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Evaluation of Earthquake Victims Admitted to an Emergency Department in Izmir Following a Major Earthquake Occurring More Than 1000 Kilometers Away

1000 Kilometreden Daha Uzakta Gerçekleşen Büyük Bir Deprem Sonrası İzmir'de Bir Acil Servise Başvuran Depremzedelerin Değerlendirilmesi

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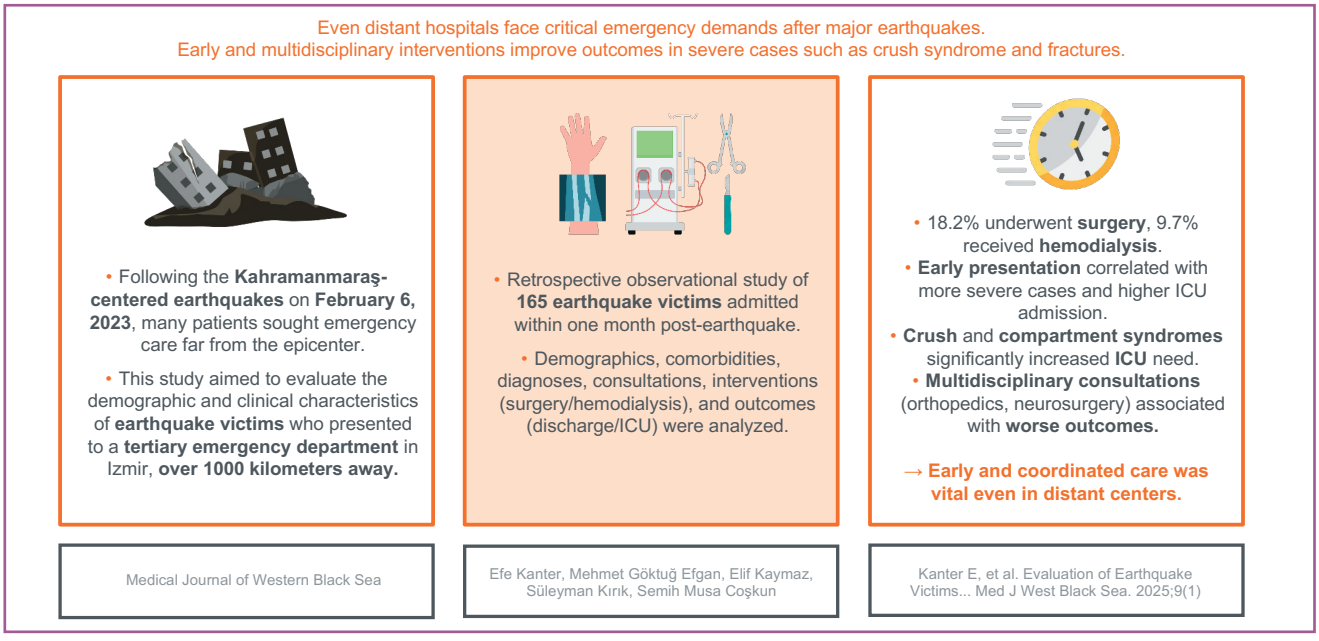
GRAPHICAL ABSTRACT



ABSTRACT

Aim: The major earthquakes centered in Kahramanmaraş on February 6, 2023, caused widespread destruction in the southern and southeastern regions of Turkey. This study evaluates how a distant earthquake affects emergency healthcare services over 1000 kilometers.

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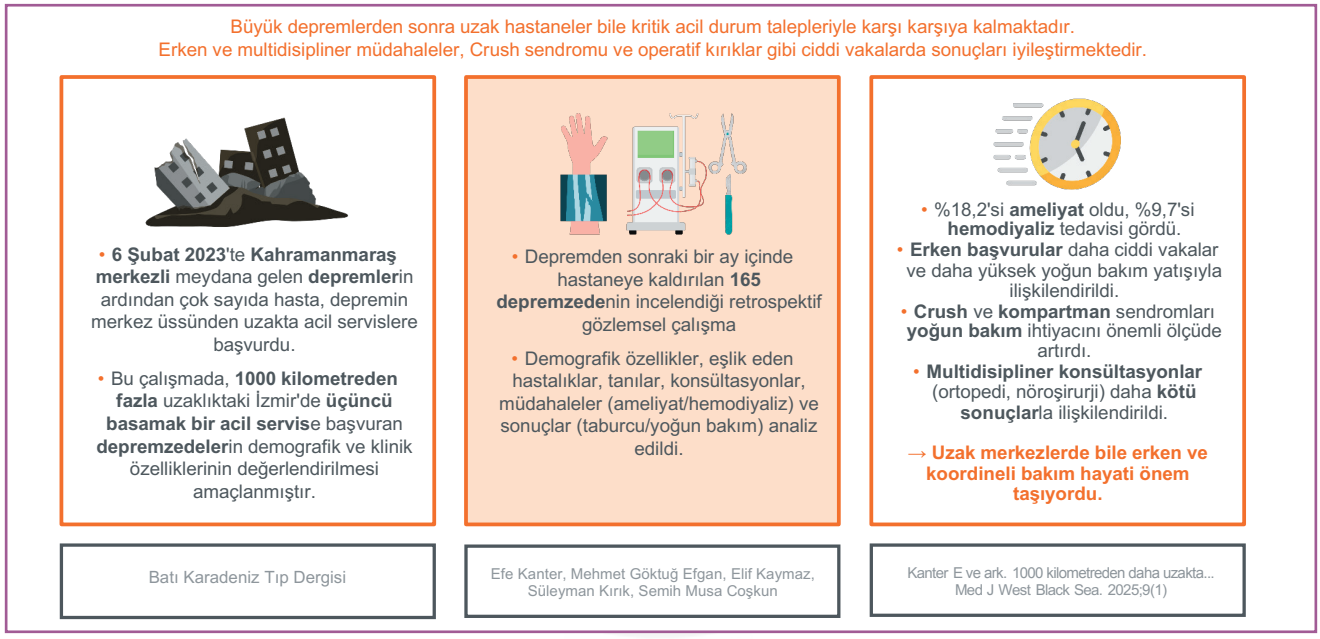
Material and Methods: This study retrospectively analyzes the demographic and clinical characteristics of 165 patients with the ICD code X34—Earthquake Victim—who presented to a tertiary emergency department in Izmir following the February 6, 2023 earthquakes. The patients' presentation times, medical histories, types of trauma, presence of Crush syndrome, and the treatments administered were examined. Additionally, the relationship between the need for hemodialysis and surgical intervention with the time of presentation was evaluated.

Results: The average age of the patients was 48 years, with 56.4% being female and 43.6% male. Hemodialysis was performed in 9.7% and surgical intervention was performed in 18.2% of the patients. These needs were found to be associated with earlier presentations. Additionally, a significant portion of these patients was diagnosed with Crush syndrome and related complications.

Conclusion: The study underscores the importance of early intervention and a multidisciplinary approach following earthquakes. Severe injuries, particularly those related to Crush syndrome, limb fractures, and emergency hemodialysis, are associated with better outcomes when managed promptly and in a coordinated manner. These findings highlight the critical importance of rapid medical response even in distant centers following major earthquakes.

Keywords: Earthquake, crush syndrome, disaster management, hemodialysis

GRAFİKSEL ÖZET



ÖZ

Amaç: 6 Şubat 2023'te Kahramanmaraş merkezli meydana gelen büyük depremler, Türkiye'nin güney ve güneydoğu bölgelerinde geniş çaplı yıkıma yol açmıştır. Bu çalışma, 1000 kilometreden daha uzak mesafedeki bir depremin acil sağlık hizmetlerini nasıl etkilediğini değerlendirmektedir.

Gereç ve Yöntemler: Bu çalışma, 6 Şubat 2023'teki depremler sonrasında İzmir'deki bir üçüncü basamak acil servise başvuran ve X34-Depremzede tanı kodu almış 165 hastanın demografik ve klinik özelliklerini retrospektif olarak analiz etmektedir. Hastaların başvuru zamanları, tıbbi geçmişleri, travma türleri, Crush sendromu varlığı ve uygulanan tedavi yöntemleri incelenmiştir. Ayrıca, bu hastaların hemodiyaliz ve cerrahi müdahale gereksinimleri ile başvuru zamanları arasındaki ilişki de değerlendirildi.

Bulgular: Hastaların ortalama yaşı 48,27±20,17 yıl olup, 93'ü kadın (%56,4) ve 72'si erkektir (%43,6). Hastaların ortalama %9,7'si hemodiyaliz uygulanmış ve %18,2'si cerrahi müdahale uygulanmıştır. Hemodiyaliz ve cerrahi müdahale gereksinimleri, daha erken başvurularla ilişkili bulunmuştur. Ayrıca, bu hastaların önemli bir kısmında Crush sendromu ve ilgili komplikasyonlar saptanmıştır.

Sonuç: Çalışma, deprem sonrası erken müdahalenin ve multidisipliner yaklaşımın önemini vurgulamaktadır. Özellikle Crush sendromu, ekstremite fraktürleri ve acil hemodiyaliz gerektiren durumlar gibi ciddi yaralanmalar, hızlı ve koordineli tıbbi müdahaleyle daha iyi sonuçlar alınabileceğini göstermektedir. Bu bulgular, büyük depremler sonrası uzaktaki merkezlerde bile hızlı tıbbi yanıtın kritik önem taşıdığını ortaya koymaktadır.

Anahtar Sözcükler: Crush sendromu, afet yönetimi, deprem, hemodiyaliz

INTRODUCTION

Earthquakes are sudden-onset natural disasters that often result in significant material damage and are associated with high mortality and morbidity rates. The consecutive major earthquakes that struck on February 6, 2023, centered in Kahramanmaraş, deeply impacted the southern and southeastern regions of Turkey, leading to widespread destruction. One of the critical medical conditions observed during such disasters is Crush syndrome, commonly seen in patients trapped under rubble. This syndrome can lead to acute kidney injury (AKI) and often necessitates interventions such as amputation, fasciotomy, and hemodialysis, which are crucial for improving the prognosis of affected patients (1,2).

Investigating the demographic and clinical characteristics of earthquake victims presenting to emergency departments is essential for evaluating the effectiveness of post-disaster healthcare services. Despite being far from the earthquake's epicenter, many patients fled to different cities due to injuries or other impacts, seeking refuge and medical care elsewhere (3).

In the immediate aftermath of the earthquake, temporary disruptions in healthcare services may have occurred in the affected regions. Healthcare workers, often facing long and exhausting shifts, demonstrated exceptional dedication to managing the crisis. Even hospitals located far from the disaster zone had to handle the increased patient load during the post-disaster period (4).

The aim of this study is to analyze the demographic and clinical characteristics of earthquake victims admitted to a tertiary emergency department in a distant region following a major earthquake, evaluating the medical needs and healthcare burden. This study provides an assessment of the impact of this significant earthquake, which occurred in a distant region, on the earthquake victims admitted to an emergency department in Izmir.

MATERIALS and METHODS

Study Design and Setting

This single-center, retrospective observational study was conducted in the emergency department of a hospital in Izmir, Turkey, where approximately 300,000 patients are treated annually. The study commenced following approval from local Clinical Research Ethics Committee. Patients who presented to our emergency department after the two major earthquakes that occurred on February 6, 2023, in Kahramanmaraş, with epicenters located 1,082 kilometers and 1,099 kilometers from our hospital, were included in the study.

Study Population

Patients who presented to Izmir Katip Çelebi University Atatürk Training and Research Hospital within one month from February 6, 2023, were included in the study. The study encompassed not only patients presenting with earthquake-related trauma symptoms but also those presenting with internal, psychiatric, and other non-traumatic conditions. Patients with incomplete data or those who were referred to another facility were excluded from the study.

Data Collection

A retrospective screening was conducted, including patients whose presenting complaints were related to the earthquake. To identify earthquake victims, data were collected from patients assigned the ICD-10 diagnosis code X34—Victim of Earthquake, as specified by the WHO. The evaluation included demographic data such as age, gender, and date of admission, as well as comorbidities. Additionally, diagnoses made in the emergency department, the specialties consulted in the emergency department, the presence of fractures, the need for surgery, the need for emergency hemodialysis, outcomes, and mortality status were recorded. Patients with incomplete records were excluded from the analysis to ensure data integrity and reliability. All data were documented in a data recording form and used for statistical analysis.

In the comparative analyses, variables included demographic data (age, gender, date of admission), comorbidities (e.g., hypertension, diabetes, heart failure), trauma-related diagnoses (e.g., crush syndrome, compartment syndrome, fractures, soft tissue injuries), non-traumatic conditions (e.g., infections, chest pain, headache, dyspnea), treatments (need for surgery, emergency ur), patient outcomes (discharge, ward/ICU admission), and consulted specialties (e.g., internal medicine, surgery, orthopedics, neurosurgery). These parameters were used to explore associations with clinical outcomes such as surgical intervention, dialysis need, and ICU admission.

Statistical Analysis

All data analyses were performed using SPSS for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive data were presented as mean ± standard deviations (SD) and median (min-max) values for continuous variables, and as frequencies (n) and percentages (%) for categorical variables. The Mann-Whitney U test was used to compare two independent groups for non-normally distributed continuous variables, while the Kruskal-Wallis test was applied for comparisons involving more than two groups. Fisher's Exact test or Chi-Square test (χ^2) was used for the comparison of categorical data, depending on sample size and expected frequencies. A p-value of <0.05 was considered statistically significant.

RESULTS

In this retrospective observational study, we analyzed the demographic and clinical characteristics of patients who presented to the emergency department following the major earthquakes on February 6, 2023. A total of 165 patients were included, with a mean age of 48.27±20.17 years (ranging from 1 to 93 years). Of these patients, 56.4% were female, and 43.6% were male. The mean time to presentation at the emergency department was 6.87±4.54 days, with a median of 5 days (Table 1).

Among the patients, the most common chronic conditions were hypertension (8.5%), diabetes mellitus (15.2%), and congestive heart failure (4.8%). Among the patients, 32.1% required an orthopedic consultation, 9.7% were evaluated by internal medicine, and 6.1% were consulted by general surgery (Table 1).

18.2% of patients presented with fractures and required surgical interventions (18.2%). The need for emergency hemodialysis was observed in 9.7% of the patients (Table 1). The mean time to presentation was significantly shorter in patients who required surgery (4.33±2.66 days) compared to those who did not (7.44±4.68 days, p<0.001) (Table 2). Similarly, patients who required emergency hemodialysis had a significantly shorter mean time to presentation (3.43±1.50 days) compared to those who did not (7.24±4.60 days, p<0.001). Moreover, patients diagnosed with crush syndrome had a mean presentation time of 3.43±1.50 days, significantly earlier than those without crush syndrome (7.24±4.60 days, p<0.001) (Table 2).

Regarding patient outcomes, 61.8% were discharged, 33.9% were admitted to the wards, and 4.2% required intensive care unit (ICU) admission. The time to presentation was significantly associated with patient outcomes; those admitted to the ICU presented earlier (mean 3.85±2.26 days) compared to those who were discharged (mean 7.97±4.67 days, p<0.001) (Table 2).

Diagnoses such as crush syndrome and compartment syndrome were strongly linked to worse outcomes, with significantly higher ICU admission rates (p<0.001 for both). Specifically, 71.4% of patients with crush syndrome and 28.6% with compartment syndrome required ICU care. Similarly, patients with extremity fractures and soft tissue injuries had higher ICU admission rates (p<0.001) (Table 3).

Consultations with certain specialties, particularly orthopedic surgery, neurosurgery, and thoracic surgery, were associated with increased ICU admissions (p<0.001, p=0.005, and p=0.003, respectively). Orthopedic consultations had the highest ICU admission rate at 71.4%. The need for multi-specialty consultations, including cardiology and general surgery, was also linked to poorer outcomes, indicating the complexity and severity of these cases (Table 4).

Table 1: General Demographic, Clinical Characteristics and Outcomes of Patients

Variables		Findings (n=165)
Gender, n (%)	Female	93 (56.4)
	Male	72 (43.6)
Age (Year±SD), median (min-max)		48.27±20.17
		49 (1-93)
Admission Date (Day±SD), median (min-max)		6.87±4.54
		5 (2-21)
Chronic Disease, n (%)	Hypertension	14 (8.5)
	Diabetes Mellitus	25 (15.2)
	Congestive Heart Failure	8 (4.8)
	Chronic Kidney Disease	4 (2.4)
	COPD	1 (0.6)
	Atrial Fibrillation	2 (1.2)
Consultation Unit, n (%)	Internal Medicine	16 (9.7)
	General Surgery	10 (6.1)
	Thoracic Surgery	10 (6.1)
	Orthopedics	53 (32.1)
	Plastic Surgery	9 (5.5)
	Cardiovascular Surgery	6 (3.6)
	Neurosurgery	18 (10.9)
	Ophthalmology	4 (2.4)
	Otorhinolaryngology	1 (0.6)
	Psychiatry	3 (1.8)
	Infectious Diseases	5 (3.0)
	Gynecology and Obstetrics	3 (1.8)
	Urology	1 (0.6)
	Cardiology	6 (3.6)
	Pulmonology	3 (1.8)
	Neurology	2 (1.2)
	Anesthesiology	13 (7.9)
Diagnosis, n (%)	Crush Syndrome	15 (9.1)
	Compartment Syndrome	10 (6.1)
	Respiratory Tract Infection	19 (11.5)
	Soft Tissue Disorder	57 (34.5)
	Extremity Fracture	18 (10.9)
	Spinal Fracture	4 (2.4)
	Thoracic Fracture	6 (3.6)
	Pelvic Fracture	5 (3.0)
	Hemopneumothorax	4 (2.4)
	Urinary Tract Infection	3 (1.8)
	Anxiety Disorder	2 (1.2)
	Chest Pain	11 (6.7)
	Dyspnea	6 (3.6)
	Headache	5 (3.0)
	Abdominal Pain	6 (3.6)
	Myalgia	8 (4.8)
	Stroke	3 (1.8)
	Abnormal Uterine Bleeding	1 (0.6)
Treatment, n (%)	Fracture Management	30 (18.2)
	Need for Surgery	30 (18.2)
	Emergency Hemodialysis	16 (9.7)
Outcome, n (%)	Discharged	102 (61.8)
	Ward Admission	56 (33.9)
	ICU Admission	7 (4.2)

COPD: Chronic obstructive pulmonary disease, **ICU:** Intensive care unit, **$\bar{x}$:** Mean, **s:** Standard deviation.

Table 2: Association of Admission Date with Clinical Interventions and Outcomes

	Need for Operation		Test Statistics	
	No	**Yes**	**z-value**	**p-value**
Admission Date				
(Day±SD), median (min-max)	7.44±4.68 6 (2-21)	4.33±2.66 3 (3-16)	4.652	<0.001
Fracture, n (%)				
No	119 (88.1)	16 (53.3)	19.999	<0.001
Yes	16 (11.9)	14 (46.7)		
	Emergency Hemodialysis		**Test Statistics**	
	No	**Yes**	**Test value**	**p-value**
Admission Date				
(Day±SD), median (min-max)	7.24±4.60 6 (2-21)	3.43±1.50 3 (3-9)	4.812	<0.001
Crush syndrome, n (%)				
No	145 (97.3)	5 (31.3)	76.306	<0.001
Yes	4 (2.7)	11 (68.8)		
	Outcome			**Test Statistics**
	Discharged	**Ward**	**ICU**	**H-value**	**p-value**
Admission Date					
$\bar{x}$±s	7.97±4.67	5.26±3.84	3.85±2.26	32.258	<0.001
median (min-max)	6 (3-21)a	4 (2-21)b	3 (3-9)b		

ICU: Intensive care unit, **$\bar{x}$:** Mean, **s:** Standard deviation. Mann-Whitney U test was used for Admission Date. and Fisher's Exact test was used for Fracture. The Kruskal-Wallis test was used for comparisons among three groups. Post-hoc pairwise comparisons were performed using Dunn's test where applicable.

Table 3: Relationship Between Diagnoses and Outcome

	Outcome (n=165)*			Test Statistics	
	Discharged	**Ward**	**ICU**	**value**	**p-value**
Crush syndrome	0 (0.0)	10 (17.9)	5 (71.4)	48.321	**<0.001**
Compartment syndrome	0 (0.0)	8 (14.3)	2 (28.6)	19.465	**<0.001**
Respiratory Tract Infection	18 (17.6)	1 (1.8)	0 (0.0)	9.878	**0.007**
Soft Tissue Disorder	46 (45.1)	11 (19.6)	0 (0.0)	14.218	**0.001**
Extremity Fracture	4 (3.9)	12 (21.4)	2 (28.6)	13.747	**0.001**
Spinal Fracture	0 (0.0)	4 (7.1)	0 (0.0)	7.979	**0.019**
Thoracic Fracture	2 (2.0)	4 (7.1)	0 (0.0)	3.046	0.218
Pelvic Fracture	1 (1.0)	2 (3.6)	2 (28.6)	17.055	**0.007**
Hemopneumothorax	0 (0.0)	3 (5.4)	1 (14.3)	8.734	**0.013**
Urinary Tract Infection	2 (2.0)	0 (0.0)	1 (14.3)	7.144	**0.028**
Anxiety Disorder	2 (2.0)	0 (0.0)	0 (0.0)	1.250	0.535
Chest Pain	7 (6.9)	4 (7.1)	0 (0.0)	0.527	0.768
Dyspnea	1 (1.0)	5 (8.9)	0 (0.0)	5.904	0.051
Headache	5 (4.9)	0 (0.0)	0 (0.0)	2.775	0.338
Abdominal Pain	6 (5.9)	0 (0.0)	0 (0.0)	3.846	0.146
Myalgia	8 (7.8)	0 (0.0)	0 (0.0)	5.193	0.075
Cerebrovascular stroke	1 (1.0)	2 (3.6)	0 (0.0)	1.495	0.474
Abnormal Uterine Bleeding	0 (0.0)	1 (1.8)	0 (0.0)	1.958	0.376

*Data were shown as n (%). **ICU:** Intensive care unit. Fisher's Exact test or Chi-Square test (χ^2) was used for the comparison of categorical variables. depending on sample size and expected frequencies.

Table 4: Relationship Between Consultation Units and Patient Outcome Status

Relationship Between Consultation Units and Patient Outcome*	Outcome			Test Statistics	
	Discharged	Ward	ICU	value	p-value
Internal Medicine	2 (2.0)	8 (14.3)	6 (85.7)	33.115	**<0.001**
General Surgery	0 (0.0)	7 (12.5)	3 (42.9)	27.307	**<0.001**
Chest surgery	2 (2.0)	6 (10.7)	2 (28.6)	11.372	**0.003**
Orthopedics	13 (12.7)	35 (62.5)	5 (71.4)	46.227	**<0.001**
Plastic Surgery	3 (2.9)	5 (8.9)	1 (14.3)	3.619	0.164
Cardiovascular Surgery	1 (1.0)	4 (7.1)	1 (14.3)	6.284	**0.043**
Neurosurgery	5 (4.9)	11 (19.6)	2 (28.6)	10.429	**0.005**
Ophthalmology	2 (2.0)	1 (1.8)	1 (14.3)	4.353	0.113
Otorhinolaryngology	1 (1.0)	0 (0.0)	0 (0.0)	0.621	0.733
Psychiatry	2 (2.0)	1 (1.8)	0 (0.0)	0.142	0.932
Infectious Diseases	2 (2.0)	3 (5.4)	0 (0.0)	1.648	0.439
Obstetric diseases	2 (2.0)	1 (1.8)	0 (0.0)	0.1442	0.932
Urology	0 (0.0)	1 (1.8)	0 (0.0)	1.958	0.376
Cardiology	3 (2.9)	3 (5.4)	0 (0.0)	0.878	0.645
Pulmonology	0 (0.0)	3 (5.4)	0 (0.0)	5.947	0.051
Neurology	0 (0.0)	2 (3.6)	0 (0.0)	3.941	0.139
Anesthesiology	0 (0.0)	6 (10.7)	7 (100.0)	48.168	**<0.001**

*Data were shown as n (%). **ICU:** Intensive care unit. Fisher's Exact test or Chi-Square test (χ^2) was used for the comparison of categorical variables. depending on sample size and expected frequencies.

DISCUSSION

The findings from our study provide crucial insights into the demographic and clinical characteristics of earthquake victims who presented to an emergency department in Izmir, Turkey, following the major earthquakes of February 6, 2023. The study underscores the importance of early and multidisciplinary intervention, particularly for patients with severe conditions such as crush syndrome, fractures, and those requiring emergency hemodialysis (5,6).

Our results revealed that patients with more severe injuries, including those requiring surgical interventions and emergency hemodialysis, tended to present earlier to the emergency department. This aligns with previous research demonstrating the critical role of rapid medical response in disaster scenarios (7,8). Early presentation has been shown to significantly impact outcomes, particularly in crush syndrome cases, where the risk of acute kidney injury (AKI) is high (9). Studies have documented that early intervention, including aggressive fluid resuscitation and timely hemodialysis, can reduce mortality and morbidity associated with AKI in crush syndrome patients (10). Similarly, prompt surgical management of fractures and compartment syndrome is crucial in improving patient outcomes (11,12).

The high rate of ICU admission among patients with crush syndrome and compartment syndrome highlights the severity of these conditions and the necessity for intensive monitoring and care (13). Our findings further indicate a significant association between the need for orthopedic, neurosurgical, and thoracic surgical consultations and higher ICU admission rates, reflecting the complexity and severity of injuries sustained by these patients (14). This is consistent with literature suggesting that patients with multi-system injuries, particularly those requiring multiple surgical interventions, are at a higher risk of complications and poor outcomes (8).

Furthermore, our study demonstrated a strong link between early presentation and better overall outcomes, including lower ICU admission rates and higher discharge rates (5). These results are supported by existing literature, which emphasizes that delays in medical care can lead to the progression of injuries and worse prognosis (7). The need for consultations from various specialties, including cardiology and general surgery, underscores the complexity of these cases and the necessity for coordinated care (11,15).

In conclusion, our findings highlight the critical importance of early, multidisciplinary intervention in improving outcomes for patients with severe earthquake-related injuries. The significant associations observed between early pres-

entation and better outcomes underscore the necessity of rapid, coordinated medical response in disaster settings (10). These findings reinforce the importance of prioritizing early intervention and multidisciplinary care to optimize patient outcomes following large-scale disasters (6,16).

Our study is limited by its retrospective design, which may introduce biases related to data accuracy and completeness. This study acknowledges the inherent bias in retrospective designs, including selection bias. To minimize this, only patients with complete records were included in the analysis. Additionally, being a single-center study, the generalizability of our findings is restricted. The small sample size, especially with only one patient outcome resulting in death, limited our ability to draw significant conclusions regarding mortality. Moreover, the reliance on patients who traveled from distant regions may have introduced variability in the timing and severity of presentations, potentially affecting the outcomes observed. However, a key strength is the detailed assessment of earthquake victims in a non-epicenter region, providing valuable insights into post-disaster healthcare needs.

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Author Contributions

Concept: **Efe Kanter, Mehmet Göktuğ Efgan,** Design: **Efe Kanter, Süleyman Kırık,** Data Collection or Processing: **Semih Musa Coşkun, Süleyman Kırık,** Analysis or Interpretation: **Elif Kaymaz, Efe Kanter,** Literature Search: **Mehmet Göktuğ Efgan,** Writing: **Efe Kanter,** Approval of Final Manuscript: **All authors.**

Conflicts of Interest

The authors declare no conflicts of interest.

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Ethical Approval

Ethical approval for the study was obtained from the Izmir Katip Celebi University Clinical Research Ethics Committee (Approval No: 0434, Date: 21.09.2023).

Review Process

Extremely and externally peer-reviewed.

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