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## Research Article

# Factors Affecting the Disaster Response Competency of Emergency Medical Technicians in South Korea

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## ABSTRACT

**Purpose:** This study explored the factors influencing disaster response competency, that is, demographic and disaster-related characteristics, personal disaster (household and workplace) preparedness, disaster risk perception, and self-efficacy in handling disasters among emergency medical technicians in South Korea.

**Methods:** The study follows a descriptive, cross-sectional design and uses a self-reported questionnaire. Emergency medical technicians, amounting to 1,020 in all, currently working in firefighting organizations from four South Korean cities (Busan, Daegu, Daejeon, and Ulsan) participated in the study.

**Results:** Disaster risk perception, self-efficacy for disaster, participation experience in disaster education/training, and personal disaster (household and workplace) preparedness predicted the disaster response competency of emergency medical technicians in South Korea.

**Conclusion:** There is a need for an antidisaster program to enhance the disaster risk perception, self-efficacy, personal disaster (household and workplace) preparedness, and the disaster education/training participation rate toward enhancing disaster response competency of emergency medical technicians in South Korea.

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## Introduction

In South Korea, firefighting organizations are part of the national infrastructure for initial response during disasters and play a key role in disaster response by minimizing damage through prompt dispatch and efficient field activities, such as emergency care and on-scene command control [1]. Disasters can occur regardless of time or place and typically not only cause severe injuries to people and damage infrastructure but also pose a danger to poorly maintained surroundings that require prompt emergency care with insufficient resources. South Korea is a divided country and thus holds the potential for military conflict. Therefore, disaster response competency of emergency medical technicians (EMTs) as the professional manpower within firefighting organizations to

handle disasters is extremely important and should be strengthened [2].

The South Korean government emphasized the importance of disaster response competency after the occurrence of disasters such as the sinking of the Sewol ferryboat in 2014 and the outbreak of the Middle East respiratory syndrome epidemic in 2015. Therefore, the South Korean government has periodically conducted a complete emergency drill as part of its new nationwide antidisaster program, involving relevant agencies such as public health centers, schools, the military, the police, and hospitals in conjunction with firefighting organizations. However, such antidisaster drills do not comprehensively reflect the nature of disasters and are not subject to timely evaluations [3]. If EMTs fail to act as first responders in the disaster response phase, secondary disasters may occur. Hence, it is necessary to implement practical measures reflecting the reality to build up and understand factors that strengthen the disaster response competency, which is the specialized knowledge and skills associated with disasters as the capacity required for EMTs to minimize damage to the victim [4,5].

Previous studies on disaster response competency among EMTs in South Korea used variables such as demographic information (gender, position, career, region, and so on) and disaster-related characteristics (evaluation and experience of disaster education/

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training, experience of disaster victims, and so on) and other variables such as disaster preparedness perception, budget for disaster education/training, command communication system, and so on [1–3]. Using these variables and simple statistical analysis such as descriptive and correlation analysis alone, it is difficult to identify factors that affect disaster response competency of EMTs who are responsible as the first line of defense for protecting people's lives and ensuring their safety.

Most disaster-related research studies have been conducted in the field of nursing, focusing on nurses, college students, and citizens all over the world. The job of the EMT in South Korea had come into existence since 1997. Therefore, previous disaster-related studies on nursing have used a greater variety of variables and have been rather detailed. Nursing-related studies [6–11] and other studies by college students [12,13], citizens [14,15], and emergency department staff [16] have reported that risk perception and self-efficacy have affected individual response behaviors in disasters.

However, few studies [2,17] have identified the positive correlation between the disaster response competency of EMTs and disaster risk perception. Therefore, a broader understanding of these factors is needed to develop a practical program to enhance the disaster response competency of EMTs as first responders in the prehospital stage.

For these reasons, we aimed to identify the factors that affect EMTs' disaster response competency including demographic and disaster-related characteristics as well as psychological variables (disaster risk perception and self-efficacy for disaster) and personal disaster preparedness. The main aim of this study is to explore factors influencing the disaster response competency of EMTs who work in four of the largest South Korean cities based on basic information such as the degree and correlation between variables (demographic and disaster-related characteristics, personal disaster preparedness, disaster risk perception, self-efficacy for disaster, and disaster response competency).

## Methods

### Study design

The study used a descriptive, cross-sectional design and a self-reported questionnaire to examine the factors that affect disaster response competency of EMTs in South Korea.

### Participants and setting

Considering the external validity of this study, it was targeted at EMTs who worked in four of the largest South Korean cities, namely, Busan, Daegu, Daejeon, and Ulsan; the total number of EMTs was 1369 [18], which is 14% of all EMTs working in Korean firefighting organizations. A total of 1020 completed questionnaires were returned (response rate: 74.5%).

### Measurements

The questionnaire comprised five sections, that is, demographic and disaster-related characteristics, personal disaster preparedness, disaster risk perception, self-efficacy for disaster, and disaster response competency. The participants took approximately 20 minutes to complete the survey that comprised 70 questions in all. To ensure the reliability and validity of the measurement in this study, published scales that reported good levels of validity and reliability in a previous study [19] were used. We also consulted two experts with national disaster life support instructor certification for the developed measurements (disaster risk perception, self-efficacy for

disaster) and conducted a pilot test ( $n = 20$ ) before conducting the study.

### Demographic and disaster-related characteristics

Demographic characteristics include gender, region, age, marital status, educational level, career, working shifts, and annual income. Furthermore, the section “disaster-related characteristics” was developed by Uhm et al [19]. It included the following three items: (a) Have you ever been exposed to a disaster? (yes/no); (b) Annually, how many times have you worked in disaster scenes? (never/once/twice or more); and (c) Annually, how many times have you attended disaster education and training? (never/once/twice or more).

### Personal disaster preparedness

Personal disaster preparedness refers to survival goods and plans that are necessary during disasters. The section “personal disaster preparedness” was developed by Uhm et al. [19] and has been modified to suit the needs of the present study. In the pilot test ( $n = 20$ ), two unclear items about the use of an extinguisher and one similar item about insurance were excluded from the original questionnaire. The final questionnaire comprised 21 items.

Personal disaster preparedness was divided into two sub-categories: household and workplace preparedness, with 14 and 7 items, respectively. The responses were either “yes (1)” or “no (0).” The range of possible total scores is from 0 to 21. High scores indicated higher levels of personal disaster preparedness. The Kuder–Richardson Formula 20 found in a previous study [19] was .81, whereas it was .77 in the present study (household preparedness, .67; workplace preparedness, .63).

### Disaster risk perception

Disaster risk perception refers to the perception of an individual's subjective risks for the occurrence of a disaster [14,15]. This scale was developed based on previous studies [12,13,19] and expert group consultation. We excluded one item that remained unclear after the pilot test ( $n = 20$ ) and finally compiled the questionnaire. It comprised four items: (a) Korea is geopolitically vulnerable to disasters; (b) A disaster can paralyze social functions such as shutting down transportation, communication, and power networks, threatening public safety and national security, and so on; (c) A disaster can cause economic crises such as inflation, pricing bubbles, and so on; (d) I think that the area I live in has a high likelihood of future disaster occurrence since a detailed safety inspection of the buildings is not conducted regularly. Each item is measured using a 5-point Likert scale, ranging from “strongly disagree (1)” to “strongly agree (5).” The range of possible total scores is from 4 to 20. A higher score indicates a higher level of disaster risk perception. The Cronbach  $\alpha$  for this study was .89.

### Self-efficacy for disaster

In this study, self-efficacy for disaster is defined as a person's confidence in his or her ability to protect himself or herself from harm during a disaster [6,13,16]. This scale was developed based on previous studies [12,13] and expert group consultation. One unclear item was excluded from the pilot test ( $n = 20$ ), and finally, the questionnaire was compiled. It comprised three items: (a) If I obtain any information on the disaster through mass media (television, radio, SNS or Social Network Services, Internet news, etc.), I will follow disaster safety guidelines in my daily life; (b) If I attend disaster education/training, I can escape a disaster scene without panicking; and (c) If I know the disaster recovery process at the national level, I can overcome with national support quickly even if I become a disaster victim. The questionnaire used a five-point scale ranging from “strongly disagree (1)” to “strongly agree (5).”

The range of possible total scores is from 3 to 15. A higher score indicates a higher level of disaster efficacy. The Cronbach  $\alpha$  for this study was .87.

#### Disaster response competency

At all disaster levels, disaster response competency refers to the specialized knowledge and skills associated with disasters as the capacity required for EMTs [4,5]. The questionnaire was a modified version of the one used by Uhm et al. [19] and was based on the on-scene emergency care guidelines for EMTs in South Korea [20] and expert group consultations. The final questionnaire comprised 31 items. One item “I can choose a hospital to transfer victims to in order to prevent overcrowding” was added to the original questionnaire after a pilot test ( $n = 20$ ). Each item was rated on a five-point scale ranging from “strongly disagree (1)” to “strongly agree (5).” The range of possible total scores is from 31 to 155. A higher score indicates a higher level of disaster response competency. The Cronbach  $\alpha$  in the study by Uhm et al. [19] was .98, whereas it was .97 in the present study.

#### Data collection and procedure

Before conducting the study, the principal investigator contacted the fire department directors of four large cities (Busan, Daegu, Daejeon, and Ulsan) to obtain permission to access the participants. The questionnaire packages with cover letters and a return envelope were mailed to EMTs working at fire stations in these four large cities. The data were collected from July to October 2017. The inclusion criteria were as follows: the participants were working in firefighting organizations and had more than one year of experience as EMTs (because the questionnaire uses the word “annually”).

#### Data analysis

The collected data were analyzed using IBM SPSS (IBM Corp., Armonk, NY, USA) Statistics for Windows, version 25.0 (Armonk, NY, USA). Statistical analyses included descriptive statistics, Pearson's correlation, and hierarchical multiple regression analysis. For independent variables, we created dummy codes to conduct the regression analysis. Finally, we calculated psychometric reliability using Cronbach  $\alpha$  and the Kuder–Richardson Formula 20 formula.

#### Ethical considerations

We followed the guidelines of the Declaration of Helsinki to ethically protect the study participants. This study was approved by the Institutional Review Board of the Daejeon University (Approval no. 1040647-201706-HR-041-03). Before conducting the study, the participants provided written consent. Furthermore, they were informed that they could withdraw their consent at any time during the study. Finally, participation was both voluntary and anonymous.

#### Results

##### Demographic and disaster-related characteristics

Most of the respondents were men (88.3%) and had worked in Busan (37.6%) and Daegu (30.6%) regions. Among them, 924 respondents (90.6%) had studied at a college or university. The mean age of the respondents was 34.09 ( $\pm 6.47$ ) years. A total of 549 respondents (53.8%) reported having career durations of less than five years. Furthermore, 976 respondents (95.7%) worked three shifts. The income of 752 respondents (73.7%) ranged between 250 and 349 million Korean Won. A total of 303 respondents (29.7%) had

experienced disaster victimization. In terms of participation experience in disaster scenes, 545 respondents (53.4%) reported that they had participated in at least one scene a year, and 804 (78.8%) had completed disaster education/training. However, 216 respondents (21.2%) had not attended any disaster education/training (Table 1).

##### Means and correlations among major variables

The mean score of personal disaster preparedness was 11.54 [standard deviation (SD) = 3.49]. The mean scores of the household and workplace subscales of personal disaster preparedness were 6.33 (SD = 2.25) and 5.22 (SD = 1.73), respectively, and those of disaster risk perception and self-efficacy were 11.21 (SD = 2.52) and 16.02 (SD = 3.23), respectively. The mean score of disaster response competency was 104.09 (SD = 1.99) (Table 2). Before conducting the regression analysis, we prepared a correlation matrix. All study variables and disaster risk perception were found to significantly correlate with each other (Table 2).

##### Predictors of disaster response competency

Table 3 depicts the results of the hierarchical multiple regression analysis. The multicollinearity among independent variables was confirmed as follows: The range of the variance inflation factor was 1.02–1.73, which did not exceed 10. The Durban–Watson test score was 2.02, and the normality distribution assumption of the residual was satisfied because there was no self-correlation between the error terms of the model. First, the hierarchical multiple regression analysis was run with demographic and disaster-related characteristics as independent variables. Ulsan ( $\beta = .07, p = .041$ ) in region, participation in disaster education/training at least once ( $\beta = .09, p = .030$ ), and participation in disaster education/training

**Table 1** Demographic and Disaster-related Characteristics ( $N = 1020$ ).

Characteristics	Category	n (%)
Gender	Men	901 (88.3)
	Women	119 (11.7)
Region	Busan	384 (37.6)
	Daegu	312 (30.6)
	Daejeon	163 (16.0)
	Ulsan	161 (15.8)
Age (yrs)	M $\pm$ SD	34.09 $\pm$ 6.47
	$\leq 30$	324 (31.8)
	31–35	343 (33.6)
	$\geq 36$	353 (34.6)
Marital status	Unmarried	426 (41.8)
	Married	594 (58.2)
Educational level	$\leq$ High school	82 (8.0)
	College/university	924 (90.6)
	$\geq$ Master's degree	14 (1.4)
Career (yrs)	$\leq 1$ –4	549 (53.8)
	5–10	258 (25.3)
	$\geq 11$	213 (20.9)
	Working shifts	Daytime
	Two	22 (2.2)
	Three	976 (95.6)
Income (million KRW)	$\leq 249$	110 (10.8)
	250–349	752 (73.7)
	$\geq 350$	158 (15.5)
Experience of disaster victim	No	717 (70.3)
	Yes	303 (29.7)
Participation experience in a disaster scene	No	475 (46.6)
	1	176 (17.2)
	$\geq 2$	369 (36.2)
Participation experience in disaster education/training	No	216 (21.2)
	1	503 (49.3)
	$\geq 2$	301 (29.5)

Note. KRW = Korean won; M = mean; SD = standard deviation; yrs = years.

**Table 2** Mean, Range, and Correlations Among Major Variables (N = 1020).

Variables	M ± SD (Range)	Personal disaster preparedness			Disaster risk perception	Self-efficacy for disaster
		Total	Household	Workplace		
<i>r</i> ( <i>p</i> )						
Personal disaster preparedness	11.54 ± 3.49 (0 ~ 21)	1				
Household	6.33 ± 2.25 (0 ~ 14)	.90 (.002)	1			
Workplace	5.22 ± 1.73 (0 ~ 7)	.84 (<.001)	.53 (<.001)	1		
Disaster risk perception	11.21 ± 2.52 (4 ~ 20)	.05 (.086)	.04 (.148)	.05 (.113)	1	
Self-efficacy for disaster	16.02 ± 3.23 (3 ~ 15)	.14 (<.001)	.12 (<.001)	.12 (<.001)	.64 (<.001)	1
Disaster response competency	104.09 ± 1.99 (31 ~ 155)	.35 (<.001)	.26 (<.001)	.38 (<.001)	.46 (<.001)	.43 (<.001)

Note. M = mean; SD = standard deviation.

twice or more times annually ( $\beta = .20, p < .001$ ) were significantly associated with disaster response competency for Model 1 ( $F = 5.48, p < .001$ ). Second, the addition of personal disaster (household and workplace) preparedness, disaster risk perception, and self-efficacy for disaster to the Model 1 equation resulted in 37.0% of the explained variance in disaster response competency ( $F = 60.73, p < .001$ ).

**Discussion**

This study examined the impact of variables such as demographic and disaster-related characteristics, personal disaster (household and workplace) preparedness, disaster risk perception, and self-efficacy on the disaster response competency of EMTs in the firefighting organizations of four big cities (Busan, Daegu, Daejeon, and Ulsan) in South Korea. This approach is novel for the study of disaster response competency of EMTs who worked at four of the largest South Korea cities because previous studies have not been able to clearly identify the major variables affecting the disaster response competency of EMTs in South Korea.

In this study, the result of the hierarchical multiple regression analysis that was run with demographic and disaster-related characteristics as independent variables identified that being located in Ulsan region and having participation experience in disaster education/training (at least once and twice or more times

annually) are significant predictors of EMTs' disaster response competency. Being located in Ulsan is likely a significant predictor because earthquakes occur more frequently in Ulsan region when compared with Busan, Daegu, and Daejeon regions [18]. The results of regression analysis including the addition of personal disaster (household and workplace) preparedness, disaster risk perception, and self-efficacy for disaster in the Model 1 equation verified that participation experience in disaster education/training (at least once and twice or more times annually), personal disaster (household and workplace) preparedness, disaster risk perception, and self-efficacy are significant predictors of disaster response competency of EMTs. Previous studies [6–11] have reported that the high-risk perception group, the high self-efficacy group for disaster, the group that had prior experience of a disaster, and the group with prior enrollment in a disaster-related training had increased likelihoods of engaging in disaster preparedness behaviors. Depending on the person, the level of these variables will vary. The learning effect also depends on the individual's experiences and characteristics. Therefore, to enhance the significant predictors of disaster response competency of EMTs, antidisaster programs need to be established based on the current level and characteristics of disaster education/training, personal disaster preparedness, disaster risk perception, and self-efficacy of EMTs for disaster.

In the results of demographic and disaster-related characteristics of this study, experience of disaster victimization (29.7%) was

**Table 3** Predictors of Disaster Response Competency (N = 1020).

Variables	Model 1			Model 2		
	B	$\beta$	t ( <i>p</i> )	B	$\beta$	t ( <i>p</i> )
(Constant)	3.16		36.95 (<.001)	.77		6.33 (<.001)
Region						
Daegu	-.03	-.02	-0.67 (.499)	-.02	-.15	-0.52 (.602)
Daejeon	.01	.01	0.24 (.810)	.07	.03	1.30 (.191)
Ulsan	.13	.07	2.05 (.041)	.01	.01	0.13 (.894)
Participation experience in a disaster scene	.06	.04	1.39 (.164)	-.02	-.01	-0.52 (.600)
Participation experience in a disaster education/training						
Once	.13	.09	2.17 (.030)	.11	.08	2.46 (.014)
Twice or more	.03	.20	4.71 (<.001)	.21	.13	4.13 (<.001)
Personal disaster preparedness						
Household				.02	.06	2.00 (.045)
Workplace				.12	.29	10.02 (<.001)
Disaster risk perception				.29	.33	10.29 (<.001)
Self-efficacy for disaster				.04	.17	5.31 (<.001)
F ( <i>p</i> )	5.48 (<.001)			60.73 (<.001)		
R <sup>2</sup>	.03			.37		
Adjusted R <sup>2</sup>	.03			.36		
Durbin–Watson	d = 2.02					

Note. The region "Busan," participation experience in a disaster scene "none," and participation experience in a disaster education/training "none" were treated as dummy variables.

found higher than in that in previous studies, which presented values of 3.3–9.6% [19,21–23]. Although this study did not analyze the distribution of disaster victimization by region, this result may be interpreted by considering that disasters such as earthquakes occur more frequently in Ulsan region than in other parts of South Korea [18]. This can also be seen in the results of multiple regression analysis.

The results for participation experience at a disaster scene and participation in disaster education/training were 53.4% and 78.8%, respectively. Participation experience at a disaster scene was higher in this study than in previous studies, which showed values of 9.4% to 12.6% [19,22]. The reason for this gap is that the respondents of previous studies were nurses, whereas those of this study were EMTs, who are first responders in disaster scenes and whose task was to protect people's lives and to ensure their safety during disasters.

The results for participation experience in disaster education/training were consistent with the results of previous studies [3,19]. However, 21.2% of respondents had never received disaster education/training, which was higher than the value of 13.2% in a previous study [23] and still lower than the results of the previous study [2]. Although this study did not examine why they did not attend disaster education/training, we consider the main reason to be the fact that such training is not mandatory on-the-job training in South Korea [18]. Whatever be the nature of the disaster, EMTs are obliged to be available to help. Disasters are spontaneous; therefore, millions of practicing EMTs must be qualified and prepared to act anytime and anywhere with specialized knowledge and skills that are necessary in emergency situations [24]. Therefore, it is important for them to recognize and take part in disaster education/training as an essential component of their occupation.

Regarding the characteristics of major variables, the mean score of personal disaster preparedness was consistent with that of the study by Uhm et al. [19], but slightly lower than that of the study by Uhm and Oh [23]. The mean score of workplace preparedness was higher than that of household preparedness, which is consistent with the findings of Uhm and Oh [23]. These may be related to the impact of the guideline on EMTs [20] as a regulation of firefighting organizations in South Korea. Although EMTs should work as rescuers in real-world disaster events, family safety of EMTs is also important because their families can also be affected by disasters [25]. Therefore, household preparedness is as important as workplace preparedness. Previous studies have reported that individuals consider disaster preparedness more seriously after receiving education/training or watching relevant advertisements [26,27]. Hence, a national-level publicity campaign is required to encourage people to actively participate in personal disaster preparedness activities.

The mean score of disaster risk perception was either consistent with [7,23] or higher than [13,25,28] the scores in previous studies. Risks are related to dangerous events and some potentially severe consequences. Risk perception causes people to worry and be upset, but ultimately causes little harm. In addition, risk perception is dependent on personal risk experience and risk history [14,15,28]. Therefore, for efficient disaster management, the individuals' sense of risk should be strengthened.

The scores of self-efficacy were consistent with those obtained in the study by Melnikov et al. [25] and higher than those obtained in previous studies [8,13,16]. Self-efficacy is an important concept that affects the choice of behavior and determines how to deal with catastrophic situations [6,16]. In this study, the mean score of disaster risk perception was higher than that of self-efficacy.

In addition, because disasters cause enormous damage to communities and community residents, it is absolutely necessary to cooperate with related organizations such as public health centers, police departments, and hospitals responsible for community safety and health of the community residents. Because nurses who work in public health centers are responsible for the health of community residents and have more access to data regarding the health of the elderly, those with chronic illnesses, vulnerable groups, and disabled people in the community than workers at any other institution, their role is especially important for the health care of community residents during a disaster [19]. Therefore, it is necessary to improve information exchange and cooperation with nurses in public health centers for the health care of community residents during disasters.

There were several limitations in this study. First, the results of this study may not extend to all South Korean EMTs because we only selected respondents from four big cities in South Korea. Thus, future studies should include a more diverse range of firefighting organizations. Second, it is necessary to investigate the core features of disaster response for the health care of community residents in disasters, with the help of scholars specializing in emergency medical services and nursing. Third, because this study identified factors influencing the disaster response competency of EMTs, a pathway analysis should be conducted to clarify these influential factors and their effects. Our findings provide a baseline for understanding the disaster response competency of EMTs, whose duty is to protect people's lives and ensure their safety in South Korea. Our study is particularly significant because it considers psychological variables such as self-efficacy for disaster and disaster risk perception, as well as demographic and disaster-related characteristics, and personal disaster preparedness.

## Conclusion

We examined the relationships between factors such as demographic and disaster-related characteristics, disaster risk perception, self-efficacy for disaster, personal disaster preparedness, and disaster response competency of EMTs. We also observed that disaster risk perception, self-efficacy for disaster, personal disaster (household and workplace) preparedness, and disaster education/training (once or more times annually) were influential variables in predicting disaster response competency. Because South Korea is a potentially disaster-prone country geopolitically, insufficient disaster response competency of EMTs can cause nationwide disasters. Therefore, an antidisaster program that focuses on increasing these factors is needed. Future research should identify methods to increase disaster risk perception, personal disaster preparedness, and self-efficacy for disaster as well as methods for enhancing the disaster education/training participation rate.

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## Declaration of Competing Interest

The authors declare that they have no conflicts of interest.

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