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Earthquake Preparedness Recommendations from Frontline Nurses and Rescuers in the 2023 Türkiye Earthquake: A Grounded Theory Study

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Abstract

Background: Two powerful earthquakes, measuring 7.8 and 7.6 in magnitude, struck Türkiye on February 6, 2023, causing widespread devastation and significant loss of life across 11 provinces. In the aftermath of such disasters, a well-coordinated, rapid, and accessible emergency response is critical. However, the well-being of rescuers, an essential factor that significantly impacts their performance, is often overlooked, despite its crucial role in disaster search and rescue operations. Addressing these challenges is vital for enhancing the effectiveness of disaster management and saving more lives.

Aim: This study aims to identify the problems faced during rescue operations in order to improve disaster response and prevention efforts in Türkiye, a country prone to earthquakes. It also seeks to enhance healthcare services, nursing care, and disaster preparedness among healthcare workers, nurses, and the broader society.

Methods: A cross-sectional study design was employed, using Grounded Theory methodology. The sample consisted of 19 participants selected from among healthcare workers and search-and-rescue teams. Data were collected through online meetings conducted via Google Meet. Participants responded to a semi-structured questionnaire comprising 16 open-ended questions related to their personal backgrounds and earthquake experiences. Data were analyzed using content analysis with the support of the MAXQDA software.

Results: A total of 19 individuals, twelve females and seven males, participated in the study. Four main themes and ten associated codes were identified. The main themes were: (i) *Scale of the Disaster*, (ii) *Challenges During the Disaster Response*, (iii) *Life After Returning from the Disaster Area*, and (iv) *Preparedness for Future Disasters*. Through interviews conducted using the Grounded Theory method, a conceptual framework titled "*Frontline Rescuer's Resilience Against Disasters*" was developed based on participants' responses. This framework synthesizes elements from various theories, including Post-Traumatic Growth, Maslow's Hierarchy of Needs, and stress response theory.

Conclusion: Search and rescue training should be provided to healthcare workers, nurses, and the general public, with a particular emphasis on building resilience in the face of disasters. Additionally, small, localized teams should be formed to plan and prepare for future disasters at the regional level. Policymakers should develop and enforce targeted legislative actions aimed at implementing preventive policies.

Keywords: *Disaster, disaster management and organization, disaster resilience, earthquake, Grounded Theory, search-and-rescue*

Introduction

Türkiye is situated in a seismically active region characterized by intense fault lines. The Great Anatolian Fault, which separates the Anatolian and Eurasian tectonic plates, is considered one of the most active fault lines in the world.[1–3] Prior to 2023, the most devastating earthquake generated by this fault line occurred on August 17, 1999, in Düzce, located along the Black Sea coast. This 7.4-magnitude earthquake, measured on the Richter scale,[I] resulted in the deaths of approximately 20,000 people.[4,5] On February 6, 2023, at 04:17 a.m., another powerful earthquake, measuring 7.8 in magnitude on the Richter scale, caused significant damage and loss of life across 11 provinces in Türkiye. This earthquake, which caused the most significant damage in Türkiye since 1999 Düzce earthquake, was followed by another tremor measuring 7.6 in magnitude in the same region just nine hours later.[5] As of February 21, 2023, according to a statement from AFAD (the Turkish Disaster and Emergency Management Presidency), a total of 42,310 people had lost their lives in the affected regions, most of which consist of residential areas, while 448,018 individuals had to be rapidly evacuated. Following national and international calls for aid, a total of 14,740 search-and-rescue personnel were deployed to the region, including healthcare workers, volunteer doctors and nurses, as well as personnel from the Police, Army, UMKE (the Turkish National Medical Rescue Team), local security forces, and various non-governmental organizations. The total number of individuals actively serving in the region was reported to be 242,392.[6,7] Due to the large-scale nature of the disaster, in addition to immediate emergency and search-and-rescue operations, those affected required urgent access to food, shelter, clean water, medicine, and adequate security.[7] The most critical needs in the first few hours following a disaster are immediate emergency assistance, search-and-rescue operations, and accessible healthcare services.[8] Regardless of the scale of the disaster, the potential loss of life can be significantly

[I] An internationally recognized scale used in seismology to measure the magnitude of an earthquake.

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reduced through the rapid delivery of humanitarian aid and the timely deployment of healthcare workers, rescue teams, and essential equipment to the affected region.[5,9] However, research indicates that critical gaps remain in disaster preparedness in Türkiye, particularly in the areas of disaster management and readiness. Among the most significant shortcomings are the absence of a comprehensive disaster preparedness plan and the lack of holistic training for rescuers, healthcare professionals, and nurses—training that would also encompass psychosocial support.[10]

Mass casualty disasters, such as earthquakes, are an unavoidable reality for societies. Therefore, in addition to the structural integrity of settlements, disaster preparedness and effective disaster management are of vital importance for surviving such events or minimizing the loss of life.[11] However, the recent earthquake in Türkiye has clearly demonstrated that the preparations of both authorized institutions and individuals is inadequate.[11,12] These shortcomings were evident in various issues, including failures in the chain of command, the inability of teams to operate effectively and in coordination, particularly due to communication breakdowns, and a general lack of resources.[13,14] Unfortunately, these deficiencies observed in the post-earthquake response process provide concrete evidence of a broader lack of disaster preparedness.[12]

Following a disaster, physical, emotional, and social needs are greatly intensified.[12,15] In addition to search and rescue personnel, nurses assume critical roles and responsibilities that extend beyond clinical care, particularly in the context of crisis management.[16,17] Through critical thinking and multitasking skills, nurses are able to provide high-quality care before, during, and after a crisis, contributing to a reduction in mortality rates by 50–70%. However, studies emphasize that these skills must be supported not only through disaster management training but also through psychological resilience and wellness programs, which are essential for sustaining effective search and rescue efforts.[12,15,18] It has been observed that disasters not only result in the loss of life and property but also have a profound impact on the personal health, psychological well-being, and quality of life of rescuers.[19] The critical role of nurses during and after disasters is gaining increasing recognition. Their responsibilities extend beyond critical care and hospital-based decision-making to include coordination, leadership, and providing emotional support to disaster victims and their families.[12,19] Although international studies highlight the importance of psychological resilience and comprehensive disaster management training,[15,17] there remains a gap in understanding the unique, region-specific challenges faced by healthcare professionals in Türkiye. Addressing these challenges requires tailored strategies and interventions to enhance both preparedness and resilience among healthcare professionals. In this context, studies emphasize the importance of continuing education programs for health professionals and nurses working on the front lines, equipping them with the necessary skills to respond effectively to disaster scenarios in a multifaceted manner.[13,17,20]

Disasters are traumatic events that can cause profound psychological shock, not only to the victims but also to the rescuers. Individuals who struggle to return to their daily routines are at increased risk of developing vicarious trauma and secondary traumatic stress due to their caregiving roles in supporting trauma victims.[19,21] Sato et al.[22] found that nurses are at a higher risk of experiencing psychological distress compared to other professional groups. This psychological burden among nurses and emergency responders negatively affects the efficiency and outcomes of rescue operations, underscoring the urgent need for targeted psychological empowerment programs.[12] Nurses and rescuers who themselves become disaster victims may experience a range of emotional challenges, including fear, helplessness, guilt, anger, sleep disturbances, and fear of death. Additionally, they may exhibit symptoms of post-traumatic stress disorder (PTSD), such as intrusive images and flashbacks of the traumatic event.[23] For example, Ünsal et al.[10] reported that nurses often struggle with feelings of helplessness and guilt while trying to fulfill their professional responsibilities, highlighting the need for a targeted support system. In another qualitative study involving nurses, Yanik and Ediz[19] found that nurses faced emotional difficulties such as guilt, anger, helplessness, nightmares, grief, and depression. These challenges not only impact the mental health and well-being of rescuers but also significantly impair the overall effectiveness of rescue teams, potentially jeopardizing disaster response efforts.[19,24]

Failure to address these challenges and the lack of psychosocial support can significantly impair nurses' functioning by reducing their coping abilities, communication skills, self-esteem, and self-awareness. This decline in the functioning of nurses and rescuers may also hinder their capacity to provide empathetic care, which is a fundamental principle of the profession.[19,25] Major disasters underscore the critical importance of having effective disaster response plans in place. However, the consequences of failing to implement such plans extend beyond measurable losses. The personal experiences, observations, and proposed solutions of first responders, particularly nurses and other healthcare professionals, are invaluable in shaping future disaster preparedness and management strategies. Unfortunately, the existing literature includes a limited number of studies using Grounded Theory and in-depth interviews to explore the challenges faced by search-and-rescue teams, including nurses, in disaster management. The primary objective of this study is to identify the problems encountered in order to improve rescue operations and disaster prevention in Türkiye, a country prone to earthquakes. Additionally, it seeks to enhance healthcare services, nursing care, and disaster preparedness among healthcare workers, nurses, and society at large. The study also aims to develop a new theoretical framework to strengthen resilience. The results derived from the Grounded Theory approach will serve as a solid foundation for designing effective disaster preparedness and training programs.

Research Questions

1. What were the main challenges encountered by frontline nurses and search-and-rescue teams during the response to the 2023 Türkiye earthquake?
2. How did the absence of basic necessities, such as food, water, shelter, and medical supplies, affect the effectiveness and well-being of rescuers and healthcare workers in the disaster area?
3. What emotional and psychological challenges did frontline responders face during and after their disaster response efforts, and how did these challenges impact their ability to work?
4. What coping strategies did rescuers and healthcare workers use to manage post-disaster trauma, and how did these experiences contribute to their personal and professional resilience?
5. What key recommendations can be made to improve disaster preparedness for healthcare workers, search-and-rescue teams, and the general public, based on the experiences and insights of frontline responders?

Materials and Methods

Study Design

This study was conducted to explore the feelings and perspectives of healthcare workers and search-and-rescue team members who were actively involved with earthquake survivors from the earliest days following the disaster. The study design is descriptive, qualitative, and cross-sectional, utilizing a Grounded Theory approach. In accordance with the Grounded Theory methodology[26] employed in this study, data collection and analysis were carried out simultaneously.[26,27] The data were analyzed through repeated reviews, with particular attention given to identifying the boundaries of each concept and the relationships between them. A conceptual framework was developed at the end of the study, based on the evaluation and conceptualization of the data. This framework offers a theoretical explanation of the problems and solutions related to disaster response.[28,29] The study followed the COREQ (Consolidated Criteria for Reporting Qualitative Research) checklist developed by Tong et al.[30] in 2007.

Sampling Strategy and Eligibility of the Participants

The target population of the study consisted of nurses and search-and-rescue team members who provided care to earthquake victims during the post-disaster period. Participants were primarily selected from the Yeditepe University Natural Disasters Search-and-Rescue Club (abbreviated as "YÜDAK" in Turkish), a university-supported volunteer social service organization. A snowball sampling method was used to recruit participants. In this approach, the sample grows as new participants are contacted and interviewed based on referrals from the initial individuals involved in the study area.[29] As a result, the study sample included volunteer undergraduate rescue team members and nurses who were identified through this strategy. The final sample consisted of 19 participants drawn from healthcare workers and search-and-rescue teams. Among them, 31.5% were students, 42.1% were nurses, 10.5% were anesthesia technicians, and 15.7% were

volunteers from outside the healthcare field. The eligibility criteria included having worked with earthquake victims in the disaster area within the first seven days following the February 6, 2023 earthquake, providing assistance to earthquake victims for at least one week, and being either a healthcare worker or a member of a search-and-rescue team.

Location and Time of Study

The study was conducted between March 20, 2023 and May 20, 2023. Interviews were conducted online with the search-and-rescue team members and nurses participating in the study to facilitate access, as they were located in various regions of Türkiye. Most of the participants who were closest to the earthquake zone were geographically distant from the researchers.

Data Collection Tools

Semi-Structured Interview Form

The interview guide was developed by the researchers based on a review of the literature.[31,32] The form included 14 open-ended questions and one introductory question related to participants' personal information. The questions were not administered in the exact same order for every participant. In accordance with the principle of data saturation, which is central to Grounded Theory, additional in-depth questions were asked during the interviews to gain a comprehensive understanding of the core issues experienced by participants. After conducting interviews with the first five participants, the semi-structured interview questions were revised by the researchers based on participants' responses and feedback. Specifically, the question "*Did you receive professional support for your psychological health?*" was merged with "*Have there been any changes in your physical and mental health?*" based on participants' responses and feedback. Additionally, two new questions were added to the semi-structured interview form: "*If you think you were not affected, which of your personal characteristics do you believe contributed to that?*" and "*When did you arrive at the disaster area, and how long did you work there (considering shelter, food, and security problems)?*" These revisions were implemented after the first interview, conducted on March 20, 2023, and the interviews with the remaining participants were completed by May 20, 2023.

Data Collection

The data collection process was carried out through online meetings using the Google Meet platform. This method provided greater flexibility for both researchers and participants. Google Meet provided a reliable and accessible platform for conducting online interviews, allowing researchers and participants to connect regardless of time or location. Its ease of use facilitated the effective execution of the data collection process. Additionally, conducting interviews via Google Meet allowed participants to join from the comfort of their home environments, which likely contributed to a more relaxed atmosphere and encouraged more open and sincere responses. However, reliance on online meetings also presented limitations. The quality of participants' internet connections occasionally affected the interviews, with poor connectivity causing audio and video disruptions that impacted the flow of discussions. Initially, the researchers contacted members of a university-affiliated voluntary social assistance club through the club president. After explaining the purpose and scope of the study, individuals who expressed interest in participating were assessed for eligibility using Google Forms, based on the study's inclusion and exclusion criteria. The study group was then determined accordingly. Google Forms offered a fast and organized method for collecting participant information, allowing for the automatic aggregation and structuring of data for analysis. Its cloud-based infrastructure enhanced data security and enabled real-time collaboration among researchers. However, a notable limitation of this approach was the potential difficulty faced by individuals without internet access or familiarity with digital tools in accessing and using the platform. The participants' contact information was initially obtained through the club president, and those who volunteered and met the eligibility criteria were contacted via mobile phone. Upon scheduling an appointment and receiving the signed consent form, online meetings were arranged and conducted. During the interviews, participants were asked to provide contact information for colleagues they had worked with during earthquake-related activities. Subsequent interviews were then conducted with those referred by the initial participants, in accordance with the snowball sampling method. At the beginning of each online meeting, the informed voluntary consent form was explained again. After participants agreed to have the conversations recorded, the interviews proceeded. Each researcher was responsible for transcribing the interviews they personally conducted. When interviews had been conducted with a total of 19 participants and similar responses were consistently received from both search-and-rescue workers and healthcare professionals, the researchers made a joint decision to conclude the data collection process. The duration of the interviews ranged from 30 to 90 minutes. All files were anonymized before being uploaded to the software and Google Drive, and each was identified using case numbers.

Data Analysis

The data were evaluated using content analysis. Each researcher independently reviewed all interviews and generated potential codes for analysis. The analysis phase spanned two months, during which the research team held eight meetings to discuss the data analysis process. In the first four meetings, the team clarified the codes to be used and grouped them into specific themes by identifying relationships among them. All documents were processed using the MAXQDA software (free trial version, VERBI Software, Berlin, Germany), and participants' comments were assigned to relevant codes. In the final meeting, the researchers reached a consensus on which comments to include in the report from the 450 individual statements made. This collaborative process marked the completion of the data analysis and the reporting of findings. The researcher with the most experience in conducting qualitative studies independently reviewed all the data and compared the audio recordings with the corresponding transcripts. The coding process and the relevance of the identified themes were also reassessed by the same researcher. After these revisions, and once the researchers reached a final consensus on the codes and themes, the data analysis was concluded.

Techniques to Enhance Trustworthiness

The researcher, who had extensive experience in psychiatric nursing and qualitative research, independently examined all the data and compared the audio recordings with the corresponding transcripts. Any discrepancies identified between the recordings and transcripts were corrected prior to the analysis phase. The same researcher reassessed the coding and the appropriateness of the themes. Any disagreements regarding coding or thematic categorization that arose during the study were carefully reviewed by the same researcher. In-depth discussions were conducted with the other researchers to resolve these differences. These discussions were guided by the theoretical framework of the study and supported by direct examples from the data to ensure alignment. Discussions continued until full consensus was achieved among the research team. Following these revisions, the data analysis process was finalized.

Researcher Characteristics and Reflexivity

The researchers who conducted this study are full-time faculty members at an accredited university. None of the researchers were personally affected by the disaster in a way that could have biased the data collection process. As a result, the interviews were conducted with complete impartiality. All researchers hold at least a Master's degree in psychiatric nursing and have prior experience in conducting qualitative research. The researchers had no prior relationship or communication with the participants. All authors conducted interviews, with each completing five interviews, except for the last author, who conducted four. At the time of the study, all researchers held at least a Master's degree, and two held PhDs. Three of the researchers were female, and one was male.

Ethical Approval

In addition to adhering to the principles of scientific ethics, universal ethical standards were also upheld throughout the study. Ethical approval was obtained from the Yeditepe University Rectorate Non-interventional Clinical Research Ethics Committee (Approval Number: E.83321821-805.02.03-165, Date: 10.03.2023), in compliance with institutional review board (IRB) requirements. In addition, institutional permission was obtained from the Social Support and Solidarity Club of Yeditepe University. Participation in the study was voluntary, and informed consent was obtained from all participants prior to recording their interviews. Participants were informed that they could withdraw from the study at any time. All recordings were stored on an encrypted computer accessible only to the research team and will be retained for five years. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki.

Table 1. Sociodemographic characteristics of participants

	n	%
Age, years (mean±SD)	27.3±4.6	
Gender		
Female	7	36.8
Male	12	63.2
Volunteer's professional field		
Nurse	8	42.1
Anesthesia technician	2	10.5
Student	6	31.6
Volunteer search-and-rescue personnel	3	15.8
Experience working in disasters		
Had experience	6	31.5
No experience	13	68.4

SD: Standard deviation.

Result

The participants had an average age of 27.31 years (SD = 4.63), with the majority being male (63.15%). In terms of professional background, 42.1% were nurses, 31.6% were students, 10.5% were anesthesia technicians, and 15.8% were volunteer search-and-rescue personnel. Additionally, 31.57% of participants had previous disaster response experience, while 68.43% were participating in such efforts for the first time. The detailed sociodemographic characteristics of the participants are presented in Table 1. In the study, five main themes and nine subthemes were identified: (1) Scale of the Disaster (Subthemes: *Emotional Impact, Perceived Magnitude*), (2) Challenges During Disaster Response (Subthemes: *Management and Communication Issues, Basic Needs and Resource Limitations, Emotional Struggles*), (3) Factors Affecting Participants' Work (Subthemes: *Workload, Team Coordination*), (4) Experiences After Returning from the Disaster Area (Subthemes: *Emotional Problems, Coping Mechanisms, Post-Traumatic Growth*) and (5) Preparedness for Future Disasters (Subthemes: *Public-Level Recommendations, Training and Readiness for Rescuers and Healthcare Professionals*).

Themes and Subthemes

Theme 1: Scale of the Disaster

The majority of participants reported that they departed for the disaster area as soon as they learned about the earthquake. Several stated that they arrived without having time to make any preparations. They described their initial impressions upon arrival. Some participants described the scene they witnessed using phrases such as "the apocalypse," "the end of the world," "the smell of death," "great destruction," "a great disaster," "the end of everything," and "a war zone."

Participants noted that the sounds of military helicopters, police sirens, and ambulance sirens contributed to the overwhelming sense of chaos in the disaster area. The smell of decomposing bodies also had a profound impact on the participants. As the number of recovered bodies increased, they were initially placed outside tents and later stacked in the back of trucks, an image many described as the most distressing. Additionally, some participants expressed fear of aftershocks and the risk of further injury.

> "*On the one hand, people were constantly arriving to search for their loved ones... There wasn't even a body bag; most of the bodies were wrapped in blankets... People were crying, uncovering the blankets, looking at the faces of those who had died one by one, and then covering them again. And you were seeing all of that there. Those memories will never be erased from my mind.*" (Participant 14, age 26, Female, Health Worker)

> "*Nobody wants to see human bodies stacked on top of each other in the back of a pickup truck.*" (Participant 16, age 21, Female, Search-and-Rescue Worker)

Theme 2: Challenges During the Disaster Response

Subtheme 1: Management, organization, and communication

Poor management and organizational inefficiencies significantly hindered the efforts of search-and-rescue teams and healthcare professionals in the disaster area. Many participants reported feeling isolated due to a lack of coordination and organization, which contributed to a sense of chaos. A major issue cited was the inconsistent functioning of the Global System for Mobile Communications (GSM) operators. Communication networks were operational for only one out of seven days during the search-and-rescue efforts, making it difficult to reach certain individuals.

> "*Even on the fifth day after the earthquake, we were looking for rubble to work on by walking around street by street. During this time, we went down streets where no rescue teams had been yet.*" (Participant 2, age 24, Male, Search-and-Rescue Worker)

> "*The most important problem was communication—as with the GSM operators. Because without communication, you can't manage this situation.*" (Participant 13, age 33, Male, Health Worker)

Subtheme 2: Basic living requirements

The lack of basic necessities significantly impacted on participants' ability to carry out their duties, with 67% expressing this concern. Many worked for long hours with minimal food, sometimes only a single piece of a cookie for the entire day and had no access to drinking water. Water shortages disrupted both medical treatments and efforts to maintain hygiene. Seasonal weather conditions created challenges related to heating, shelter, and personal security, each of which is essential for meeting basic daily needs.

> "*We got dinner on the third day... When we were working on the debris, our only meal for the whole day was a cookie cut in half.*" (Participant 16, age 21, Female, Search-and-Rescue Worker).

> "*For example, when we first arrived, the people rescued from the rubble had fractures. Those who had been pulled from the debris had broken arms and legs and needed casts... It was raining, meaning you had to use the water on the ground because there was no [other] water.*" (Participant 10, age 27, Male, Health Worker)

Subtheme 3: Emotional responses

Participants reported significant emotional distress in the aftermath of the earthquake, largely due to inadequate equipment, which led to feelings of helplessness and frustration. Inexperienced rescuers experienced greater emotional difficulties. The condition of children was reported as the most emotionally distressing aspect of disaster triage for many participants.

> "*Desperation. I guess the only emotion was desperation, not even anger... Sounds were coming from hundreds of buildings, and from thousands of people under the rubble, but there were only a few crews. On the second or third day, when the despair turned into anger, I started to get angry.*" (Participant 7, age 23, Male, Search-and-Rescue Worker)

> "*When we pulled the children out from under the rubble, as a father, I remembered my own child, and the only thing I could think of was why these children had to go through something like this.*" (Participant 1, age 37, Male, Search-and-Rescue Worker)

Theme 3: Life After Returning from the Disaster Area

Subtheme 1: Emotional problems

Participants reported experiencing a range of emotional difficulties upon returning from the earthquake zone. These included anger, insomnia, irritability, frequent crying, fear of another earthquake, and heightened sensitivity to everyday triggers. Below are some representative statements:

> "*Insomnia, for example: I can't sleep at night. I can't sleep until 4:30 and 5:00 a.m. every day. Whether I go to bed early or late, I can't sleep because I'm thinking.*" (Participant 11, age 28, Male, Search-and-Rescue Worker)

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> "*One day after I came back, I saw two children holding their mother's hand as I was getting off the bus, a girl and a boy, the same age as some of the children we pulled out of the wreckage. I froze when I saw them the week after the event. I didn't talk to anyone much; I cut off communication a bit. Seeing those kids affected me deeply*." (Participant 7, age 23, Male, Search-and-Rescue Worker)

Subtheme 2: Coping methods

Our study found that participants employed various positive coping strategies, including spending time with friends, discussing earthquake preparedness, and focusing on positive aspects of their experiences. Negative coping behaviors included avoidance, and one participant reported an increase in smoking. Additionally, some participants experienced ongoing fear triggered by frequent aftershocks.

> "*Especially when someone is sitting next to me and swinging their leg, it really bothers me. You know: 'Don't shake me!' I try to avoid getting on anything that sways, as much as possible*." (Participant 16, age 21, Female, Search-and-Rescue Worker)

> "*When I first came back, I had trouble staying indoors. Then I couldn't sit in a restaurant for long. I realized I couldn't even be alone in my own home*." (Participant 19, age 28, Female, Health Worker)

Subtheme 3: Post-traumatic growth

Participants in our study reported experiencing positive changes in their lives following this difficult experience. They described becoming calmer, more composed, and more solution-oriented in their approach to problems. Many stopped postponing things they wanted to do, grew spiritually stronger, gained a deeper appreciation for their health, became less materialistic, and found joy in the small things in life.

> "*In particular, they pulled a couple out from under the rubble, or a whole family, and everyone was dead. After witnessing these things, thoughts like 'Life is very short. It's not worth getting upset or treating someone badly when everything could end so suddenly,' became deeply ingrained in me. It's not worth being upset, getting angry, or holding grudges. Buildings can collapse on us in the middle of the night*." (Participant 17, age 33, Male, Health Worker)

> "After this experience, I've come to realize that working just to buy a house or a car, or trying to live in comfort... it's not really about that. I now understand much better how important it is to live in the moment. Life is truly too short." (Participant 15, age 25, Woman, Health Worker)

Theme 4: Preparedness for Future Disasters

Subtheme 1: Recommendations at the public level

Based on their experiences in the earthquake-affected region, participants recommended enhancing disaster preparedness at the public level. This included educating communities, improving planning, ensuring the availability of necessary equipment, organizing response teams, informing citizens, and strengthening infrastructure. They particularly emphasized the urgent need to increase preparedness in Istanbul, given the high risk of a potential earthquake.

> "*Let's say there was an earthquake in Istanbul: the houses here are very close to each other. The roads will be blocked when buildings collapse. It will not be possible to reach some of the debris. Helicopter use should be planned in advance. Or boats could be used for sea transport*." (Participant 3, age 25, Female, Search-and-Rescue Worker)

> "*Disaster shipping containers are very important. They should be placed in every neighborhood and every region for use in emergency response during a disaster*." (Participant 11, age 27, Male, Health Worker)

Subtheme 2: Recommendations for search-and-rescue workers

Participants suggested that search-and-rescue teams should be equipped with the necessary tools and be effectively organized to respond to future earthquakes. They recommended conducting frequent training sessions in smaller groups, incorporating a variety of disaster scenarios. The formation of motorized units was also proposed to help overcome transportation and communication problems. Additionally, participants emphasized the importance of providing communication training and enhancing the psychological resilience of search-and-rescue teams.

> "*I thought about developing a protocol for a motorized team... giving a seismic acoustic listening device to someone on the motorized team and sending them around the city. They could go directly to the people coordinating at buildings they are really certain about, and this could be a faster way to proceed*." (Participant 5, age 26, Female, Search-and-Rescue Worker)

> "*There is a bit of a lack of psychological training. Because you encounter bodies or people with severed limbs there... I think it requires people who can psychologically cope with these situations, and for that, there should be mental preparation to endure them*." (Participant 12, age 25, Male, Search-and-Rescue Worker)

Subtheme 3: Recommendations for health professionals

Participants recommended training healthcare professionals to become members of UMKE and encouraging student nurses to join search-and-rescue clubs. They emphasized the importance of strengthening psychological resilience, improving readiness for challenging conditions, providing communication training, and implementing comprehensive pre-deployment planning. Additionally, they advocated for greater emphasis on nursing practices and practical, disaster-related training within undergraduate education programs.

> "*I also support my own teammates. Join UMKE, take responsibility there, you feel more prepared*." (Participant 14, age 26, Female, Health Worker)

> "*The topic of 'communication' is included in our training, but it is very limited. What approach should we take to understand another person's psychology? What mindset should other workers have? Before deployment, training should recreate those moments. Demonstrations and simulations should be used, like 'Look, you are getting this reaction for this reason; here's how you can respond differently,' In my opinion, that would help a lot*." (Participant 15, age 25, Female, Health Worker)

Discussion

Losing loved ones, homes, belongings, and livelihoods, as well as witnessing collapsed buildings, injured individuals, deceased bodies, or those dying, and the ongoing search for missing persons under the rubble, can cause significant trauma not only for survivors but also for rescuers.[19,33] Participants in this study were deeply affected by the earthquake and described witnessing unforgettable and distressing scenes. To ensure the effectiveness and safety of search-and-rescue operations, the essential needs of volunteers must be met.[34] It is critically important that basic necessities such as food, water, shelter, personal security, and hygiene are provided during disaster response efforts. The most significant and unavoidable challenge encountered during disasters is the lack of resources.[35–37] Maslow's Hierarchy of Needs outlines the fundamental requirements for human survival, beginning with physiological and safety needs; higher-level needs cannot be fulfilled until these basic needs are met.[38] This study found that participants were often required to work without having their basic needs met, which negatively impacted their performance. Access to essential resources such as food, water, and hygiene facilities would have improved their ability to carry out their duties effectively. This issue is commonly reported among healthcare providers and search-and-rescue teams responding to disasters.[32,39] The location of disaster can hinder intervention efforts due to factors such as ground conditions, damaged roads, traffic congestion, and adverse weather. Improved disaster policies and planning are essential to addressing these issues.[19,32,39] For instance, the delivery of relief supplies to rescuers was delayed due to heavy rainfall following both the Kahramanmaraş earthquakes and the 2015 Nepal earthquake. In the latter case, relief supplies waiting at Kathmandu Airport c were unable to reach the affected areas until the third day after the earthquake.[40] Although the lack of basic resources was not the primary issue reported by participants in this study, when combined with the emotional burden of the disaster, it significantly disrupted search-and-rescue operations.[32,41] Consistent with our findings,

participants in other studies have also reported challenges related not only to the lack of basic necessities but also to emotional distress.[19,32,37,42] Using a qualitative research method similar to our own, Yanik and Ediz19 investigated the experiences of nurses who volunteered as rescuers during the same disaster. They found that participants were most likely to struggle with emotional difficulties after returning from the disaster zone. Nurses in the study by Farokhzadian et al.[43] also described emotional and psychological difficulties similar to those identified in our research, particularly highlighting the emotional strain of communicating with the families of disaster victims. In our study, individuals who had not previously experienced a disaster or witnessed traumatic loss, especially the death of children, were significantly affected by what they encountered. This finding aligns with the experiences reported by participants in the present study and underscores the critical connection between unmet needs among rescuers and emotional distress. Addressing this dual challenge is essential and should be prioritized by policymakers.

Given the relatively young average age of participants in our study, this is an additional concern for authorities to consider. In a study conducted by Yang et al.,[37] one participant described witnessing the death of a young girl while holding her hand after she was pulled from the rubble. The participant reported that this, along with similar traumatic experiences, led to ongoing sleep disturbances during and after the relief efforts.[37] Similarly, in the study by Harmanci Seren and Dikeç,[23] experiences similar to those reported in our research underscore the importance of incorporating psychological preparation and support components into disaster preparedness programs. For example, practical training aimed at developing skills to manage trauma and grief during disasters is considered an effective strategy for enhancing individual resilience and improving teams performance.[12] In 2014, Lu and Xu42 noted that psychological needs were largely overlooked during the 2008 Sichuan earthquake. However, by the time of the 2013 Lushan earthquake, psychiatric support teams were deployed to the field within a few days alongside medical teams, marking a significant improvement in disaster response efforts. Based on both our study findings and the supporting literature, integrating rapid psychological support response systems and peer counseling programs into disaster response plans are vital strategies for addressing the emotional and psychological needs of search-and-rescue workers, nurses, and physicians working in the field. These strategies have the potential to improve not only the well-being of frontline workers but also the overall effectiveness and coordination of disaster management operations.

Effective disaster response requires proper organization of teams and equipment, as well as timely transportation to the affected area. During the 2017 Sichuan earthquake, a well-coordinated response successfully transported 1,108 soldiers, 396 rescue vehicles, 30 search-and-rescue dogs, 24 electric generators, and other essential necessities to the region within just three hours.[44] According to AFAD's report, 14,740 search-and-rescue personnel and 242,392 field personnel were deployed, along with 116 helicopters and 78 aircraft, to the 11 provinces affected by the earthquake.[6] This response more extensive compared to that of the Marmara earthquake.[45] However, consistent with findings in the literature,[10,12,19,46] participants in our study perceived the response as inefficient, possibly due to the unprecedented magnitude and scope of the disaster. Effective crisis management also depends heavily on reliable communication. Participants in recent studies noted communication difficulties during crises, particularly due to disruptions in GSM operator services. For instance, telephone communication was virtually impossible during the 1999 Marmara Earthquake.[45] In the 21st century, individuals are able to contact their relatives not only through GSM operators but also via internet-based platforms and social media accounts.[47] During disasters, communication is just as critical as search-and-rescue operations. AFAD in Türkiye has recognized this and incorporated communication strategies into its emergency action plan. AFAD has also developed a mobile application to support communication during crises.[48] One of the key themes identified in the qualitative study conducted by Farokhzadian et al.[43] in 2024 in Iran was the use of inappropriate interactive platforms during disaster response efforts. This suggests that communication issues during emergencies are not unique to Türkiye. Furthermore, the nurses who participated in that study emphasized deficiencies in effective communication, leadership, and team management.[43]

Participants in our study reported experiencing emotional issues following post-disaster relief efforts, including anger, insomnia, and fear of future earthquakes. The literature also indicates that rescue workers and healthcare professionals are at risk of developing PTSD,[12,49,50] psychological distress,[51] depression,[52] and anxiety disorders.[53] The behaviors observed in our participants, such as insomnia, nightmares, and avoidance, are indicative of symptoms commonly associated with PTSD. According to Horowitz's Stress-Response Theory, traumatic events create stress that disrupts the processing of new information and disturbs internal schemas. Incompatibilities with internal schemas during information processing can trigger a post-traumatic stress response. Experiencing PTSD can also affect an individual's ability to respond to future disasters. Brown et al.[54] in 2018 conducted a study in which individuals who had previously experienced a disaster were followed over time and evaluated for suicidal thoughts or behaviors after encountering another disaster. The study found that participants with a history of PTSD were more likely to experience suicidal ideation or engage in suicidal behaviors following the subsequent traumatic event. In a meta-analysis of studies investigating the prevalence of PTSD in search-and-rescue workers, it was found that factors contributing to the development of PTSD included the decision to participate in rescue operations, the preparations required before deployment, and the specific tasks performed in the field.[53] It is important to assess the mental health of disaster response workers and encourage them to seek help when needed to maintain their well-being and effectiveness. Coping strategies after a traumatic event are crucial for effective problem-solving. Ehring et al.[52] in 2011 found that the coping methods used by search-and-rescue workers following an earthquake influenced their emotional outcomes. Our study similarly found that participants employed both positive and negative coping mechanisms, with some relying on avoidance behaviors. Despite these negative experiences, most participants reported gaining a new perspective on life and no longer being upset by everyday problems. Janoff-Bulman's[55] theory of Post-Traumatic Growth explains how some individuals find satisfaction in their survival after a traumatic event and come to cherish what they value most in life, such as family, friendships, or spirituality. In a study conducted by Carlile et al.[56] in 2014, a team of volunteers was formed, provided with long-term training, and later participated in the rescue efforts following the 2010 Haiti earthquake. After the earthquake, a Grounded Theory study found that the psychological resilience and social bonds of the participants had strengthened. Search-and-rescue workers and nurses reported feeling calmer and adopting a more solution-focused approach. They also began to prioritize what truly mattered, felt spiritually stronger, placed greater importance on health, became less materialistic, and found happiness in small, everyday things.

In our study, healthcare and search-and-rescue workers similarly emphasized the critical need for public-level disaster preparedness. Şahin and Üçgül[57] in 2019 evaluated the Türkiye Disaster Response Plan and noted that a 7.5 magnitude earthquake would likely cause significant damage to nearly all buildings in Hatay. One participant in our study pointed out that while knowing what to do during an earthquake is important, it is not sufficient on its own. Altınsoy and Aksakal[20] in 2020 reported a rescue rate of 28.1% during the Van earthquake search-and-rescue operations. Although the response was well-coordinated, only about a quarter of those trapped were rescued. This finding highlights the importance of prioritizing sturdy building construction and preventive measures, rather than focusing solely on improving rescue operations. Similarly, Şahin and Üçgül[57] in 2019 emphasized the need for a paradigm shift in Türkiye's Disaster Plan, advocating for improved coordination and resource preparedness. They highlighted the importance of focusing on risk management and pre-disaster preparedness, rather than relying solely on post-disaster response efforts.

Healthcare and search-and-rescue workers in our study reported that many of their colleagues were affected by trauma while working in the disaster area. Psychological preparation and mental resilience training were frequently emphasized as essential. Aker[58] in 2006 found that medical personnel, firefighters, and search-and-rescue teams involved in the 1999 Marmara earthquake experienced high rates of major depression and PTSD. Traumatic events encountered during recovery operations had long-lasting psychological effects. To address these risks, psychological preparation and well-being assessments should be provided to all personnel involved in disaster response. Additionally, even experienced personnel should be regularly re-evaluated before participating in future operations.[59] Supporting this perspective, Mao et al.[60] in 2019 found that healthcare professionals who had received training in disaster response, psychological first aid, and stress management prior to deployment in earthquake-affected areas demonstrated greater resilience and experienced more positive outcomes after the disaster. Similarly, a study by Kaya and Erdoğan[46] in 2024 indicated that nurses' competency levels were positively correlated with disaster preparedness, which directly influenced their roles and responsibilities during disaster response efforts. The study also emphasized that partial knowledge of disaster preparedness does not equate to true competency. In line with these findings,

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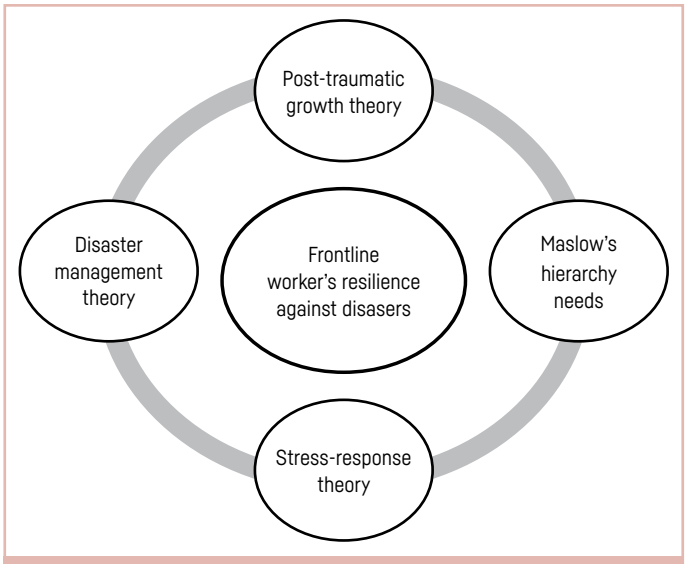

Figure 1. Frontline worker's resilince against disasters.

the authors stressed the need for additional training for frontline nurses and rescue teams to enhance their resilience in the face of future disasters and highlighted the importance of widespread dissemination of such training programs.

Limitations

Several limitations were encountered during the course of this research. The first was that all interviews were conducted online, which may have made it more difficult to capture participants' emotional expressions and nonverbal cues compared to face-to-face interactions. Although online platforms such as Google Meet and Google Forms allowed participants to take part in the study from the comfort of their homes, limited internet access and technical difficulties may have excluded some individuals from participating. Additionally, as this study employed a qualitative methodology, it was conducted with a limited sample size. While this may affect the generalizability of the findings, it allowed for in-depth exploration of participants' personal experiences, an essential strength of qualitative research. Moreover, the use of snowball sampling may have impacted the homogeneity of the sample and c led to the overrepresentation of certain groups. This sampling method may also limit the ability to generalize the results to the wider population. Nonetheless, the conclusions drawn from these individual experiences provide a rich and meaningful understanding of the research topic.

Conclusion

Large-scale disasters have a profound impact on entire societies. This study, conducted using the Grounded Theory approach, identified key themes and patterns that contribute to understanding the resilience of frontline rescuers in disaster situations. Based on participants' responses and supported by existing literature, including concepts such as Post-Traumatic Growth Theory, Maslow's Hierarchy of Needs, Stress-Response Theory, and various disaster management frameworks, a conceptual framework has been proposed to explain the factors influencing frontline rescuers' resilience (Figure 1). This framework provides a foundation for future research and contributes to the ongoing theoretical discourse in disaster response and resilience.

The development of this theory began with the identification of recurring themes in participants' responses using a method known as open coding. These themes were then compared with existing theoretical frameworks, resulting in the creation of a coherent model of resilience. The iterative nature of the Grounded Theory method allowed for the continuous alignment of emerging concepts with both the collected data and the relevant literature. Within the framework of this theory, the concept map presented in Figure 1 was developed to strengthen the resilience of frontline rescue workers, nurses, and other healthcare providers. Problems encountered during search-and-rescue and recovery operations emerged as the most critical factors affecting the ultimate success of disaster response efforts. In addition to the provision, or lack, of basic necessities, essential resources such as management, organization, and communication were found to directly impact the overall effectiveness of disaster response operations. It was also concluded that psychological support mechanisms, including post-trauma counseling and peer support systems, should be integrated into disaster response plans. Rescuers need training not only on what to do during a disaster, but also on how to adapt to life afterward. Incorporating psychological support services, such as post-trauma counseling and peer support programs, into disaster preparedness planning is essential. This integration will help field workers better cope with the emotional and psychological challenges they may face following traumatic events. Rescuers frequently experience significant emotional and psychological difficulties both during and after disasters, which can negatively affect their well-being and performance. Therefore, ensuring access to mental health services and trauma recovery programs is critical to promoting long-term resilience. In-service training for relevant groups of workers should be conducted periodically, and the necessary resources must be allocated to promote disaster awareness among the general population. To provide clear guidance, model training programs and policy frameworks should be developed and piloted, offering scalable solutions for broader implementation. Regional disaster planning should involve small, well-coordinated groups, and policymakers must develop and enforce preventive strategies through specific legal regulations.

Ethics Committee Approval: The study was approved by the Yeditepe University Rectorate Non-interventional Clinical Research Ethics Committee (Approval Number: E.83321821-805.02.03-165, Date: 10.03.2023).

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