

# Research And Development Of Nurse's Knowledge, Attitude, And Self-Efficiency On Chemical, Biological, Radiological, And Nuclear Hazards

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## Abstract:

**Background:** Chemical, Biological, Radiological and Nuclear Hazards (CBRN) have the potential to pose risks to human life. These threats affect the people directly exposed and a much broader audience regarding their indirect effects. Those who respond first to these threats constitute the core audience that should first be informed about these threats that may occur and that may affect themselves.

**Objective:** This study aims to develop measurement tools to determine nurses' knowledge levels, attitudes, and self-efficacy about chemical, biological, radiological, and nuclear threats and hazards and to evaluate their validity and reliability.

**Materials and Methods:** In the study, data were obtained from 171 nurses working in Adiyaman province and its districts using a simple random sampling method. "Individual Information Form" and "Chemical, Biological, Radiological, Nuclear Hazards Information, Attitude and Self-Efficacy Scale for Nurses" were used to obtain the data.

**Results:** As a result of the analysis for validity and reliability, the knowledge test KR-20 value; is 0.82. In addition, as a result of the reliability analysis, Cronbach's Alpha coefficient of the scale was calculated as 0.925. The attitude scale consists of 16 items and three factors.

**Conclusion:** As a result, an increase in the score obtained from the scale indicates that the CBRN attitude and self-efficacy level increase. The scores the participants got from the CBRN knowledge test, attitude scale, and self-efficacy scale after the training were significantly higher than their scores before the training.

**Key Word:** CBRN, Nurse, Danger, Self-Efficacy, Attitude.

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## I. Introduction

Chemical, biological, radiological, and nuclear hazards (CBRN) have been evaluated within the disaster group that has negatively affected human life in the last century. As a result of the accidental or intentional release of substances evaluated in these four groups, it is observed that situations that can be described as harmful to both human and environmental health<sup>1</sup>. Chemical hazards are described as chemical warfare agents include poisoning or injury caused by chemical agents, including hazardous industrial or household chemicals. Biological hazards are diseases caused by the deliberate release of dangerous bacteria, viruses, or toxins, while radiological hazards consist of diseases caused by exposure to dangerous radioactive substances. Nuclear hazards refer to life-threatening health problems caused by exposure to nuclear radiation, thermal effects, light effects, and pressure effects of nuclear explosions<sup>2</sup>. In the context of health problems, It is essential to provide appropriate and timely emergency responses to persons exposed to CBRN reagents. In order to combat this public health threat, nurses should have skills such as CBRN presentation, triage, intervention procedures, decontamination procedures, crime scene management, psychosocial impact management, surveillance, communication, incident reporting, isolation practices, and leadership. In particular, the preparedness of healthcare workers is vital in minimizing the effects of damage that may occur from CBRN threats<sup>3</sup>.

Nurses, who intervene in the context of providing medical aid to the affected people in the face of the panic and unrest caused by CBRN incidents, have difficulty facing such huge events. Nurses who offer practices to correct or stabilize vital signs during the event must have personal protective equipment<sup>4</sup>. Decontamination in the area and health center where the incident occurred is critical. CBRN agent should be suspected when situations such as a large number of people in an area have difficulty breathing, nausea and vomiting, redness in the eyes, watering, bleeding, and convulsions. CBRN agents should also be suspected if the environment has an unpleasant

odor, unexpected smoke or fog, unexplained plant or animal death, or suspicious water or oil droplets<sup>5</sup>. In this context, the importance of nurses in the intervention of CBRN threats and dangers is increasing. This study aims to determine the knowledge levels, attitudes, and self-efficacy perceptions of nurses about CBRN, and it is thought that the outputs obtained from this will contribute to the literature and provide measurement tools that they can use by researchers working in the field.

## II. Material and Methods

**Study Design:** This is a methodological intervention study in which validity and reliability analyses were made. This study was approved by the Scientific Research and Publication Ethics Committee of Iskenderun Technical University (28.04.2022/04). The data were obtained using a face-to-face survey method with the nurses working in various hospitals in the province and districts of Adıyaman.

**Study Group:** The research population comprises 1370 nurses working in Adıyaman province and its districts. Sample size was calculated based on study of Gürlü et al. (2021). It is calculated that at least 171 people should be included in the study, with  $\alpha$ : 0.05 power: 0.90<sup>6</sup>.

**Data Collection Tools:** It was obtained using the questionnaire form, the data collection technique used in quantitative data analysis in the study. The questionnaire form consists of a questions about the socio-demographic characteristics of the participants and the "Chemical, Biological, Radiological, Nuclear Hazards Knowledge, Attitude and Self-Efficacy Scale for Nurses." The scale was developed by Huyar and Esin (2021)<sup>7</sup>. The CBRN attitude scale consists of 16 items and a 3-factor structure. Factors were named individual attitude, professional attitude, and social attitude, and cronbach's alpha coefficient was calculated as 0.925. The CBRN self-efficacy scale consists of 9 items and a single factor. The cronbach's alpha coefficient of is the CBRN self-efficacy scale is 0.902. The higher the score obtained from the scale, the higher the CBRN attitude and self-efficacy level. The CBRN knowledge test has two options (true/false) and consists of 31 items. The cronbach's alpha coefficient of is the CBRN knowledge test is 0.82. The study was conducted face-to-face with 171 nurses working in Adıyaman.

### Statistical analysis

Data were evaluated in the SPSS 20 package program. The conformity of the quantitative data to the normal distribution was analyzed with the Kolmogorov-Smirnov test. The t-test (paired sample t-test) was performed for the dependent groups to compare the participants' pre-training and post-training averages. In order to compare the differences between groups, a t-test (Independent Sample t-test) and one-way analysis of variance (Oneway ANOVA) were used for independent groups. For statistical significance, a p-value of <0.05 was considered significant.

## III. Result

### Characteristics of Participants

One hundred seventy-one nurses working in hospitals in Adıyaman city center and its districts participated the study voluntarily. 53.8% of the participants were male, and 46.2% were female. 14% of the participants are high school graduates, 31.6% are associate degree graduates, 52% are undergraduate graduates, and 2.3% are postgraduate graduates. In this context, 42.7% of the participants graduated from foundation universities, 57.3% graduated from state universities. Considering the seniority of the participants in the profession, 30.4% of participants have 1-5 years, 33.3% of participants have 6-10 years, 31.6% of participants have 11-20 years of seniority, and 4.7% of participants have seniority over 20 years experience in the profession. 109 people (63.7%) who participated in the research stated that they received training on CBRN during their educational process, 62 people (36.3%) stated that they did not. In the study, 159 participants (93%) stated they wanted to receive training on CBRN. 138 people (80.7%) who participated in the research stated that it is essential to be able to intervene in CBRN cases as a professional necessity, 33 people (19.3%) stated that it is not necessary (Table 1).

**Table no 1.** Distribution of the participants according to their personal and educational status and their attitudes towards CBRN cases.

Features (n=171)		Number	%
Gender	Male	79	46.2
	Female	92	53.8
University Attended	Foundation	73	42.7
	State	98	57.3
Years in the profession	1-5	52	30.4
	6-10	57	33.3
	11-20	54	31.6
	over 20 years	8	4.7
	High school graduate	24	14.0

Education status	Associate degree	54	31.6
	Bachelor's degree	89	52.0
	Master's degree	4	2.3
Status of having received training for CBRN	Received	109	63.7
	Not-received	62	36.3
The state of wanting to receive training on CBRN	Those who want education	159	93.0
	Those who do not want education	12	7.0
The state of thinking whether it is necessary for the profession to be able to intervene in CBRN cases	Those who think it is necessary	138	80.7
	Those who think it is not necessary	33	19.3
Total		171	100.0

**Table no 2.** Comparison of the scores of the participants from the CBRN knowledge test, attitude scale and self-efficacy scale before and after the training.

n=171	Before training		After training		p
	Min-Max	Mean±SD	Min-Max	Mean±SD	
CBRN knowledge test	7-27	20.2±3.7	12-29	22.2±3.6	0.001
CBRN Attitude Scale	1.0-5.0	3.5±0.9	1.1-5.0	3.7±0.7	0.001
CBRN self-efficacy scale	1.0-5.0	3.5±1.0	1.7-5.0	3.8±0.7	0.001

p<0.05: Statistically significant difference, SD: standart deviation.

Table 2 shows a significant difference between the scores of all participants from the CBRN knowledge test before and after the training (p<0.05). The score the participants got from the CBRN knowledge test after the training was significantly higher than the score they got from the CBRN knowledge test before the training. There was a significant difference between the scores of all participants from the CBRN attitude scale before and after the training (p<0.05). The score the participants got from the CBRN attitude scale after the training was significantly higher than the score from the CBRN attitude scale before the training. A significant difference was found between the scores of all participants from the CBRN self-efficacy scale before and after the training (p<0.05). The score the participants got from the CBRN self-efficacy scale after the training was significantly higher than the score they got from the CBRN self-efficacy scale before the training.

**Table no 3.** Comparison of the CBRN attitude scale scores before and after the training according to the participants

Features (n=171)		n	Before training CBRN attitude scale (Mean±SD)	After training CBRN attitude scale (Mean±SD)	p
Gender	Male	79	3.6±0.9	3.8±0.8	0.001
	Female	92	3.4±0.9	3.7±0.7	0.001
	p		0.248	0.346	
University Attended	Foundation	73	3.6±0.8	3.7±0.7	0.012
	State	98	3.4±1.0	3.7±0.8	0.001
	p		0.266	0.726	
Education status	High school graduate	24	3.5±1.0	3.7±0.8	0.016
	Associate degree	54	3.4±0.8	3.5±0.7	0.001
	Bachelor's and Master's degree	92	3.6±1.0	3.9±0.8	0.001
	p		0.410	0.095	
Status of having received training for CBRN	Received	109	3.6±1.0	3.8±0.8	0.001
	Not-received	62	3.4±0.8	3.6±0.6	0.001
	p		0.234	0.139	
The state of wanting to receive training on CBRN	Those who want education	159	3.5±0.9	3.7±0.7	0.001
	Those who do not want education	12	3.2±1.1	3.3±1.1	0.027

	p		0.181	0.195	
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p<0.05: Statistically significant difference, SD: standart deviation.

Table 3 shows no significant difference between the participant's scores in the CBRN attitude scale before the training according to their gender. Before the training, there was no significant difference between the participants' scores from the CBRN attitude scale according to the university they attended. Before the training, there was no significant difference between the participants' scores from the CBRN attitude scale according to their educational status. After the training, there was no significant difference between the scores obtained from the CBRN attitude scale according to the educational status of the participants. There was no significant difference between the participants' scores from the CBRN attitude scale according to the training status of the participants before the training. After the training, there is no significant difference between the participants' scores from the CBRN attitude scale according to their training on CBRN. There is no significant difference between the participants' scores from the CBRN attitude scale, according to their willingness to receive training on CBRN before the training. After the training, there is no significant difference between the participants' scores from the CBRN attitude scale according to their willingness to receive training on CBRN. In all conditions in Table 3 (gender, university, education level, receiving education for CBRN, and the desire to receive education to intervene in CBRN cases), the scores obtained in the post-training attitude scale were significantly higher than before the education (p<0.05).

**Table no 4.** Comparison of CBRN self-efficacy scale scores before and after the training according to the participants.

Features (n=171)		n	Before training CBRN self-efficacy scale (Mean±SD)	After training CBRN self-efficacy scale (Mean±SD)	P
Gender	Male	79	3.5±0.9	3.9±0.7	0.001
	Female	92	3.5±1.0	3.8±0.7	0.001
	p		0.893	0.760	
University Attended	Foundation	73	3.6±0.9	3.9±0.7	0.001
	State	98	3.4±1.0	3.8±0.8	0.001
	p		0.217	0.285	
Education status	High school graduate	24	3.6±0.9	4.0±0.7	0.001
	Associate degree	55	3.3±0.9	3.8±0.7	0.001
	Bachelor's and Master's degree	92	3.5±1.0	3.8±0.7	0.001
	p		0.422	0.444	
Status of having received training for CBRN	Received	109	3.5±1.1	3.9±0.8	0.001
	Not-received	62	3.4±0.8	3.8±0.7	0.001
	p		0.366	0.328	
The state of wanting to receive training on CBRN	Those who want education	159	3.5±1.0	3.9±0.7	0.001
	Those who do not want education	12	3.3±0.8	3.7±0.7	0.01
	p		0.644	0.371	

p<0.05: Statistically significant difference, SD: standart deviation.

According to the data in Table 4, there is no significant difference between the scores obtained from the CBRN self-efficacy scale according to the gender of the participants before the training. After the training, there was no significant difference between the participants' scores from the CBRN knowledge test according to their gender. Before the training, there was no significant difference between the participants' scores from the CBRN self-efficacy scale according to the university they attended. After the training, there was no significant difference between the participants' scores from the CBRN self-efficacy scale according to the university they attended. Before the training, there was no significant difference between the participants' scores from the CBRN self-efficacy scale according to their educational status. After the training, there was no significant difference between the participants' scores from the CBRN self-efficacy scale according to their educational status. There is no significant difference between the participants' scores from the CBRN self-efficacy scale according to the training status of the participants before the training. After the training, there was no significant difference between the participants' scores from the CBRN self-efficacy scale according to their training on CBRN. There is no significant difference between the participants' scores from the CBRN self-efficacy scale, according to their

willingness to receive training on CBRN before the training. After the training, there is no significant difference between the participants' scores from the CBRN self-efficacy scale according to their willingness to receive training on CBRN. In all conditions in Table 4 (gender, university, education level, receiving education for CBRN, and the desire to receive education to intervene in CBRN cases), the scores obtained in the self-efficacy scale after the education were significantly higher than before the education ( $p < 0.05$ ).

**Table no 5.** Comparison of the CBRN knowledge test, attitude scale and self-efficacy scale scores before and after the training according to the participants' thinking whether it is necessary for their profession to be able to intervene in CBRN cases.

State of considering whether CBRN intervention is necessary for their profession	n	Before training CBRN knowledge test (Mean±SD)	After training CBRN knowledge test (Mean±SD)	p
Those who think it is necessary	138	20,7±3,3	22,5±3,5	0,001
Those who think it is not necessary	33	18,1±4,6	21,1±3,5	0,001
p		0,004	0,038	
State of considering whether CBRN intervention is necessary for their profession		Before training CBRN attitude test (Mean±SD)	After training CBRN knowledge test (Mean±SD)	p
Those who think it is necessary	138	3,6±0,9	3,8±0,7	0,001
Those who think it is not necessary	33	3,1±1,0	3,4±0,8	0,001
p		0,003	0,003	
State of considering whether CBRN intervention is necessary for their profession	n	Before training CBRN efficacy scale (Mean±SD)	After training CBRN efficacy scale (Mean±SD)	p
Those who think it is necessary	138	3,5±1,0	4,0±0,7	0,001
Those who think it is not necessary	33	3,1±0,7	3,5±0,6	0,001
p		0,008	0,004	

$p < 0.05$ : Statistically significant difference, SD: standart deviation.

Before training, participants who think that CBRN intervention is necessary for their profession to have a significantly higher score on the CBRN knowledge test than those who think it is unnecessary ( $p < 0.05$ ). After the training, participants who think that CBRN intervention is necessary for their profession to have a significantly higher score on the CBRN knowledge test than those who think it is unnecessary ( $p < 0.05$ ). Before training, participants who think that CBRN intervention is necessary for their profession to have a significantly higher score on the CBRN attitude scale than those who think it is unnecessary ( $p < 0.05$ ). After the training, participants who think that CBRN intervention is necessary for their profession to have a significantly higher score on the CBRN attitude scale than those who think it is unnecessary ( $p < 0.05$ ). Before training, participants who think that CBRN intervention is necessary for their profession to have a significantly higher score on the CBRN self-efficacy scale than those who think it is unnecessary ( $p < 0.05$ ). After the training, Participants who think that CBRN intervention is necessary for their profession to have a significantly higher score on the CBRN self-efficacy scale than those who think it is unnecessary ( $p < 0.05$ ). In the knowledge test, attitude scale, and self-efficacy scale, the scores obtained after the training were significantly higher than before, regardless of whether they thought CBRN intervention was necessary for their profession or not ( $p < 0.05$ ).

#### IV. Discussion

CBRN disasters are often a substantial threat and, therefore, can cause significant damage to livelihoods as well as cause many injuries and deaths. CBRN threats can cause irreparable damage to global security for long periods. Therefore, first of all, the level of preparedness of health personnel for CBRN crises should be evaluated<sup>8</sup>. In a study conducted by Doğan (2019), in which the needs of institutions against CBRN incidents were determined, 283 participants (66.6%) stated that they received CBRN training, while 142 people (33.4%) did not receive CBRN training<sup>9</sup>. In our study, 109 people (63.7%) stated that they received CBRN training, and 62 people (36.3%) did not receive CBRN training. The rates in both studies are similar to each other. In addition, in our study, 159 people (93%) wanted to receive CBRN training. These results show that there is still a need for adequate training in the face of CBRN events. In addition, when we look at the findings in our study, it has been seen that those who think that CBRN intervention is necessary for their profession is at a better level in terms of knowledge, attitude, and self-efficacy after the education than before the education. These findings show us the importance of awareness on the subject.

Yildirim et al. (2021), in the study they conducted in Adana province, evaluated the personal protective equipment (PPE) usage status, knowledge, and skill status of pre-hospital healthcare workers in the face of CBRN events. As a result of their study, the level of CBRN knowledge of those who received Personal Protection Method (PPM) training and PPM training in CBRN was higher than those who did not. They showed that the level of

knowledge of those who received more than one PPM training in CBRN was higher than those who did not receive or had less education. They documented that the level of CBRN knowledge of those with an associate's or bachelor's degree was higher than those with high school education<sup>10</sup>. In our study, there was no significant difference between education level (associate degree and an undergraduate degree, etc.) and CBRN knowledge level. However, the knowledge level of graduates from state universities was found to be higher than those who graduated from foundation universities. In addition, we found a significant difference between the knowledge levels before and after education in both the knowledge test and the attitude scale. When we combine the findings of both studies, it is seen that knowledge about CBRN events increases significantly with specific training. These data show that CBRN knowledge should be supported continuously with both primary and post-graduate educations.

In the study conducted by Özden and Yaman (2022), a CBRN application questionnaire consisting of 43 questions was applied to 108 people working in the health sector of the International Medical Rescue Teams Association (UMKE-DER) who are members of the National Medical Rescue Team (UMKE) and whose management is located in Kütahya. As a result of the data analysis, it was concluded that training should be given to increase the knowledge and application skills about CBRN<sup>4</sup>. Eyison et al. (2020) stated that it is important for emergency health workers to receive relevant training to be prepared for CBRN incidents and that the preparedness of emergency services to respond to CBRN incidents is the most objective indicator<sup>3</sup>. Our study observed that both the level of CBRN knowledge and the appropriate attitude in CBRN events increased significantly with the education given. In a study conducted to determine the CBRN knowledge levels of the teachers in the central village schools of Kırşehir province before and after the Basic First Aid and CBRN awareness training, the average CBRN knowledge test scores of the teachers from the pre-training was  $20.12 \pm 6.53$ , post-training was  $37.49 \pm 3.23$ , and a statistically significant difference was found between pre-training and post-training knowledge levels (6). Our study determined that the scores obtained after the training in the CBRN knowledge test, attitude scale, and self-efficacy test were significantly higher than before the training.

## V. Conclusion

As a result, in the light of previous studies and the data obtained from our study, the need for training of our health personnel continues whether they have received training for CBRN events. CBRN is a significant health problem, and it is necessary to keep the health personnel ready with up-to-date information against these events and supporting them in core and post-graduate training. Establishing CBRN units in large health institutions, employing the personnel trained in this field, and sending them to periodic training to receive new applications is very important in having expert health personnel who will carry out dynamic and on-site applications against the events.

## VI. Suggestion:

1. CBRN education in the core curriculum needs to be developed both qualitatively and quantitatively.
2. Postgraduate CBRN education needs to be developed both qualitatively and quantitatively.
3. It should be ensured that practical applications should support the theoretical training given continuously in the hospital about CBRN threats.
4. Practices (poster, cine-vision, public service announcement) should be made to increase society's awareness about the issue's importance.
5. Since there is a need for more academic studies on CBRN education, the projects submitted by academicians working in this field should be supported.

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