8% of Greek students, 80.7% of Lebanese students (36), 51% of students in Jordan (31) reported that they properly wash their hands. It is however important to note that all these results, as well as those found in this study, were self-reported and sometimes they may differ from actual hygiene

practices (49). Almost 95% of Malaysian food sellers declared that they wash their hands after using toilet, while merely 4.7% of them actually did this (50). In addition, some studies have shown that food handlers might be aware of some safe food handling practices, but they do not perform them in everyday life. For example, 85.1% Spanish students declared that washing hands with water and soap before and during food preparation is very important for preventing cross-contamination, but only 13.5% of them performed proper hand hygiene (51). Our results showed also that only 47.5% of all cadets report washing their hands for at least 20 s, as it is recommended (52). It is worth noting that this study was performed before the onset of novel Coronavirus disease (Covid-19) outbreak, which is currently continuing at the time of writing this paper. The hand hygiene knowledge and handling practices will be certainly better in future, due to great number of published instructions, guidelines and videos that have been issued during this worldwide outbreak (53, 54).

When cadets were asked which food is most commonly contaminated with *Trichinella*, 64.2% of them responded correctly, despite the relatively low prevalence of *Trichinella* contamination in Serbian meat nowadays (55). It seems that cadets are well aware of risks related to protozoa in raw meat, as a result of great public interest for this matter in the past and the well-known need for *post mortem* veterinary inspection of meat when pigs are traditionally slaughtered at home arrangements (56). On the other side, *E. coli* O157 is also pathogen most commonly associated with raw (minced) meat (57), and merely 27.5% of all cadets knew this. In addition, only 13.3% of cadets knew that *Listeria monocytogenes* is associated with ready-to-eat meat products (58, 59), and almost 60.0% of cadets circled "I do not know", indicating low level of knowledge in this field. Finally, only 10% of cadets knew that *Campylobacter* is food-borne pathogen mostly associated with raw and under-cooked chicken meat. Obtained results showed insufficient knowledge on pathogens associated with meat and meat products, except for *Trichinella*. This is in line with results presented elsewhere (30, 31, 34, 60). It is of note that cadets involved in this study do not have any course covering food microbiology topic in their education, and therefore it is to be expected that cadets will show limited knowledge in this field.

Desired elimination of pathogenic microorganisms in ground or minced meat can be achieved through heat treatment, that should comprise temperature of at least 74 °C in the center of the product, and only 20.8% of cadets knew this (Table 3), while 50.8% of them indicated that they do not know the answer. In addition, almost half of all participants would check if meat is done, by using a fork and checking if there are bloody juices coming from the meat (49.2%), while only 5.8% of cadets use thermometer (Table 2). Similar was seen in other studies, only 7.4% of Lebanese students (36) and 1.1% of Greek students (34) was using thermometer for this purpose. It is of note that 51.4% of Canadian students indicated that the best way to check the readiness of meat is to use thermometer (33). The obtained difference seen in the study performed in Canada might be related to the fact that they have asked a question related to knowledge, not a practice as it was in this study.

What seems to be promising is the fact that Serbian cadets are aware of labeling instructions given by food producers, as 90.8% of them knew that it is not safe to consume food when the shelf-life is expired, and 89.2% knew that the opened sterilized milk should not be stored outside the refrigerator (Table 3). Finally, 91.7% of cadets are familiar with the fact that content of blown can is not safe for the consumption, due to possible outgrowth of anaerobic bacteria *Clostridium botulinum* (61).

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The symptoms of food poisoning usually involve diarrhea, vomiting and fever (1), and 52.5% of cadets were able to recognize them. Nevertheless, food poisoning might include more serious symptoms, such as meningitis, septicemia, spontaneous abortion, still birth or fetal death in patients with listeriosis (62) and only 24.2% of cadets knew this. Not only listeriosis, but other food-borne illnesses may result in very serious conditions, which can be life treating, particularly for vulnerable population (YOPI group including young, old, pregnant and immune-compromised). The population which is mostly resistant to food poisonings includes young people/teenagers and 51.7% of Serbian cadets were aware of this. Other studies have reported better results, as 66.2% of Lebanese (36) and 82% of Jordan students knew about the most resistant population.

Our results showed that cadets possess relatively low level of knowledge and bad handling practices, as it was also noticed in other similar studies. Nevertheless, some differences could be seen, and they are most probably related to the university curriculum. Some studies involved only students from food/health related faculties (63, 64), other involved students also from non-food/health related faculties (30, 34, 36). In general, better knowledge was seen among students who had a chance to participate in some food safety courses during their education. Participants in this study involved also cadets studying at the module Logistic Defence, at Military Academy in Serbia. It is of note, that students of this module have only few elective courses in which some aspects of food safety have been covered. These courses are Food products, Food technology and Nutrition organization. Cadets studying at other modules at Military Academy, such as Management in Defense, Military Mechanical Engineering, Military Electronic Engineering, Military Chemical Engineering, Military Aviation do not have any of food related courses in their curriculum. Therefore, it is assumed that cadets' food safety knowledge mainly originates from the previous education, as well as from private home, family and friends, media, Internet, etc. (34, 49). This might explain the lack of some important food safety facts, related to food microbiology. Having in mind that these young people might be also active in some military food services, it is important that during their education they should be provided with adequate information. Additionally, this knowledge must be complemented with practical things, using the means of social media (65).

## CONCLUSION

In conclusion, our results indicated that Serbian cadets have shown relatively good knowledge for some food safety issues, including prevention of cross contamination in the kitchen, hand and personal hygiene, labeling instructions. On the other side, areas such as food microbiology, behavior and manifestation of food pathogens, the seriousness of the food-borne disease and its symptoms, seems to be inadequately understood and recognized by Serbian cadets. Information obtained in this study could be helpful for improving their knowledge, designing various educational programs and courses within their university curriculum. Finally, media and internet courses, material or short clips could also help in improving knowledge and practices among young people in order to prevent food poisonings in future.

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