


Do Health-Care Students Know About Chemical Biological Radioactive Nuclear Weapons?

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Original Research

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Abstract

Objective: The aim of this study was to determine the level of knowledge of students receiving different levels of health-care education (doctors, nurses, paramedics) on chemical, biological, radioactive, and nuclear weapons (CBRNW).

Methods: This study was designed as a qualitative, descriptive, and cross-sectional research. The study reached 87.68% of the population. A survey form was created by the researcher in line with the literature. Ethical permission and verbal consents were obtained. The data were collected by face-to-face interviews.

Results: It was observed that there was no difference between the enrolled departments, that the participants had very low levels of knowledge on the subject despite considering it a likely threat for Turkey, and that they thought the public and the health-care professionals in this field had insufficient knowledge. Sex, age, and field education were the variables that created a difference.

Conclusion: Training regarding CBRNW should be further questioned and individuals should receive ongoing training to increase and update their knowledge and skills.

Chemical, biological, radioactive, and nuclear weapons (CBRNW) have existed throughout history. The use of these weapons even in a single attack could endanger the lives of millions of people,¹ put enormous burdens on the health resources of societies,² and threaten health safety. The effects of CBRNW attacks on public health have been described as direct effects (mortality, injuries, and disabilities), psychological trauma (for both patients and medical staff), overload of health system (depletion of supplies, exhaustion of medical staff, and increased bed occupancies), socioeconomic effects (disorder of social structures and families, displacement, disabilities, and unaccompanied children), and environmental effects (air, food, and water contamination, and animal and plant poisoning). Overload of health systems and socioeconomic effects include less availability and low quality of health care, effects on health-care management, less access to health care, and effects on health financing. The final result of all these effects is explained as the deterioration of individual and social health.³

Despite that the use of CBRNW has been perceived as unfavorable in the international arena and many measures have been taken, the presence of these weapons has become increasingly more significant.⁴

In the literature, it is mentioned that health systems and health professionals in many stages are not prepared or competent about the subject,⁵ and it is emphasized that health-care professionals in particular would qualify as a link in the management of such disasters.⁶ The key strength of nurses, doctors, paramedics, and public health professionals in such circumstances is particularly important.⁷ In the case of a CBRNW attack, health-care professionals should have good knowledge, attitude, and skills in many subjects like communication, cooperation, leadership, and status awareness, and it is necessary to be prepared for complex responses in areas like triage, monitoring, diagnosis, decontamination, and self-protection.⁸ Regardless of the type of weapon used, rapid and focused medical intervention is essential for the victims, both during pre-hospitalization and hospitalization. Such circumstances refer to sudden changes in the routines in hospitals.⁸

Turkey is located at the intersection of 3 very important and just as unstable regions, the Balkans, the Caucasus, and the Middle East, and continues to display a consistent image in policies toward CBRNW and disarmament. Turkey has ratified the 3 most comprehensive conventions for combatting the proliferation of CBRNW: the Treaty on the Non-Proliferation of Nuclear Weapons (1980), the Chemical Weapons Convention (1997), and the Biological and Toxin Weapons Convention (1974).⁹ Considering the countries that are known to possess CBRNW and their close proximity to Turkey, the awareness and preparedness of Turkey becomes a state policy.

In Turkey, health-care education is given at universities, following 8 y of basic education. Doctors complete their training in 6 y, nurses and midwives in 4, and paramedics and medical laboratory personnel in 2. The universities appear in 3 different structures as state, foundation, and private. Each is affiliated with a higher education institution. Although they have common curricula in basic vocational education and training, some contents may still differ in terms of

quality and quantity. Public health courses are mandatory in some universities and elective in others. The subject of CBRNW is included within the curriculum for Public Health courses. However, the content of this subject has no common base and varies between universities, which tends to affect the knowledge, attitude, behavior, and skills of health-care personnel, who should be equipped on this issue.

The purpose of this study was to determine the awareness levels and approaches of senior students at different stages of health education regarding CBRNW (doctors, nurses, midwives, paramedics, and medical laboratory technicians) and to compare them based on certain characteristics.

Methods

Study Design

This study was designed as a quantitative cross-sectional research. The data were collected by face-to-face group interviews.

Population and Sample

The population of the study consisted of 471 senior students at Giresun University, 24 from the faculty of medicine, 174 from the faculty of health sciences (113 from the department of nursing and 61 from the department of midwifery), and 273 from the vocational school of health services (167 from the department of paramedics and 106 from the medical laboratory techniques program). No sample was selected and all senior students who volunteered to participate in the research were included. The number of participants was 413 (87.68% responsiveness rate). A post-hoc test was carried out on the 413 participants for the chi-squared test using the G*Power 3.1.9.2 software. Effect size was taken as 0.3 and the 1- β err probe value (power) was determined as 0.99. The participation rates according to the departments were 83.33% for the faculty of medicine, 90.26% for the department of nursing, 90.16% for the department of midwifery, 81.43% for the department of paramedics, and 94.33% for the medical laboratory program.

Data Collection Tools

The survey form used here was developed by the researcher to inquire qualitative characteristics regarding the subject. Table 1 shows the independent variables (age, sex, department, additional training/courses about CBRNW, etc.). Table 2 shows the dependent variables (perception on Turkey's risk for a CBRNW attack, perception on self-competence for professional knowledge and skills, etc.). The form was collected by the researcher during the last 5 min of any lesson. Ethical permission for the conduct of the research was obtained (90139838-000-E.32493), participants were informed about the study, and their verbal consents were taken. The independent variables of the study were the demographic characteristics of the participants and dependent variables were the questions that aimed to measure their CBRNW awareness.

With the information text provided at the top of the research form according to the criteria of the Helsinki Declaration, the data were collected from "volunteer participants who reported not having any psychiatric illness diagnosed by a physician." All participants gave their informed consent in line with the principle of volunteering.

Table 1. Socio-demographic characteristics of the participants ($N = 413$)

Variable	Characteristics	Number	%
Age group	21 y and under	233	56.4
	22 y and over	180	43.6
Gender	Female	317	76.8
	Male	96	23.2
Department	Faculty of Medicine	22	5.3
	Faculty of Health Sciences	155	37.5
	Vocational School of Health Services	236	57.1
Being oriented toward a health-care profession in high school education	No	310	75.1
	Yes	103	24.9
Longest living area	Metropolitan city/provincial center	206	49.9
	District	141	34.1
	Village	66	16.0
Was this profession his/her own choice?	No	71	17.2
	Yes	342	82.8
Does s/he currently love his/her job?	No	30	7.3
	Yes	383	92.7
Did s/he receive any additional education/course about CBRNW?	No	396	95.9
	Yes	17	4.1

Statistical Analyses

The SPSS 22 software was used for the analyses, error checks, and creating the tables. Descriptive data are presented as number and percentage distributions. The chi-squared test was used for data analysis and $P < 0.05$ was accepted as the level of significance.

Results

The mean age of the participants was 21.55 ± 2.42 y (median: 21 y, min-max: 18-42 y). 4.8% of the participants studied at the faculty of medicine, 38.0% at the faculty of health sciences, and the rest at the vocational school of health-care services. The participation rates according to departments were compatible with the rates in the population.

Table 1 lists some of the socio-demographic characteristics of the participants. As it turns out, most of the participants chose the profession themselves and their families or immediate environment were not effective in this choice.

Table 2 shows the perceptions of the participants about CBRNW. It was found that 80.9% of the participants considered Turkey under the threat of CBRNW, 16.5% considered their professional knowledge and skills sufficient in case of a CBRNW attack, and 4.4% believed that the social awareness about this issue was sufficient. A total of 52.5% stated that they were knowledgeable about biological weapons, 52.1% about chemical weapons, 43.8% about radiological weapons, and 55.0% about nuclear weapons, with various information sources (lectures, symposiums, courses).

Table 3 demonstrates the distribution of the participants according to their knowledge of biological and chemical weapon agents. Approximately 1 in 2 participants knew some types of biological and chemical weapons.

Table 2. Perceptions of participants about CBRNW (N = 413)

Variable	Yes n (%)	No n (%)
Is Turkey a potential candidate for the risk of CBRNW attack?	334 (80.9)	79 (19.1)
Does s/he consider his/her professional knowledge and skills competent in case of a CBRNW attack?	68 (16.5)	345 (83.5)
Does s/he know his/her professional roles and responsibilities in case of a CBRNW attack?	103 (24.9)	310 (75.1)
Is the public awareness about CBRNW sufficient?	18 (4.4)	395 (95.6)
Is the awareness of health personnel about CBRNW sufficient?	92 (22.3)	321 (77.7)
Is the laws and regulations regarding CBRNW sufficient?	72 (17.4)	341 (82.6)
Does s/he know about biological weapons?	217 (52.5)	196 (47.5)
Does s/he know about the indications that might suggest a biological weapon attack?	176 (42.6)	237 (57.4)
Does s/he know how to defend against biological agents?	84 (20.3)	329 (79.7)
Does s/he know how to protect against biological agents?	116 (28.1)	297 (71.9)
Does s/he know about chemical weapons?	215 (52.1)	198 (47.9)
Does s/he know how to defend against chemical weapons?	67 (16.2)	346 (83.8)
Does s/he know how to protect against chemical weapons?	85 (20.6)	328 (79.4)
Does s/he know about radiological weapons?	181 (43.8)	232 (56.2)
Does s/he know how to defend against radiological weapons?	65 (15.7)	348 (84.3)
Does s/he know how to protect against radiological weapons?	70 (16.9)	343 (83.1)
Does s/he know about nuclear weapons?	227 (55.0)	186 (45.0)
Does s/he know how to defend against nuclear weapons?	58 (14.0)	355 (86.0)
Does s/he know how to protect against nuclear weapons?	66 (16.0)	347 (84.0)

Table 3. Distribution of participants according to their knowledge of biological and chemical weapon agents (N = 413)

Variable	Yes n (%)	Partially n (%)	No n (%)
Variola major (smallpox)	193 (46.7)	56 (13.6)	164 (39.7)
Bacillus anthracis (anthrax)	241 (58.4)	79 (19.1)	93 (22.5)
Yersinia pestis (plague)	291 (70.5)	71 (17.2)	51 (12.3)
Clostridium botulinum toxin (botulism)	123 (29.8)	49 (11.9)	241 (58.4)
Francisella tularensis (tularemia)	67 (16.2)	35 (8.5)	311 (75.3)
Filovirus (Ebola, Marburg)	186 (45.0)	75 (18.2)	152 (36.8)
Arenavirus (Lassa, etc.)	109 (26.4)	63 (15.3)	241 (58.4)
Nerve agents (tabun, sarin, etc.)	87 (21.1)	45 (10.9)	281 (68.0)
Burning gases (mustard gas, etc.)	152 (36.8)	70 (16.9)	191 (46.2)
Lung irritants (suffocating gases) (chlorine, phosgene, etc.)	199 (48.2)	88 (21.3)	126 (30.5)
Blood poisons (those that cause chemical asphyxia: cyanide, arsine)	221 (53.5)	82 (19.9)	110 (26.6)
Anticholinergic agents (3-quinuclidinyl benzilate)	36 (8.7)	42 (10.2)	335 (81.1)
Riot control agents (chloroacetophenone)	155 (37.5)	69 (16.7)	189 (45.8)

The dependent variables were compared according to age, length of education, sex, professional commitment, previous education about the subject, and knowledge about CBRNW. Table 4 shows the variables that created a difference, so the remaining variables showed no significant difference among groups ($P > 0.05$). The students' current departments and their professional commitment were found to have no significant effect on their perceptions about CBRNW ($P > 0.05$).

Limitations

Although this research provides data on the knowledge of a group of students in health education on CBRNW, it also has limitations. First, the data used in the study were based solely on health-care students' self-report and involved only 1 interview with each participant. Second, the data that we used are relatively few, and consists of 1 school in total, which may limit our findings in terms of

their generalizability to a broader scope of schools across Turkey. The third limitation is that the data were collected through questionnaires. End, all the participants to the survey were volunteers.

Discussion

Recently, pandemic attacks have been experienced in many countries of the world, and there has been a considerable increase in related concerns.⁶ The past biological attacks reported in the world history occurred in the United States of America (USA), Germany, and France in 2018; chemical attacks in the United Kingdom, USA, and France in 2018; radioactive attacks in North Korea in 2017; and nuclear attacks in Indonesia.¹⁰ These incidents revealed whether countries were prepared for these circumstances. For instance, in a study by Barbosa investigating whether emergency departments and health-care workers in hospitals in Italy were prepared for a CBRNW attack, it was stated that less than 20% of the

Table 4. Distribution of the CBRNW perceptions of the participants according to certain variables (N = 413)

Finding oneself sufficient in case of a CBRNW attack			
Variable	Yes n (%)	No n (%)	Test value
Age			
21 years and under	187 (80.3)	46 (19.7)	$\chi^2 = 4.176$
22 years and over	158 (87.8)	22 (12.2)	$P = 0.041$
Knowledge about chemical weapons?			
No	175 (88.4)	23 (11.6)	$\chi^2 = 6.501$
Yes	170 (79.1)	45 (20.9)	$P = 0.011$
Knowledge about professional roles and responsibilities in case of a CBRNW attack			
Sex			
Female	249 (78.5)	68 (21.5)	$\chi^2 = 8.865$
Male	61 (63.5)	35 (36.5)	$P = 0.003$
Previous training on the subject			
No	304 (76.8)	92 (23.2)	$\chi^2 = 14.977$
Yes	6 (35.3)	11 (64.7)	$P = 0.001$
Does s/he know about biological weapons?			
No	163 (83.2)	33 (16.8)	$\chi^2 = 13.083$
Yes	147 (67.7)	70 (32.3)	$P = 0.001$
Does s/he know about chemical weapons?			
No	165 (83.3)	33 (16.7)	$\chi^2 = 13.905$
Yes	145 (67.4)	70 (32.6)	$P = 0.001$
Does s/he know about radiological weapons?			
No	189 (81.5)	43 (18.5)	$\chi^2 = 11.601$
Yes	121 (66.9)	60 (33.1)	$P = 0.001$
Does s/he know about nuclear weapons?			
No	152 (81.7)	34 (18.3)	$\chi^2 = 8.018$
Yes	158 (69.6)	69 (30.4)	$P = 0.005$
Finding the awareness of the public sufficient or not in case of a CBRNW attack			
Age group			
21 years and under	216 (92.7)	17 (7.3)	$\chi^2 = 11.069$
22 years and over	179 (99.4)	1 (0.6)	$P = 0.001$
Finding the laws and regulations on CBRNW sufficient or not			
Age group			
21 years and under	181 (77.7)	52 (22.3)	$\chi^2 = 8.860$
22 years and over	160 (88.9)	20 (11.1)	$P = 0.003$
Previous training on the subject			
No	330 (83.3)	66 (16.7)	$\chi^2 = 3.929$
Yes	11 (64.7)	6 (35.3)	$P = 0.047$

* Row percentages were considered.

hospitals were ready and health-care professionals had problems in various circumstances.⁵ No matter if a country is developed or not, CBRNW is a threat for all countries in the world.¹ Even though such attacks have been experienced many times in the past century, there are still significant deficiencies.

This study was conducted to determine the awareness of health education students within a university sampling in Turkey and who would be employed within 2-3 mo about CBRN weapons and to find out whether certain characteristics would create differences in their awareness.

A single use of a CBRNW could cause human casualties in numbers corresponding to repeated uses of conventional weapons and could lead to further negative effects after the attack.¹¹

An article reported by Galatchi mentioned particularly Turkey, Romania, Greece, and Bulgaria as candidates for CBRNW attacks.¹² Although a high rate (80.9%) of participants considered

Turkey under the threat of CBRNW, those who believed that they had sufficient professional knowledge and skills in this regard were much fewer (16.5%). This is believed to stem from the fact that not all participants received education on CBRNW. Aslan Huyar and Esin conducted a research on nursing students in Turkey and found that 94% of the participants received no training on CBRNW, and 91.7% did not wish to receive such training, believing that nurses' intervention is not required in CBRNW cases.¹³ Another study focused on the knowledge and views of emergency unit nurses on bioterrorism and revealed that 57.8% knew about the concept of bioterrorism, but considering our country in a risky position, they wanted to receive a more comprehensive education on the matter.¹⁴ Consistent with the literature, students seem to have a negative attitude, as well as an increasingly more awareness toward this subject during their education. In a study conducted in Poland, 78% of nurses perceived their country to be under threat of

bioterrorism.¹⁵ One research investigated officers working in institutions that will intervene in case of a CBRNW attack/threat in Turkey and found that only 5.9% received training on this subject during their university education.¹⁶

As presented in Table 2, the participants perceived their roles and responsibilities at high percentages, but the awareness level of the public at lower rates. The most notable finding was that the participants considered the active health-care personnel insufficient in terms of CBRNW attacks. However, Turkey faces a more likely threat of CBRNW compared to other countries due to its geostrategic location, intercontinental transportation in international energy transportation, the nuclear power plants in neighboring countries, irregular urbanization, and other risks brought by industrialization. This puts the society at high risk, necessitating preparation. In this regard, creating awareness on CBRNW and providing the necessary basic education will reduce potential damages in case of a possible threat in both the country where this research is conducted and in other geographies with similar positional characteristics.

The participants had similar percentages in terms of knowledge on CBRNW weapons, except for a higher knowledge on radiological weapons. This finding was because the participants had received detailed training on radiology.

Another finding of the study was the varied perceptions of the participants about CBRNW. It was important to see that their field of education did not create any difference. In Turkey, the period of training differs among professions. Although these differences could be acceptable based on the differences in both the education period and the contents, the reasons could be the importance and priority given to treatment and rehabilitation and the superficial importance attributed to preventive health services within these education programs. The subject of CBRNW is taught as a part of Public Health courses on a theoretical basis in all these professions. Almost all the participants in this study (95.9%) stated that they had not received training on the subject. Another notable result was that professional commitment did not make a difference in terms of CBRNW perceptions. This finding supports the approach mentioned above. In a study conducted by Sevinç et al. on paramedics, 38.5% stated that they did not receive training on disaster medicine. Here, it was demonstrated that the percentages of having received training on disaster medicine among physicians and nurses were close to the percentages of paramedics.¹⁷

In this study, 68.0% of the participants stated that they did not know about nerve agents, 46.2% about burning gases, 30.5% about lung irritants, 81.1% about anticholinergic agents, and 45.8% about riot control agents. Nerve agents and blood poisons have lethal effects, burning gases cause tissue damage, lung irritants cause physical damage to the respiratory system, anticholinergic gases could cause psychosis and serious mental deficiencies, and riot control agents cause rapid and temporary loss of capacity.^{18,19} Footer et al. examined the matter on Syrian health-care workers who had suffered a chemical weapon attack and highlighted the significance of training, even when given from a distance.²⁰

In the present study, the variable of age created a difference in perceiving one's professional knowledge and skills as competent in case of a CBRNW attack. It was observed the percentage of finding oneself incompetent was higher at ages 22 y and older. Also, it was determined that participants who stated that they did not know about chemical weapons had higher percentages for perceiving themselves as incompetent. Valkanova et al. investigated whether physicians and nurses knew their roles and responsibilities in case of a CBRNW threat and found that 79% of the participants aware

of the hospital plan, 69% were aware of their role in this plan, and 71% stated that they had the ability to collect information and perform analysis in case of a threat.²¹

Another study reported that only 7.1% of participants felt ready to intervene in case of a CBRNW attack. The same cohort noted a very low level of preparedness for the institutions where they worked.¹⁶ In this study, it was observed that knowing one's professional roles and responsibilities in case of a CBRNW attack differed according to sex, previous training on the subject, and knowledge about each type of CBRNW weapons. The percentage of not knowing one's professional roles and responsibilities was higher among those who did not know about CBRNWs. Some studies in the literature emphasize the importance of receiving long-term training on CBRNW.²² Öner compared awareness regarding CBRNW among family physicians and paramedics and found a significantly higher level of knowledge on biological weapons in non-physician health-care personnel (paramedics and emergency medical technicians).²³ Wiesner et al. demonstrated the importance of receiving educational training on disaster medicine in a cohort study.¹⁹ Demirağ et al.^{24,25} found that 45.1% of paramedic students had no knowledge about bioterrorism. In another study comparing whether nurses and medical staff were prepared for a bioterrorism attack, it was found that paramedics were better prepared than nurses, although both groups were found to be insufficient.²⁵ Arslan mentioned that emergency personnel should be provided with training on CBRNW, that in-service training was not performed in some hospitals, and that decontamination units were not suitable.²⁶

The CBRNW regulations were enforced in Turkey in 2012.²⁷ According to this regulation, the Ministry of Health and all its affiliates are authorized and assigned at all stages from the management of the event to its treatment and rehabilitation. The percentage of finding laws and regulations about CBRNW insufficient was higher in the age group for 22 y and older and among those who did not receive any training on the subject.

Conclusion

The awareness of the participants regarding CBRNW was found to be very low. It was notable that whether they loved their profession or not did not make any difference. It was observed that variables such as age, sex, previous education on the subject, and knowledge about CBRN weapons made a difference in terms of CBRNW perceptions. Giving importance and priority to raising awareness and increasing training and practices on the subject should be considered not only an educational requirement, but also as a state and public policy. Contributions should be made to the literature about these deficiencies with further national and international research and with different cultures and structures.

Conflict(s) of interest. The authors declare no conflicts of interest.

Ethical standards. The research was approved by the research ethics committee of the university (protocol number: 90139838-000-E.32493-20-06/2019). Participation was voluntary. All subjects received previous information about the content of this research.

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