

Original Research

Cite this article: Iseri A and Baltaci R (2024). Psychological Impact of Disaster Relief Operations: A Study Following Consecutive Earthquakes in Turkey. *Disaster Medicine and Public Health Preparedness*, 18, e128, 1–8 <https://doi.org/10.1017/dmp.2024.134>

Received: 23 October 2023

Revised: 13 March 2024

Accepted: 23 May 2024

Keywords:

PTSD; disaster relief teams; prevalence; earthquakes

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Psychological Impact of Disaster Relief Operations: A Study Following Consecutive Earthquakes in Turkey

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Abstract

Objective: This cross-sectional study investigates the immediate psychological effects of disaster relief operations on team members following 2 consecutive major earthquakes in Turkey.

Methods: A total of 170 participants, including professional firefighters, search and rescue (SAR) workers, and volunteers, were surveyed approximately 1 month after the conclusion of active SAR operations. The study utilizes the DSM-V criteria and the Posttraumatic Stress Disorder Checklist (PCL-5) to assess symptoms of post-traumatic stress disorder (PTSD) among participants.

Results: The findings reveal a point prevalence of 35.3% for probable PTSD, highlighting the substantial psychological impact on disaster relief teams. Factors such as age, residency in affected areas, and active SAR involvement significantly influenced probable PTSD rates. Interestingly, actively engaged SAR members had lower probable PTSD rates, possibly due to their training. Those who directly witnessed the earthquakes had higher scores, highlighting the impact of firsthand exposure. Additionally, individuals aged 50 and above displayed a higher mean total severity score compared to younger participants.

Conclusions: This research contributes to understanding the mental well-being of disaster relief professionals. The study's findings underscore the importance of timely mental health support and training for these responders, emphasizing the need for preparedness in disaster relief teams.

Post-traumatic stress disorder (PTSD) is a psychiatric condition that can develop in individuals who have undergone or witnessed a traumatic event. As defined by the American Psychological Association (APA)¹, PTSD is characterized by the development of specific symptoms after exposure to one or more traumatic events. This traumatic stress typically results from experiences involving death, the immediate threat of death, or severe injury.

The screening and measurement of PTSD primarily rely on criteria outlined in the DSM (Diagnostic and Statistical Manual of Mental Disorders) publications issued by the APA. For more thorough information on these screening approaches, readers can consult the systematic review article on instruments for assessing PTSD risk in adults.²

Natural disasters such as earthquakes, hurricanes, floods, wildfires, and tsunamis often lead to widespread devastation, loss of life, and community destruction. Beyond the physical damage, these disasters can profoundly affect individuals' mental and emotional well-being. Consequently, those involved face a heightened risk of developing psychiatric disorders.³

Earthquakes, among other natural disasters, represent formidable and catastrophic forces of nature. Their unpredictability results in widespread destruction and loss of life. Survivors frequently experience profound psychological symptoms in the aftermath.⁴

PTSD emerges as the predominant mental health condition among survivors of earthquakes⁵. In the general US population, the lifetime prevalence of PTSD typically hovers around 6.8%, with rates of 9.7% among females and 3.6% among males.⁶ However, earthquake victims exhibit notably higher prevalence rates. Literature reports global prevalence rates for PTSD in earthquake survivors that span a wide spectrum, ranging from 11.7% to as high as 86.7%.⁵

Disaster relief members, including firefighters, paramedics, police officers, medical personnel, and specialized response teams, are crucial in the immediate aftermath of disasters. They provide essential aid following natural disasters such as earthquakes, rescuing survivors, securing public safety, providing emergency shelter and food distribution, and coordinating resources amid chaos and devastation. However, their exposure to devastating scenes and the demanding work environment can significantly impact their mental health. Understanding the psychological effects of disaster response on these critical personnel is essential for developing effective support systems.

Alghamdi⁷ conducted a review of the psychological challenges faced by emergency medical service (EMS) providers during disasters. His analysis revealed a scarcity of research addressing mental health challenges among EMS providers, with an overall lack of gender-specific studies.

Tahernejad et al.⁸ comprehensively analyzed 13 articles up to 2022 addressing PTSD in medical workers engaged in earthquake response. Notably, all these studies focused on eastern countries, a trend justified by the region's significant contribution to earthquake-related casualties. Over the past 30 years (1994–2023), the total death toll reached 933 420, with the top 10 countries accounting for approximately 98% of casualties, predominantly situated in the east, except Haiti. Turkey, positioned as the fifth country in this ranking, follows Haiti, Indonesia, China, and Pakistan.⁹ The prevalence rates of PTSD in these 13 studies vary widely, ranging from 0.6% to 39%, influenced by factors such as the earthquake's nature, sampling technique, time interval post-disaster, and assessment tool. Nonetheless, the average PTSD prevalence after the earthquake among the selected population was calculated at 16.37%.

Although Skogstad et al.¹⁰ focused on the aftermath of a terror attack, their findings hold relevance for earthquake preparedness. They found surprisingly low PTSD rates among first responders after the 2011 Norway attacks, particularly EMS providers (<2%), 90% of whom had prior disaster training. This suggests that pre-incident training and preparedness may play a crucial role in mitigating psychological trauma.

Following the tsunami in Asia, a study was conducted on 33 disaster relief team members 1 month after their service.¹¹ The assessment revealed that 8 of 33 participants (24.2%) were diagnosed with PTSD. Notably, the study found that the severity of PTSD symptoms was significantly higher among women, nurses, and participants with fewer than 3 previous disaster duty experiences.

The prevalence of PTSD and depression among local disaster relief workers was investigated approximately 14 months after the Great East Japan Earthquake in 2011.¹² This comprehensive study involved 1294 participants. Results indicated a higher prevalence of probable PTSD among municipality workers (6.6%) and medical workers (6.6%) compared to firefighters (1.6%). In follow-up assessments conducted at 30, 43, and 54 months post-disaster, the percentage of participants with probable PTSD declined from 8.3% after 14 months to 4.6% after 30 months, remaining relatively stable at 4.8% at 43 months and 5.3% at 54 months.¹³

Eighty-four male firefighters engaged in earthquake rescue work were evaluated 5 months after the 1999 Taiwan earthquake (Mw7.7, 2415 casualties). The observed PTSD prevalence was 21.4%, with rescue workers having longer job experience exhibiting the highest risk for post-traumatic distress development.¹⁴

Another study was done assessing the risk of PTSD among emergency medical technicians (EMTs) who had responded to the 2016 Taiwan earthquake (Mw6.4, 116 casualties).¹⁵ The survey was conducted 1 month after the earthquake and included 447 EMTs. The findings revealed that 12.7% of the respondents met the criteria for probable PTSD.

A total of 267 earthquake rehabilitation and reconstruction workers engaged in the response to the 2005 earthquake (Mw7.6, around 86,000 casualties) in Northern Pakistan completed self-report questionnaires approximately 24 months after the earthquake.¹⁶ Notably, 42.6% reported earthquake-related post-traumatic stress disorder. Levels of PTSD symptoms were linked to the severity of the earthquake experience, prior traumas, work-related stressors, low social support, and female gender.

These studies, together with the available research, have provided valuable insights into PTSD among disaster relief teams. However, further investigation will undoubtedly add valuable insights to our understanding of the psychological impact on these dedicated responders.

On February 6, 2023, 2 large earthquakes struck the southeastern region of Turkey at 04:17 and 13:24 Turkey time. The epicenters were in the Pazarcik and Elbistan districts of Kahramanmaraş, with magnitudes of Mw7.7 (focal depth = 8.6 km) and Mw7.6 (focal depth = 7 km), respectively. Approximately 2 weeks later, on February 20, 2023, at 20:04 Turkey time, another earthquake with a magnitude of Mw6.4 occurred, centered in Hatay Yayladagi. These earthquakes, which occurred in a relatively short period, affected approximately the same southeastern regions of Turkey and resulted in massive destruction across 11 provinces¹⁷.

As a result of the earthquakes, according to formal sources,¹⁷ more than 48 000 people lost their lives. Additionally, more than half a million buildings sustained damage, communication and energy infrastructure were severely affected, and substantial financial losses were incurred. The total population affected by the earthquake was 14 013 196, accounting for approximately 16.4% of the country's total population.

By examining the immediate effects of relief efforts on disaster relief teams just 1 month after these seismic events, this study aims to provide valuable insights into the challenges faced by these responders. This knowledge not only contributes to our understanding of how disaster response operations can impact their mental health but also can inform strategies and support mechanisms to safeguard the mental resilience of these professionals.

The significance of this study is underscored by its distinctive approach. The authors' direct participation in the immediate search and rescue (SAR) operations after the earthquakes bestowed them with valuable firsthand insights into the challenges encountered by relief teams. Throughout the SAR missions, informal observations of team interactions were conducted, yielding valuable insights into the challenges and experiences of relief teams. Furthermore, informal discussions took place with relief personnel during mealtimes, creating a relatively relaxed environment that encouraged the sharing of their experiences and feelings post-SAR operations. This perspective enabled us to develop practical recommendations for improving disaster response and support for relief teams. This triangulation of data from diverse sources facilitated a more accurate selection of appropriate participants and interpretation of survey results, ensuring the validity and relevance of our findings.

Methods

Participants and Data Collection

This cross-sectional study was designed to assess the immediate effects of PTSD on disaster relief teams in the aftermath of the 2023 earthquakes in Kahramanmaraş and Hatay, Turkey. It specifically aimed to measure the point prevalence of probable PTSD approximately 1 month after the primary SAR phase concluded. Following the February 6th earthquakes, relief teams were rapidly deployed. While relief efforts continued beyond, active SAR operations primarily concentrated on the first 10 days. Data collection for this study occurred between March 15th and 21st, ensuring at least a 1-month interval from the beginning of trauma exposure. It is important to note that some participants were still actively involved in relief efforts during data collection.

A total of 170 members of the disaster relief teams voluntarily participated in this study. These individuals represented a diverse range of roles within disaster relief operations, including professional firefighters, SAR workers, and charity/civil volunteers. The demographic characteristics of the participants, such as age, gender, residency (inside or outside the earthquake zone), and participation in

SAR operations, are detailed in Table 1. The inclusion criteria ensured that participants were actively engaged in disaster relief efforts and encompassed roles such as SAR, emergency shelter and food distribution services, infrastructure support, and health services.

Due to the time-sensitive nature of the research following the disaster, a convenience sampling approach was employed to recruit participants. The data collection for this study utilized a comprehensive online survey form created using Google Forms. The authors, who were members of active WhatsApp groups dedicated to disaster relief teams, facilitated the distribution of the survey and the subsequent collection of data. Their active involvement in disaster relief teams provided them with direct access to the study's participant pool, streamlining the data collection process.

Approximately 920 disaster relief team members were invited to participate in this online survey through a link to the Google Form shared in active WhatsApp groups. The invitation, repeated 4 times with different encouraging messages throughout the 1-week data collection phase, yielded an 18% response rate. This lower-than-anticipated participation can be attributed to the immediate timing of the study, as many members may have been hesitant to return to the traumatic experience they had during disaster relief operations. Data collection took place during approximately 1 week, ensuring sufficient time for the participants to complete the survey at their convenience.

Participants were required to provide informed consent before commencing the online survey. The consent process was clearly explained by defining the study's purpose, procedures, and the voluntary nature of participation. Participants were explicitly

informed of their rights, including the option to withdraw from the study at any point without facing any adverse consequences. Consent was officially granted when participants acknowledged a statement expressing their willingness to participate.

Furthermore, participants were provided with a summary of the screening results. This summary emphasized that these screening results were intended solely for preliminary screening purposes. A clinical interview would be required for a formal diagnosis of PTSD.

This research received ethical approval from the Ethical Review Committee of Mudanya University, underscoring its commitment to adhering to ethical standards throughout the study. To protect participant anonymity, the study refrained from collecting personally identifiable information, such as names or surnames. The survey link itself did not contain any identifiers, and no IP addresses were collected. All collected data, including demographic and survey responses, were securely stored on Google servers, bolstering data security.

Measures and Questionnaire

DSM-V¹ outlines 8 criteria for screening and measuring PTSD. These criteria address various aspects of the traumatic experience and its aftermath, encompassing exposure, re-experiencing symptoms, avoidance behaviors, negative cognitive and mood alterations, hyperarousal and reactivity, and functional impairment. A summary of these criteria follows:

Exposure to trauma (Criterion A): Direct or indirect experience of a life-threatening, injurious, or sexually violent events such as war, natural disasters, accidents, assault, etc.

Re-experiencing (Criterion B): Re-experiencing the trauma through vivid memories, flashbacks, nightmares, or dissociative reactions. These can cause intense distress and disruption.

Avoidance (Criterion C): Deliberate efforts to avoid reminders of the trauma, including memories, thoughts, feelings, people, places, conversations, activities, objects, and situations.

Negative alterations in cognitions and mood (Criterion D): Persistent negative thoughts and emotions about oneself, others, and the world, along with difficulty recalling aspects of the trauma and blaming oneself or others.

Hyperarousal (Criterion E): Heightened vigilance, irritability, aggression, reckless behavior, sleep disturbances, and exaggerated startle response.

Duration (Criterion F): The duration of symptoms must be at least 1 month.

Functional impairment (Criterion G): The symptoms must significantly disrupt crucial areas such as work, relationships, or social functioning.

Exclusion (Criterion H): The disturbance is not attributable to the physiological effects of a substance or another medical condition.

One of the most employed methods for screening for probable PTSD is the PCL-5¹⁸ questionnaire, which aligns with the diagnostic criteria of the DSM-V.¹ The PCL-5 shows a significant improvement from its earlier version, which followed DSM-IV criteria. It is a 20-item questionnaire that uses a 0-4 response scale, and the lowest possible score is denoted as 0, which is more intuitive.¹⁹

Validated cutoff scores for the PCL-5 total severity score can help determine PTSD diagnostic status. Calculating the PCL-5 total severity score involves summing responses to all 20 items. Research suggests that a PCL-5 cutoff score within the range of 31-33 may suggest probable PTSD across various samples.²⁰ Additionally, the PCL-5 allows for the application of the DSM-V diagnostic rule for a probable PTSD diagnosis. A score of 2 (moderately) or higher indicates the presence of the respective symptom. Meeting the

Table 1. Demographic characteristics of the participants (N=170)

| Characteristics | # of participants who meet provisional diagnosis / # of participants | % of participants in the sample |
|---------------------------------------|--|---------------------------------|
| Age | | |
| 18–29 | 22/51 (43%) | 30.0 |
| 30–39 | 9/43 (21%) | 25.3 |
| 40–49 | 17/55 (31%) | 32.4 |
| 50 or above | 12/21 (57%) | 12.4 |
| Gender | | |
| Male | 49/150 (33%) | 88.2 |
| Female | 11/20 (55%) | 11.8 |
| Residency | | |
| Inside earthquake zone | 22/48 (46%) | 28.2 |
| Outside earthquake zone | 38/122 (31%) | 71.8 |
| Participated in SAR operations | | |
| Yes | 44/134 (33%) | 78.8 |
| No | 16/36 (44%) | 21.2 |
| Mission | | |
| Professional firefighter | 20/62 (32%) | 36.5 |
| SAR worker | 20/57 (36%) | 33.5 |
| Charity/Civil volunteer | 20/51 (39%) | 30.0 |

criteria for probable PTSD necessitates the presence of at least 1 re-experiencing criterion, 1 avoidance criterion, 2 negative alterations in cognitions and mood criterion, and 2 hyperarousal criterion symptoms, along with the fulfillment of the functional impairment criterion.

The survey form used the clinically validated Turkish adaptation of PCL-5²¹ as the primary tool for assessing PTSD symptoms among participants. It's worth noting that the exposure to trauma criterion was intentionally excluded from the PCL-5, as it was assumed that all participants had experienced traumatic events during their disaster relief operations.

Functional impairment criterion, assessing the impact of the disturbance on social, occupational, or other important areas, was evaluated using 3 questions from the questionnaire, specifically addressing whether the disturbance significantly affected the participant's family, social, or work life. A positive response to any of these questions was considered indicative of meeting this criterion. The exclusion criterion was intentionally omitted from consideration, as it was highly unlikely for drug abusers to be part of the disaster relief teams.

Additionally, demographic data about the participants were collected in the survey, as presented in Table 1. The survey was designed to be user-friendly, allowing participants to complete it easily within approximately 5-10 minutes.

Statistical Analysis

The influence of various factors on probable PTSD symptoms was examined using a factorial analysis of variance (ANOVA) conducted in Minitab's General Linear Model tool. The dependent variable was the total severity score, a discrete numeric measure that demonstrated a strong correlation with screening for probable PTSD. Five categorical independent variables were considered: age (18-29, 30-39, 40-49, ≥50 years; 4 levels), gender (female, male; 2 levels), mission type (professional firefighter, SAR worker, charity/civil volunteer; 3 levels), residency (inside or outside the earthquake zone; 2 levels), and participation in SAR operations (yes, no; 2 levels). This analysis enabled us to assess the main effects of each factor on the total severity score simultaneously. To gain deeper insights into the significant main effects identified through the ANOVA, post hoc analyses were conducted using Tukey's honestly significant difference (HSD) tests with a 95% confidence level. These tests allowed for pairwise comparisons between the different levels of each factor, pinpointing which specific level differences were statistically significant.

Results

Descriptive statistics were computed for the responses of the 170 participants to all 20 questions of the PCL-5, and the results are summarized in Table 2. Notably, the mean scores for responses to the avoidance criterion exhibited the highest average at 1.89, followed by criteria for re-experiencing (1.59), negative alterations in cognitions and mood (1.37), and hyperarousal (1.26). This variation in mean responses across different criteria offers preliminary insights into the distribution of symptoms among the participants. It is important to highlight that, while mean responses varied among individual questions, the standard deviation of responses remained relatively consistent across all questions. This suggests a degree of homogeneity in the variability of symptom severity among the study's participants.

The responses of all participants are meticulously examined individually to screen for probable PTSD. For this purpose, the PTSD diagnostic criteria outlined in DSM V¹ were employed. The results, illustrating the number and percentage of participants meeting the criteria for re-experiencing, avoidance, negative alterations in cognitions and mood, and hyperarousal for PTSD as per DSM-V, are also presented in Table 2.

It's important to note that all participants were considered to meet the exposure to trauma criterion, given their involvement in large-scale disaster relief operations, which inherently exposed them to traumatic events. Notably, 80% of the participants met the avoidance criterion, which necessitates a response of 2 or higher to at least 1 of the 5 re-experiencing criterion questions, as explained in the introduction. Similar calculations were applied to determine compliance with the DSM-V guidelines for the avoidance criterion, negative alterations in cognitions and mood criterion, and hyperarousal criterion, requiring 1 out of 2, 2 out of 7, and 2 out of 6 positive responses, respectively. Data collection occurred 1 month after the conclusion of active search and rescue operations, aiming to ensure that all participants met the duration criterion of at least 1 month for PTSD diagnosis. Among the participants, 86 (50.6%) met the criterion for functional impairment, indicating that their PTSD symptoms significantly disrupted at least 1 major area of their work, family, or social life. Sixty (35.3%, 95% CI: 28.1%, 43.0%) of the 170 participants met all the DSM-V criteria for probable PTSD.

As explained in the Methods section, the total severity score of the PCL-5 is also utilized for probable PTSD screening. This score is derived by summing the responses to all 20 items. The mean total severity score across all 170 participants was 28.9 (median = 27), with a standard deviation of 18.7. When focusing on the subsample of 60 participants screened as positive, their mean total severity score was 46.6 (median = 42.5) and the standard deviation was 13.5. Using a recommended cutoff score of 33, 75 out of 170 participants were identified as screening positive for probable PTSD. Importantly, it's worth noting that 54 of these participants both meet all the criteria of the DSM-V and have a total severity score of 33 or above.

The results of the factorial ANOVA are shown in Table 3. According to the results, mission and gender effects were not found to be statistically significant. As shown in Table 1, which is based on descriptive statistics, females had a probable PTSD rate of 55%, while males had a rate of 33%. Although it may appear that females have a higher probable PTSD rate, this difference is not statistically significant due to the relatively small sample size of female participants. In contrast, the effects of age, residency, and active participation in SAR operations are all found to be statistically significant because they have *P* values less than 0.05.

The coefficients of the factorial ANOVA model, along with the post hoc analysis, are presented in Table 4. As explained before, for the post hoc analysis, Tukey's HSD tests with a 95% confidence level are used.

Post hoc tests revealed a significant difference in total severity scores based on participation in SAR operations. Individuals who actively participated had a mean score of 8.32 points lower than those who did not participate (4.16 vs. -4.16, *P* < 0.05). Residency also played a significant role, with relief team members directly exposed to the earthquakes reporting a higher total severity score of 6.02 points on average (3.51 vs. -3.51, *P* < 0.05). Age emerges as another significant factor in this study. Specifically, individuals aged 50 and above displayed a notably higher total severity score in comparison to their younger counterparts.

Table 2. Descriptive statistics of the participants' responses for PCL-5 and number of participants meeting DSM-V criteria

| | n | Mean | Median | SD | CV | Min. | Max. | # of participants | % of participants |
|---|-----|------|--------|------|------|------|------|-------------------|-------------------|
| Re-experiencing (Criterion B) | | | | | | | | | |
| Repeated, disturbing, and unwanted memories of the stressful experience? | 170 | 2.04 | 2 | 1.07 | 0.52 | 0 | 4 | 136 | 80% |
| Repeated, disturbing dreams of the stressful experience? | 170 | 1.36 | 1 | 1.22 | 0.90 | 0 | 4 | | |
| Suddenly feeling or acting as if the stressful experience were actually happening again (as if you were actually back there reliving it)? | 170 | 1.42 | 1 | 1.17 | 0.82 | 0 | 4 | | |
| Feeling very upset when something reminded you of the stressful experience? | 170 | 2.07 | 2 | 1.15 | 0.56 | 0 | 4 | | |
| Having strong physical reactions when something reminded you of the stressful experience (for example, heart pounding, trouble breathing, sweating)? | 170 | 1.05 | 1 | 1.25 | 1.18 | 0 | 4 | | |
| Avoidance (Criterion C) | | | | | | | | | |
| Avoiding memories, thoughts, or feelings related to the stressful experience? | 170 | 2.02 | 2 | 1.22 | 0.60 | 0 | 4 | 116 | 68% |
| Avoiding external reminders of the stressful experience (for example, people, places, conversations, activities, objects, or situations)? | 170 | 1.75 | 2 | 1.29 | 0.74 | 0 | 4 | | |
| Negative alterations in cognitions and mood (Criterion D) | | | | | | | | | |
| Trouble remembering important parts of the stressful experience? | 170 | 1.52 | 1 | 1.19 | 0.78 | 0 | 4 | 104 | 61% |
| Having strong negative beliefs about yourself, other people, or the world (for example, having thoughts such as: I am bad, there is something seriously wrong with me, no one can be trusted, the world is completely dangerous)? | 170 | 1.18 | 1 | 1.23 | 1.05 | 0 | 4 | | |
| Blaming yourself or someone else for the stressful experience or what happened after it? | 170 | 1.30 | 1 | 1.21 | 0.93 | 0 | 4 | | |
| Having strong negative feelings such as fear, horror, anger, guilt, or shame? | 170 | 1.32 | 1 | 1.25 | 0.95 | 0 | 4 | | |
| Loss of interest in activities that you used to enjoy? | 170 | 1.55 | 1 | 1.27 | 0.82 | 0 | 4 | | |
| Feeling distant or cut off from other people? | 170 | 1.30 | 1 | 1.22 | 0.94 | 0 | 4 | | |
| Trouble experiencing positive feelings (for example, being unable to feel happiness or have loving feelings for people close to you)? | 170 | 1.41 | 1 | 1.24 | 0.88 | 0 | 4 | | |
| Hyperarousal (Criterion E) | | | | | | | | | |
| Irritable behavior, angry outbursts, or acting aggressively? | 170 | 1.31 | 1 | 1.22 | 0.94 | 0 | 4 | 87 | 51% |
| Taking too many risks or doing things that could cause you harm? | 170 | 0.81 | 0 | 1.11 | 1.37 | 0 | 4 | | |
| Being "super alert" or watchful or on guard? | 170 | 1.52 | 1 | 1.25 | 0.82 | 0 | 4 | | |
| Feeling jumpy or easily startled? | 170 | 1.24 | 1 | 1.20 | 0.97 | 0 | 4 | | |
| Having difficulty concentrating? | 170 | 1.21 | 1 | 1.24 | 1.02 | 0 | 4 | | |
| Trouble falling or staying asleep? | 170 | 1.49 | 1 | 1.33 | 0.89 | 0 | 4 | | |

Limitations

This cross-sectional study was conducted approximately 1 month after the conclusion of active SAR operations and aimed to assess the immediate psychological effects on disaster relief team members. However, it's important to consider the temporal aspect of

PTSD prevalence. Santiago et al.,²² in their review paper, noted that the mean prevalence of PTSD across various studies tends to decrease over time. They found that at 1 month, the mean prevalence was 28.8%, while at 12 months, it decreased to 17.0%. This suggests that the point prevalence of PTSD is likely to decrease as more time elapses after the disaster.

Table 3. Factorial ANOVA results

| Source | DF | Adj SS | Adj MS | f | P |
|---------------------------------|-----|--------|--------|-----|-------|
| Residency | 1 | 1578 | 1578 | 5.0 | 0.027 |
| Participation of SAR operations | 1 | 1385 | 1385 | 4.4 | 0.038 |
| Age | 3 | 2590 | 864 | 2.7 | 0.047 |
| Gender | 1 | 100 | 100 | 0.3 | 0.576 |
| Mission | 2 | 81 | 40 | 0.1 | 0.881 |
| Error | 161 | 51194 | 318 | | |
| Total | 169 | 59120 | | | |

Table 4. Factorial ANOVA model coefficients and post hoc analysis

| Term | Coef | SE Coef | t | P | Grouping* |
|--|-------|---------|------|-------|-----------|
| Constant | 35.27 | 2.37 | 14.9 | 0.000 | |
| Residency | | | | | |
| Inside earthquake zone | 3.51 | 1.58 | 2.2 | 0.027 | A |
| Outside earthquake zone | -3.51 | 1.58 | -2.2 | 0.027 | B |
| Participation of SAR operations | | | | | |
| No | 4.16 | 1.99 | 2.1 | 0.038 | A |
| Yes | -4.16 | 1.99 | -2.1 | 0.038 | B |
| Age | | | | | |
| 50 or above | 8.97 | 3.29 | 2.7 | 0.007 | A |
| 18–29 | -1.06 | 2.41 | -0.4 | 0.660 | A B |
| 40–49 | -3.81 | 2.30 | -1.7 | 0.100 | B |
| 30–39 | -4.11 | 2.51 | -1.6 | 0.104 | B |
| Gender | | | | | |
| Females | 1.38 | 2.46 | 0.6 | 0.576 | A |
| Males | -1.38 | 2.46 | -0.6 | 0.576 | A |
| Mission | | | | | |
| Professional firefighters | 0.89 | 2.08 | 0.4 | 0.671 | A |
| SAR workers | 0.12 | 2.10 | 0.1 | 0.954 | A |
| Charity/Civil volunteer | -1.01 | 2.22 | -0.5 | 0.651 | A |

*Means that do not share a letter are significantly different with 95% confidence.

For future research, a longitudinal study could provide valuable insights into how the psychological effects on disaster relief team members change over time. This approach would allow for a more thorough understanding of the long-term effects and potential recovery trends. Additionally, while this study served as a screening assessment, future studies could involve inviting participants who screened positive for probable PTSD to participate in separate studies where formal diagnostic evaluations are conducted by mental health professionals. Such an approach would increase the

accuracy of point prevalence determination and provide a clearer picture of the mental health status of disaster relief team members.

The study encountered a relatively low response rate (18%). Informal communication with the invitees showed that their unwillingness to participate was primarily due to the timing of the study, which occurred approximately 1 month after active SAR operations had concluded. Many invitees expressed their reluctance to engage in any earthquake-related study after the demanding experiences they had endured in the previous month. This may introduce a potential limitation to the study's findings due to the presence of nonresponse and voluntary response biases. It's important to note that the probable PTSD prevalence reported in the study may be underestimated, as those experiencing more severe symptoms may have been less likely to participate in this study.

In the scientific literature, several studies suggest that females are at higher risk of developing anxiety, depression, and PTSD.⁵ In the current study, the gender effect was not statistically significant. However, this is most likely related to the relatively small sample size (20) of females in the study. It's important to note that most disaster relief teams were composed of men. Nevertheless, when examining descriptive statistics, it's noteworthy that 55% of females and 33% of males were screened as having probable PTSD. This observation aligns with the trends observed in the literature.

Discussion

While extensive research investigates the psychological impact of natural disasters on victims, studies exploring the experiences of disaster relief teams remain comparatively limited. This study contributes to examining the immediate psychological impact of disaster relief operations on team members involved in a large-scale response following 2 consecutive major earthquakes. By shedding light on the challenges faced by disaster relief teams, this study contributes to a deeper understanding of the toll that these operations can have on their mental well-being.

While the current study did not establish a control group, it's worth noting that a related study conducted on the prevalence of probable PTSD among Turkish firefighters²³ can serve as a useful benchmark. Firefighters comprised a significant portion of the disaster relief team population, acting as the backbone of the SAR operations. In this study, the point prevalence of probable PTSD among disaster relief team members was found to be 35.3%, whereas the prevalence among firefighters before the earthquakes was notably lower at 16.5%. Given that approximately one-third of the participants in the current study consisted of professional firefighters, this stark difference underscores the significant mental impact of earthquakes on disaster relief teams, highlighting the unique challenges and psychological toll experienced by them.

When comparing the point prevalence calculated in this study with similar research, a noticeable variation becomes apparent. For example, Armagan et al.¹¹ reported a prevalence of 24.2% 1 month after the 2004 Tsunami in Asia, resulting from a catastrophic Mw9.1 magnitude earthquake that claimed over 200 000 lives. Ma et al.¹⁵ found a prevalence of 12.7% 1 month after a less severe Mw6.4 magnitude earthquake in Taiwan, which resulted in 116 casualties. In contrast, Sakuma et al.¹² reported a prevalence of 8.3% 14 months after a devastating Mw9.1 earthquake and resulting tsunami in Japan, which tragically claimed more than 18 000 lives. Ehring et al.¹⁶ found a 42.6% probable PTSD rate among disaster relief workers 24 months after the 2005 Mw7.6 earthquake in northern Pakistan. These suggest significant mental health impacts

on disaster relief personnel. In this study, we report a point prevalence of 35.3% observed after Mw7.7 earthquakes that caused the loss of over 48 000 lives. Notably, the current study's prevalence rate is higher than that of most other studies in similar contexts.

This variation highlights that the psychological effects of earthquakes on disaster relief teams cannot only be attributed to the magnitude of the earthquake or the number of casualties. Factors such as cultural differences, post-disaster relief efforts, the level of training and education provided to disaster relief teams, and the organizational preparedness of professionals are likely to play critical roles. While group differences (firefighters, SAR, volunteers) weren't statistically significant here, future research could explore variations within these groups based on the type of training and preparedness provided, which might affect PTSD risk. This could provide a more nuanced understanding of PTSD risk factors beyond broad team categories. A potential avenue for future study could involve conducting a systematic review that compares findings across studies aiming to extract valuable insights from the existing research on disaster relief teams.

The findings of this study support the proposed cutoff score of 33²⁰ for the total severity score. Among the 60 participants who screened positive for probable PTSD based on DSM-V criteria, 54 (90%) also had total severity scores of 33 or higher. Only 6 (10%) positive cases had lower scores. While 21 participants exceeding the cutoff score screened negative by DSM-V, this aligns with the intended purpose of cutoff scores: prioritizing sensitivity over specificity.²⁴ This approach aims to capture potential patients who might benefit from further evaluation, ensuring no potential cases are missed. Subsequent clinical interviews can then provide definitive diagnoses.

It is crucial to highlight that team members who witnessed the earthquake had a significantly higher probability of developing PTSD, underscoring the importance of firsthand exposure to the traumatic event. This suggests that relief personnel are not only vulnerable to the traumas inherent in their disaster response duties but also to the personal losses and devastation they may experience as citizens of the affected area. For example, in the earthquake, local relief teams in Hatay faced the tragic collapse of their fire station, potentially traumatizing colleagues even while they were engaged in rescue efforts. This underscores the benefits of implementing rapid deployment of nonlocal teams and prioritizing support for local relief personnel to alleviate their burdens and enhance their ability to function effectively. Such an approach could potentially reduce the emotional impact on local responders who are personally struggling with the disaster's consequences.

The lower probable PTSD scores observed among those who participated in active SAR operations may initially appear unexpected, given their increased exposure to traumatic events such as encountering deceased or injured individuals, hearing the cries of victims and their relatives, and other emotionally challenging situations. However, it's essential to consider that a significant portion of them were professionals with prior training and experience. In contrast, various other disaster relief roles, such as emergency shelter and food distribution services, infrastructure rebuilding, and coordination, were carried out by individuals without such specialized training, including nonprofessional volunteers. This aligns with the findings of Armagan et al.,¹¹ which assert that disaster relief team members with less than 3 previous disaster duty experiences are at a higher risk of developing PTSD. Therefore, it may underscore the importance of providing comprehensive training to all personnel engaged in disaster relief efforts to enhance their resilience and preparedness when confronting distressing situations.

Findings suggest that older individuals (≥ 50) within the disaster relief teams may be more susceptible to experiencing PTSD symptoms following exposure to traumatic events. Age-related factors, such as differences in coping mechanisms, prior trauma experiences, and resilience levels, could potentially contribute to this observed disparity in total severity scores. Future research on these affecting variables could provide insights into age-specific vulnerabilities.

Competing interest. The author(s) declare none.

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