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Assessment of the Relationship Between the Risk Perception and Preparedness Attitudes of Search & Rescue and Firefighting Teams Against Event Site Hazards in CBRN Events: Adana Province Case[1]

KBRN Olaylarında Arama & Kurtarma ve İtfaiye Ekiplerinin Olay Yeri Tehlikelerine Karşı Risk Algısı ile Hazırlık Tutumları Arasındaki İlişkinin Değerlendirilmesi: Adana İli Örneği

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Abstract

CBRN events can put first responders at risk in the form of hazardous chemical, biological, radioactive, nuclear agents. This study aims to measure the risk perceptions of search & rescue and firefighters involved in the first response in CBRN events against the hazards at the scene and to evaluate the relationship between their attitudes towards pre-event preparedness. Within the scope of our study, we designed a survey to address the risk perception and preparedness for CBRN events based on a 5-Likert scale. The study was conducted on 134 search & rescue and fire brigade workers who had the potential to take part in responding to CBRN incidents in Adana province, who agreed to fill out a questionnaire. As a result of the study, participants were found to have a significant positive linear relationship between CBRN event site hazard risk perception levels and preparedness levels. First responders should know and identify hazardous materials they may encounter in any CBRN event. During the preparedness process, attention should be pay to the fact that the pieces of training on CBRN hazards increase the risk perception of first responders.

Keywords: *Search & Rescue, CBRN Events, Firefighters, Risk Perception, Preparedness*

Öz

KBRN olayları tehlikeli kimyasal, biyolojik, radyoaktif, nükleer ajanlarını içermesi bakımından ilk müdahale ekiplerini risk altında bırakabilmektedir. Bu çalışma, KBRN olaylarında ilk müdahalede yer alan arama & kurtarma ve itfaiyecilerin olay yerindeki tehlikelere karşı risk algılarını ölçmeyi ve olay öncesi hazırlığa yönelik tutumları arasındaki ilişkiyi değerlendirmeyi amaçlamaktadır. Çalışma kapsamında, KBRN olaylarına yönelik risk algısı ve hazırlıklı olma durumunu ölçen 5'li likert ölçeğine dayanan bir anket tasarlanmıştır. Çalışma, Adana ilinde KBRN olaylarına müdahale etme potansiyeline sahip ve anket doldurmayı kabul eden 134 arama & kurtarma ve itfaiye çalışanı üzerinde gerçekleştirilmiştir. Çalışma sonucunda, katılımcıların KBRN olay yeri tehlike risk algı düzeyleri ile hazırlık düzeyleri arasında anlamlı pozitif doğrusal bir ilişki olduğu görülmüştür. İlk müdahale ekipleri, herhangi bir KBRN olayında karşılaşabilecekleri tehlikeli maddeleri bilmeli ve tanımlamalıdır. Hazırlık sürecinde, KBRN tehlikeleri ile ilgili eğitimlerin ilk müdahale ekiplerinin risk algısını artırmasına dikkat edilmelidir.

Anahtar Kelimeler: *Arama & Kurtarma, KBRN Olayları, İtfaiyeciler, Risk Algısı, Hazırlık*

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Introduction

The term CBRN means chemical, biological, radiological and nuclear and includes certain hazards that may be encountered during an event (Calder & Bland, 2018:417). Intentional and unintentional actions or events, including accidents, may result in exposure to CBRN agents (International Committee of the Red Cross, https://shop.icrc.org/chemical-biological-radiological-and-nuclear-response-introductory-guidance-pdf-en Date of access: 22.05.2019). There have been many events related to the CBRN issue in history. The Fukushima and Chernobyl radiological events, the chemical events of Seveso, the deliberate release of sarin gas in the Tokyo subway, as well as biological outbreaks such as swine flu and the Ebola epidemic, have killed many people and have made CBRN risks a real and global threat (İşbilir et al., 2018; Malizia et al., 2016).

First responders include police, firefighters, ambulances, paramedics, rescue, and other emergency service personnel who respond to any emergency, whether it is the result of a natural disaster, an accident, or a deliberate human act causing injury or loss of life (Barratt at al. 2018). First responders are often the first to encounter difficult, dangerous, and drained situations on the square. They are the first to reach out to disaster victims and provide them with emotional and physical support. While these tasks are necessary for the whole community, they are very tiring to first responders and put them at an increased risk of trauma over time (SAMHSA, 2018).

It is necessary to be prepared and to carry out risk reduction studies to manage mass accident events due to human-induced accidents involving CBRN agents and to develop an effective response mechanism (Bhardwaj, 2010). In this context, it is significant to be prepared to overcome the unfavorable effects that any CBRN event may have on people, structures, critical facilities, environment, and other living things by responding in the fastest and most effective way.

The perception of risk drives decisions about the acceptability of risks and is a fundamental factor in behavior before, during and after a disaster. Human behavior in emergency management is influenced by risk perception, risk attitude, risk communication and risk management aspects (Rohrmann, 2008). Risk perception greatly influences risk management and therefore determines whether risk management is successful in reducing vulnerability (Bubeck et al. 2012). Managing risk perceptions is an important component of the hazards risk management process (Coppola, 2015).

The purpose of this study is to measure the risk perceptions of search & rescue and firefighters involved in the first response in CBRN events and to evaluate the relationship between their attitudes regarding pre-event preparedness.

1. Material and Methods

The study used a cross-sectional design. The study sample consisted of 134 search & rescue and firefighter employees who will take part in response to the possible CBRN events in Adana and are included in the first response team. Search & rescue workers in this study were selected from Adana Provincial Directorate of Disaster and Emergency, and firefighters from Adana Metropolitan Municipality Fire Department.

The data were collected by applying a face-to-face to the participants between 05 November 2018-26 April 2019. The survey process was carried out by the researchers themselves. A survey method was used to collect data. As a result of the literature review and expert opinion, a survey form based on the 5-point Likert scale was created by the researchers to measure the risk perception and preparedness of the first responders for CBRN events. It consisted of a total of 36 questions, 8 of which were demographic information, working year, CBRN; status of receiving education, taking part in response and participating in exercises, 14 of which were risk perception of CBRN event site hazards and 14 of which were preparedness for CBRN. In the 5-point Likert scale, the options of strongly disagree (1), disagree (2), no idea (3), agree (4), and strongly agree (5) were included. The computer statistic program was used to analyze the data.

Percentage, frequency, number (n), mean, standard deviation (SD), and percentage values (%) were given as descriptive statistics. While interpreting the arithmetic means, (1.00-2.33) low, (2.34-3.67) medium and (3.68-5.00) high were evaluated. Significance level was accepted as p-value < 0.05. The relationship between the participants' risk perceptions and preparedness was determined by performing Simple Linear Correlation Analysis. The reliability of the survey was obtained with Cronbach's Alpha. The Cronbach's Alpha value of the reliability analysis was determined as (0.940). (Table1). The analysis of the preparedness and risk perception levels of the participants according to the variables of receiving education CBRN and participating in training was performed by Independent Sample T-Test.

Table 1. Reliability Analysis

Cronbach's Alfa	Number of Items
0.940	28

2. Results and Discussion

A total of 134 people completed the survey and 134 forms analyzed. The gender of the participants were 130 males (97.0%) and 4 females (3.0%). 1 (0.7%) of the participants was in the 18-25 age range, 27 (20.1%) in the 26-34 age range, 71 (53.0%) in the 35-45 age range, and 35 (26.1%) in the 46-55 age range. The job of the participants was 33 search & rescue (24.6%) and 101 firefighters (75.4%). The working years of the participants were 8 (6.0%) people between 1-5 years, 24 (17.9%) people between 6-10 years, 34 (25.4%) people between 11-15 years, 54 (40.3%) people between 16-20 years, 21 and over 14 (10.4%) people. 126 (94.0%) of the participants stated that they were married, while 8 (6.0%) stated that they were single. (Table 2).

Table 2. Demographic Information and CBRN Related Education, Training and Response Situations of the Participants

Characteristic	Category	n	%	Characteristic	Category	n	%
Gender	Male	130	97.0	Job	Search & Rescue	33	24.6
	Female	4	3.0		Firefighters	101	75.4
	Total	134	100		Total	134	100
Age	18-25	1	0.7	Working year	1-5 years	8	6.0
	26-34	27	20.1		6-10 years	24	17.9
	35-45	71	53.0		11-15 years	34	25.4
	46-55	35	26.1		16-20 years	54	40.3
	Total	134	100		21 and overs	14	10.4
					Total	134	100
Marital Status	Married	126	94.0	CBRN Education	Yes	80	59.7
	Single	8	6.0		No	54	40.3
	Total	134	100		Total	134	100
CBRN Training	Yes	58	43.3	CBRN Response	Yes	42	31.3
	No	76	56.7		No	92	68.7
	Total	134	100		Total	134	100

80 (59.7%) of the participants received education on CBRN related, and 54 (40.3%) people did not receive education on CBRN related. Participation in CBRN related training; while 58 (43.3%) people took part in the training, 76 people (56.7%) did not take part in any training related to CBRN. The number of participants involved in an a response to any CBRN-related event was 42 (31.3%), and the number of those not involved in the response was 92 (68.7%). (Table 2).

The education status of the participants about CBRN was analyzed according to their level of preparedness.According to the Independent Sample T-Test analysis, it was found that there was a significant difference between the participants education status on CBRN and their level of preparedness because the p-value was less than 0.05. The results of the analysis showed that the education received increased the preparedness levels. (Table 3).

Table 3. Independent Sample T-test Result of the CBRN-Related Education and Preparedness

CBRN-Related Education	N	$\bar{x}$	SD	*t*	*p*
Yes	80	4.10	0.61	8.22	0.001
No	54	3.17	0.67		

The education status of the participants about CBRN was analyzed according to their level of risk perception. According to the Independent Sample T-Test analysis, it was found that there was a significant difference between the participants education status on CBRN and their level of risk perception because the p-value was less than 0.05. The results of the analysis showed that the education received increased the risk perception levels. (Table 4).

Table 4. Independent Sample T-test Result of the CBRN-Related Education and Risk Perception

CBRN-Related Education	N	$\bar{x}$	SD	*t*	*p*
Yes	80	4.27	0.58	3.77	0.001
No	54	3.87	0.61		

Simple Linear Correlation Analysis was conducted to determine the relationship between the participants' risk perceptions and preparedness attitudes. According to the result of the correlation analysis, the p-value (0.001) was determined. It has been determined that there is a positive correlation of (0.493) between the risk perception levels of individuals and their preparedness attitude levels, and this relationship is significant. (Table 5).

Table 5. The Relationship Between CBRN Risk Perception and Preparedness

		Risk Perception	Preparedness
Risk Perception	Pearson Correlation	1	**0.493**
	p-value	-	**0.001****
	n	134	134
Preparedness	Pearson Correlation	**0.493**	1
	p-value	**0.001****	-
	n	134	134

The participation of the teams in the study in CBRN-related training was analyzed according to their level of preparedness. According to the Independent Sample T-Test analysis, it was found that there was a significant difference between the participants' participation in the CBRN-related training and their level of preparedness, since the p value was less than 0.05. The results of the analysis showed that taking part in the training increased the levels of preparedness. (Table 6).

Table 6. Independent Sample T-test Result of the CBRN-Related Training and Preparedness

CBRN-Related Training	N	$\bar{x}$	SD	*t*	*p*
Yes	58	4.16	0.64	6.42	0.001
No	76	3.39	0.71		

It was aimed to determine the risk perceptions of search & rescue and fire brigades regarding CBRN hazards and the effect of these perceptions on their preparedness attitudes. In the findings obtained, it was observed that there was a positive relationship between the risk perceptions of the participants and their preparedness levels. Melo at al., (2020) the way rescuers perceive the risks of ionising radiation hazards will influence their preparedness to respond in case of a radiological or nuclear emergency. The training and exercises had a positive effect on the level of preparation. Participants with high risk perception have previously received training on CBRN. Sharma (2010) as with other disasters, proper education is key to preparedness for CBRN events. Prati at al., (2013) examined the risk perception of different emergency

situations among firefighters. Higher risk perception has been associated with higher perceived education, practical experience, and acute stress reactions.Yamada et al., (2020) assessed the Nagasaki County firefighters' preparedness, awareness and concerns for the radiation disaster. Willingness to be assigned to a radiation disaster response team has been found to be linked to radiation disaster response and confidence in the use of materials and / or equipment. They stated that it may be beneficial to have continuing education programs that combine basic knowledge with practical competence. Iyama et al., (2020) regular nuclear disaster exercises can increase firefighters' intention to participate in nuclear disaster activities. Li at al., (2015) in nuclear, biological and chemical incidents, countermeasures, establishing response coordination, public education, practical training and exercise, and a professional advisory team or system should be the focus of emergency medical response facilities. Melnikova at al., (2018) limited information is available on injuries to responders that occur during hazardous chemical incidents. The percentage of respondents among the groups injured in chemical incidents has not changed over the years. Firefighters were the most frequently injured group among the response teams. Most tampering injuries have been caused by human error or equipment failure. All responders should have hazardous materials training, at least at the basic level of awareness, to recognize and prevent exposure. Rebmann et al., (2019) it is very important for first responders to receive radiological event training, participate in exercises involving radiological scenarios, and access information and resources on time.

Coppola (2015), personal factors that determine risk acceptability are driven by risk perception. Managing risk perceptions is an important component of the hazards risk management process. Paek and Hove (2017), risk perception is important for health and risk communication because it determines which dangers people care about and how they deal with them. Risk perceptions are important determinants of health and risk-related decisions, such as adopting healthy behaviors, reducing unhealthy behaviors, and accepting or rejecting a certain risk level. Ingram (2018), timely and accurate communication of hazards and risks associated with radiation threats and incidents can increase the amount and level of training in response to such events.

Conclusion

CBRN incidents are events that put first responders at risk due to the dangers they create, have difficult response conditions and require team members to act in coordination. It may be beneficial to increase the risk perceptions of the teams in the preparations for the CBRN incidents, in the training given for the dangers that first responders may encounter, in terms of not being adversely affected by the incidents.The roles and responsibilities of the first responders should be clearly stated in the planning made primarily in the preparedness studies for CBRN events. For the teams to act in coordination and cooperation on the scene, joint training (desk, hands-on trainings) should be carried out with all intervention units. Trainings should include realistic scenarios, and after the training, the deficiencies or wrong situations that arise as a result of the evaluations should be considered and corrected.

First responders should have completed the necessary training in terms of situations that may pose a danger in CBRN incidents and effective response techniques. Training on these situations should be practical and contribute to the development of intervention skills of the teams. In case of CBRN-related events, the equipment and equipment to be used by the teams must be sufficient to intervene, the deficiencies in the information about their use must be eliminated, the necessary training must be completed in terms of the use of personal protective equipment that will provide protection at the scene, and the teams must be tested and the deficiencies must be eliminated.

First responders should know and identify hazardous materials they may encounter in any CBRN incident. It should be knowledgeable about what kind of precautions to take against adverse situations (exposure to dangerous substances) that may occur in relation to dangerous substances, what the symptoms and findings are in the exposure that may occur and how to act.

First responders should review past CBRN events, experienced malfunctions, errors, deficiencies and wrongful interventions should be evaluated, and if there is a damage or loss case related to the incident (injury or death), all necessary measures should be taken and implemented to prevent them.

The fact that the trainers who provide training on CBRN events are knowledgeable and equipped, update themselves at regular intervals, and complete all necessary trainings can contribute to increase the quality of the training and practices received by first responders.

It has been observed in the literature that there are limited studies on first responders in CBRN events. In future studies on CBRN, it is thought that more focus should be placed on first responders. It is expected that the information and findings obtained from this study will contribute to the relevant public institutions and organizations, decision makers who will carry out the preparation and mitigation studies for CBRN events in their future studies.

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Annex

Risk perception of CBRN hazards **(5) I totally agree, (4) I agree, (3) No idea, (2) I don't agree, (1) I totally disagree**						
Express your opinions about the risks that can be caused by dangerous situations for first responder in CBRN events.						
	1	**2**	**3**	**4**	**5**	**mean**
1. Explosives at the scene; It is risky in terms of shock waves, thermal radiation and toxic fumes.	2.2	2.2	3.7	47.0	44.8	4.29
2. I am concerned about the presence of flammable gases at the scene of chemical burns or poisoning.	2.4	1.3	3.7	47.0	45.5	4.32
3. The type of radiation, distance from the source and duration of exposure are effective in the radiation exposures.	1.2	1.7	15.7	38.8	42.5	4.18
4. In an event involving biological agents, the negative effects of exposure may not be apparent immediately	1.5	3.7	18.7	38.1	38.1	4.07
5. I am concerned about exposure from contaminated person(s) in an event involving chemical agents.	2.5	2.2	3.7	50.4	41.0	4.26
6. Exposure to nuclear accidents; cancer formation, skin burns and disrupt the structure of the DNA.	2.8	0.7	11.2	39.6	46.0	4.26
7. Spilled or scattered toxic substances, including vapors and puddles at the scene, are risky for teams.	3.4	0.7	2.2	45.2	48.5	4.38
8. I think I will be affected faster and easier by CBRN hazards because of my work.	2.2	7.5	6.0	41.0	43.3	4.15
9. I would volunteer to response in a CBRN event.	17.2	23.9	17.2	18.7	23.1	3.06
10. I think that CBRN events can pose a threat to future generations.	1.5	1.5	5.2	48.5	43.3	4.30
11. There are risk situations that may involve a large number of people in CBRN events.	1.3	0.2	3.0	45.5	50.0	4.42
12. I think personal protective equipment will provide significant protection against CBRN hazards at the scene.	1.8	2.2	9.0	39.3	47.8	4.29
13. If I experience exposure to CBRN hazards, I will overcome potential harmful effects with personal skill and effort.	5.2	14.9	24.6	33.6	21.6	3.51
14. I'm concerned about being harmed / injured by CBRN hazards.	0.7	5.2	3.0	44.0	47.0	4.31

Preparedness for CBRN events **(5) I totally agree, (4) I agree, (3) No idea, (2) I don't agree, (1) I totally disagree**						
For first responder teams express your opinions about preparing for CBRN events.						
	1	**2**	**3**	**4**	**5**	**mean**
1. I have knowledge of the plans and procedures to be applied to respond to a CBRN-related event.	4.5	14.2	23.9	44.0	13.4	3.47
2. I have knowledge of how to identify a contaminated area at the scene.	3.7	19.4	26.9	38.8	11.2	3.34
3. I have knowledge of the hot and cold zone at the scene.	5.2	12.7	25.4	43.3	13.4	3.47
4. I have knowledge of the symptoms of exposure to CBRN agents and how to identify them.	3.5	17.9	29.3	37.3	11.9	3.35

		1	2	3	4	5	mean
5.	Frequent training and exercises should be performed in order not to forget the knowledge and skill in responding to a CBRN event.	3.7	2.2	5.2	28.4	60.4	4.39
6.	I think our institution has enough response personnel to respond to CBRN events.	5.2	17.2	29.1	32.1	16.4	3.37
7.	I think I have enough equipment and knowledge to respond to CBRN-related events involving dangerous agents.	5.5	21.6	29.1	28.1	15.7	3.27
8.	Inspection, maintenance and storage of equipment prior to response to CBRN events is important.	3.4	1.8	4.5	34.3	56.0	4.37
9.	I feel ready to intervene in any event related to CBRN.	7.5	23.9	18.7	36.6	13.4	3.24
10.	I know when and how to use my personal protective equipment.	5.2	14.9	19.4	40.3	20.1	3.55
11.	I have sufficient knowledge of the risks arising from CBRN hazards.	6.7	17.2	20.9	37.3	17.9	3.42
12.	Prior preparation is important to reduce the risk of exposure to a potential accident involving CBRN.	4.1	1.5	3.0	43.3	48.1	4.31
13.	It is the responsibility of the institution to which I am connected to make plans in advance and implement these plans to respond effectively to CBRN events.	3.0	2.8	19.6	41.8	32.8	3.98
14.	The researches, information and inventories made by science and technology on CBRN make an important contribution to our preparedness for the events.	3.1	1.4	8.2	40.3	47.0	4.26