ORIGINAL RESEARCH

After the Türkiye Earthquake: The Experience of a Pediatric Emergency Department in a University Hospital Distant from the Disaster Area

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Abbreviations:
AKI: acute kidney injury
ED: emergency department
ESI: Emergency Severity Index
ISS: Injury Severity Score
PED: pediatric emergency department
PICU: pediatric intensive care unit
PTS: Pediatric Trauma Score
TPR: time period under rubble

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Abstract

Introduction: Earthquakes rank among the most deadly natural disasters, and children are particularly affected due to their inherent vulnerability. Following an earthquake, there is a substantial increase in visits to emergency services. These visits stem not only from patients seeking care for physical traumas resulting from the earthquake and its subsequent complications, but also from individuals affected by the circumstances created by the disaster.

Study Objective: This study aims to determine the characteristics and outcomes of children who presented to the pediatric emergency department (PED) after the earthquake and to evaluate children who had crush injuries at a referral tertiary university hospital away from the earthquake area.

Methods: The medical records of children who presented to the PED from the earthquake area from February 6 through March 7, 2023 were retrospectively reviewed. Children rescued from under rubble were categorized as Group 1, those affected by earthquake conditions as Group 2, and patients seeking medical attention due to the follow-up of chronic illnesses were considered as Group 3. Patient data, including sociodemographic characteristics, time period under rubble (TPR), laboratory findings, and details of medical and surgical procedures, developing acute kidney injury (AKI), and the requirement for hemodialysis were recorded.

Results: A total of 252 children were enrolled in the study, with 52 (20.6%) in Group 1, 180 (71.4%) in Group 2, and 16 (6.0%) in Group 3. The median age was six (IQR = 1.7-12.1) years. In the first group (n = 52), 46 (85.2%) children experienced crush injuries, 25 children (46.3%) developed crush syndrome, and 14 of them (14/25; 56.0%) required dialysis. In the second group, the most common diagnoses were upper respiratory tract infections (n = 69; 37.9%), acute gastroenteritis (n = 23; 12.6%), simple physical trauma (n = 16; 8.8%), and lower respiratory tract infections (n = 13; 7.1%). For children in the third group, pediatric neurology (n = 5; 33.3%), pediatric oncology (n = 4; 25.0%), and pediatric nephrology (n = 3; 18.8%) were the most frequently referred specialties.

Conclusion: Crush injuries, crush syndrome, and AKI were the most common problems in the early days following the earthquake. Along with these patients, children who were affected by the environmental conditions caused by the earthquake, as well as children with chronic illnesses, also accounted for a significant portion of visits to the PED, even if they were distant from the disaster area.

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Introduction

Türkiye is located on a highly seismically active Anatolian plate where major earthquakes have occurred throughout history.[1] On February 6, 2023, two earthquakes with magnitudes of 7.8 and 7.5 near Kahramanmaraş heavily affected 11 provinces in Southern and Southeastern Türkiye.[1,2] These devastating earthquakes were followed by several aftershocks, killing thousands and injuring many more in the region. The affected region

represents a large area inhabited by 14 million people, which corresponds to 16.4% of country's population.[1,2] Among these, 4.6 million were children. According to data from April 16, 2023, nearly 50,000 people died[2] and 108,000 were seriously injured.[3] It has been the largest earthquake in this region since the 1900s.[1]

The effects of the disaster were felt, especially in emergency departments (EDs), minutes after the earthquake, and the emergency systems quickly became overwhelmed. In mass-casualty events, particularly significant ones such as this particular disaster, coping with patients in the ED, which are usually the most capable of providing care for critical patients regardless of prior notification, can be challenging.

The literature on the management of children affected by earthquakes is scarce and mostly adopted from adults. Children are inherently different from adults and experience much more of the impact of earthquakes because of their unique needs and vulnerabilities, such as smaller body portions, different physiology, and developing organ systems.[4] Therefore, it is important for children to be evaluated by a physician experienced in their special needs, even in the midst of disasters and emergencies.

The most common type of injury in children affected by earthquakes is fracture, followed by soft tissue injuries.[5] Crush injuries and crush syndromes are common patterns of earthquake injuries.[6]

The institution used for study, located 600km from the epicenter of the earthquake, is a tertiary university hospital and Level 1 trauma center, one of the out-field hospitals where earthquake victims were referred for further treatment. This study aimed to determine the characteristics and outcomes of children who presented to the pediatric emergency department (PED) after an earthquake and to evaluate children who had crush injuries at a referral tertiary university hospital away from the earthquake area. In addition, another objective of the study was to guide disaster management and planning for children for possible earthquakes in the future.

Material and Methods

Study Design

The medical records of all children who presented to the PED by self-presentation or transportation from the earthquake area from February 6 through March 7, 2023 were retrospectively reviewed. Approximately 75,000 children are evaluated annually in the PED. The hospital is located in the capital city of Türkiye and is a 272-bed tertiary-care pediatric hospital. It is also a Level I trauma center for children. This study was approved by the Clinical Research Ethics Board of Hacettepe University Faculty of Medicine (Ankara, Türkiye; GO 23/376).

Disaster Action Plan

In the early morning after the earthquake, a "Disaster Action Plan" was implemented. All elective operations and admissions to the pediatric wards were canceled. Pediatric emergency physicians and residents, pediatric intensive care physicians, pediatric nephrology physicians, and other trauma-related departments, including pediatric surgery, orthopedics, plastic and reconstructive surgery, and cardiovascular surgery, were prepared for possible future cases of PED. Additionally, on the first day of the earthquake, three pediatric emergency specialists and two pediatric intensive care specialists who worked in the hospital voluntarily visited the earthquake area. The following days, volunteers from pediatric residents and specialists went to the region as teams.

Patient Population and Referral System

Following extraction, victims were transferred to the frontline hospitals in the region that were not damaged and to secondary referral hospitals in the region or nearby. Many of these hospitals were located in Adana and Mersin. After stabilization and initial treatment in these referral centers, the patients were referred to the study center or other tertiary hospitals, especially Ankara (Figure 1). Additionally, many children presented to the PED through their own means with their families.

All children who applied from the earthquake region were included in this study period. There were no exclusion criteria.

All patients were evaluated in three categories according to the complaint at admission to PED. The first group of patients (Group 1) were those rescued from rubble. Patients in this group were transferred from a field hospital or referral center in the earthquake area, and some were admitted by their own means. The second group of patients (Group 2) were in the earthquake zone and presented with complaints of clinical symptoms, such as simple injuries, infectious diseases, gastroenteritis, or health issues that arose from inadequate nutrition and living conditions in the next period. The third group (Group 3) included the children whose caregivers had to migrate while living in the earthquake area, presented to the PED due to any health problem not related to the earthquake but to chronic diseases that needed follow-up, and had problems accessing their medication.

The information about medical and surgical procedures performed and time period under the ruble (TPR) was obtained from the medical records sent over from the first center along with the patients. For patients who arrived without medical records, their information was recorded based on the verbal statements they provided. The information after their arrival at the PED was retrieved from the hospital's electronic medical recording system.

Patients' demographic data, complaints, Pediatric Trauma Score (PTS), Injury Severity Score (ISS), TPR, diagnoses, injury types, number of affected extremities, laboratory findings, prognoses, presence of crush syndrome and/or acute kidney injury (AKI), dialysis need, and surgical procedures undertaken, such as fasciotomy and amputation, were recorded.

Therapeutic Strategy

Triage acuity levels of all patients were determined using the Emergency Severity Index (ESI version 4th). The first group of patients and all unstable patients were immediately evaluated in the trauma room. All children who had been rescued from the rubble were initially evaluated by a trauma team consisting of a pediatric emergency physician, pediatric intensive care unit (PICU) physician, chief of the pediatric resident, and pediatric resident. After the initial assessment and stabilization, oligo-anuric children were hydrated with 1,200cc/m^2 alkalinized solutions (50mEq bicarbonate in 1L D5 0.45% NaCl); any children with suspicion of crush syndrome were hydrated with 3000cc/m^2 - 4000cc/m^2 alkalinized solutions (50mEq bicarbonate in 1L D5 0.45% NaCl) in PED. The patients were referred to the departments of orthopedics, pediatric surgery, pediatric nephrology, plastic surgery, and cardiovascular surgery according to their needs. The need for antibiotics and tetanus prophylaxis was also determined.

Definitions

Crush injuries with direct injury due to collapsing material and debris were considered crush injuries.[7] Swelling, pain, paresthesia, paresis or paralysis, and/or absent peripheral pulses, pallor, and reduced capillary return in the extremities were considered

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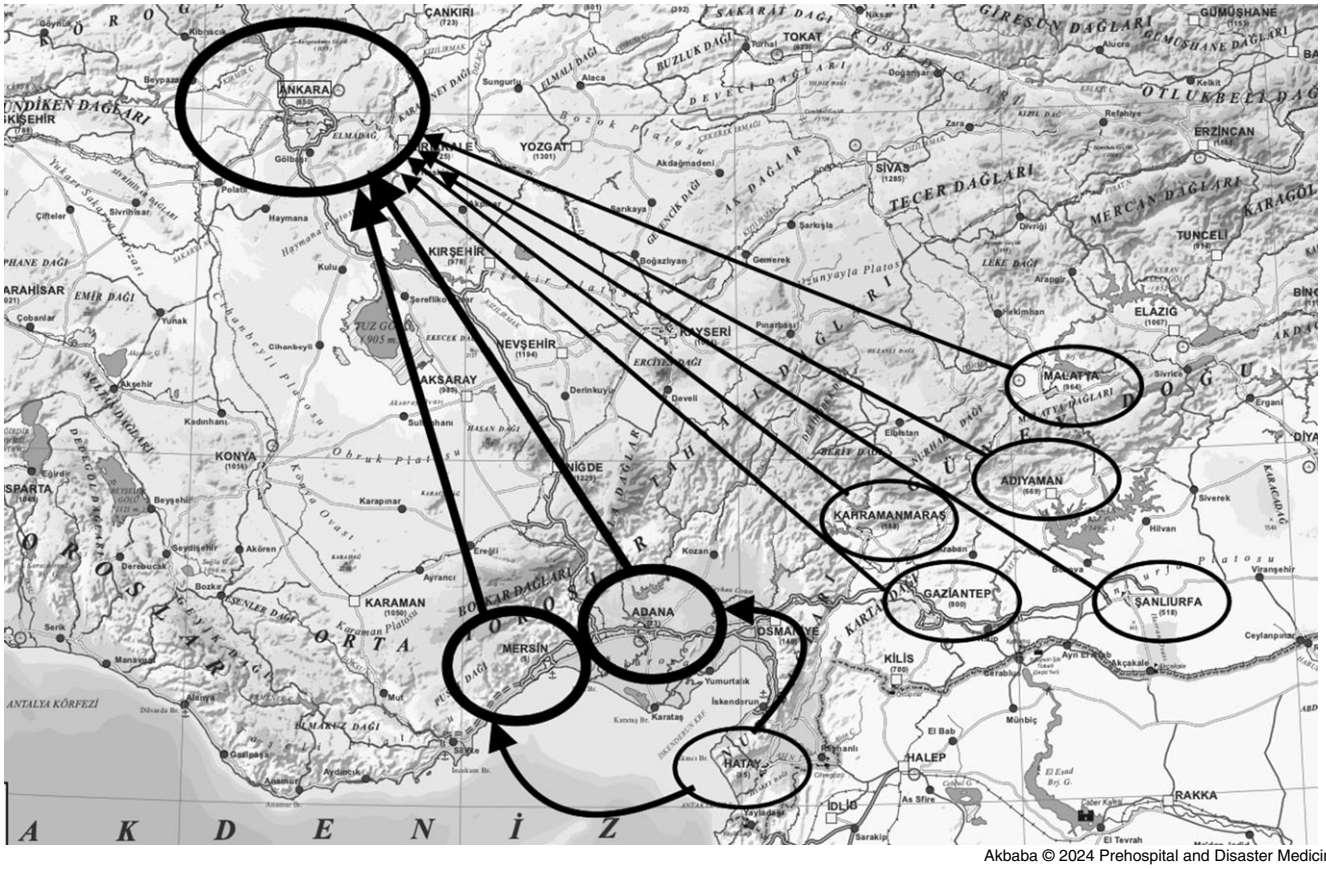

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Figure 1. Patient Transportation Network to Hospital.

symptoms and signs of acute compartment syndrome.[7,8] Patients with systemic symptoms, including local tissue injury, organ dysfunction (reduced urinary output), and metabolic abnormalities (acidosis, hyperkalemia, and hypocalcemia) were considered to have crush syndrome.[7] The presence of oligo/anuria (<0.5ml/kg/h x6-12h) and the need for hemodialysis were accepted as AKI due to crush syndrome.[7] Indications for renal replacement therapy were defined by pediatric nephrology and/or PICU specialists.

The PTS, Abbreviated Injury Scale (AIS), and ISS were used to determine injury severity.[9,10]

Outcomes

The primary outcome was to define the characteristics of earthquake victims in a PED which is located distant from the epicenter of the disaster. The secondary outcome was the evaluation of children with crush injuries.

Statistical Analysis

Descriptive statistics of all numeric variables, including mean, standard deviation (SD), minimum and maximum values, median (interquartile range [IQR]), and proportions of all categorical variables, were calculated. Two independent group means were compared using Student's *t*-test for independent groups. Non-parametric results are presented as medians (IQR) and were compared using the Mann-Whitney U test. A *P* value significance was set at $P < .05$. SPSS for Mac (version 23.0; IBM Corp.; Armonk, New York USA) was used for all the statistical analyses.

Results

From February 6, 2023 through March 7, 2023, 252 children affected by the earthquake were admitted to the Hacettepe University Ihsan Doğramacı Childrens Hospital PED (Ankara, Türkiye). The distribution of patients according to group and days after the earthquake is shown in Figure 2. The patients consisted of 128 (50.8%) girls and 124 (49.2%) boys with a median age of six (IQR = 1.7-12.1) years, ranging from zero to 17.9 years.

Evaluation of Children Rescued from the Rubble (Group 1)

Fifty-four patients rescued from the rubble were evaluated. The primary characteristics of children in the first group are presented in Table 1. At the presentation time, 55.6% (n = 30) of children had no guardian. Thirty-seven children (68.5%) presented to PED through ambulance, 78.3% (n = 29) of them were transferred from a secondary referral hospital in the region, and the rest of the children were transferred from the frontline hospitals in the region. Nine children (16.7%) presented to PED by their own means following admission to the frontline hospitals in the region. Eight children (14.8%) presented directly to PED without previous admission to any health institution after the earthquake.

Thirty-four children (64.2%) were administered intravenous fluid in the field hospitals; seven children (13.7%) had no medical records of fluid management in the previous hospital. Eight children (14.8%) had undergone hemodialysis, two children (3.8%) had plasma exchange, and seven children (13.2%) had been transfused before being transferred.

Extremity injuries were the leading physical examination finding (n = 48; 88.9%). Neurological (n = 17; 31.5%) and

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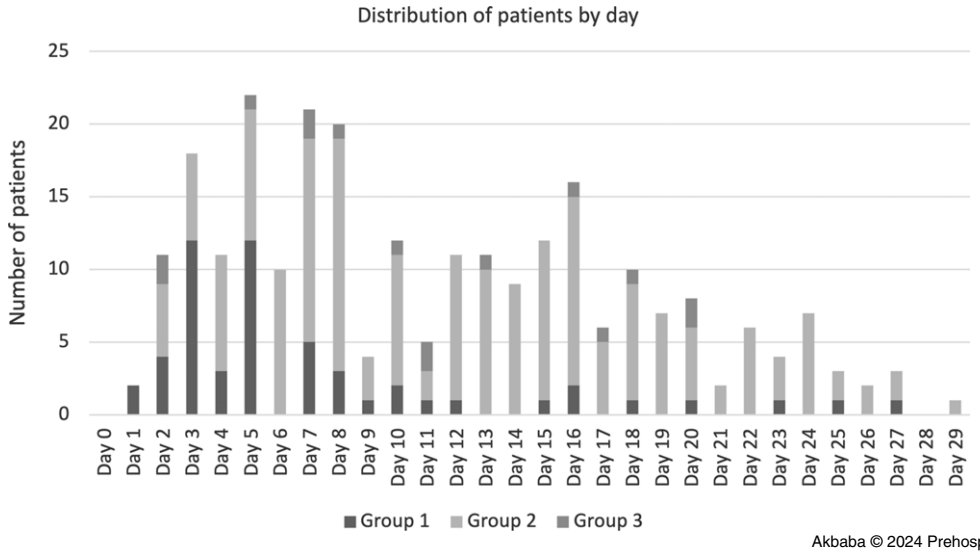

Figure 2. Distribution of Patients Admitted to the PED According to the Groups and Days After Earthquake (Group 1: Children Rescued from the Rubble; Group 2: Children Affected by Environmental Conditions of Disaster; and Group 3: Children with Chronic Illnesses).
Abbreviation: PED, pediatric emergency department.

abdominal findings (tenderness was accepted as a positive sign; n = 13; 24.1%) were the other common abnormalities.

Ten children (18.5%) had extremity fractures and 14 (25.9%) children had vertebral and/or pelvic fractures. Compartment syndrome findings were detected in 34 children referred (64.2%); six (11.1%) of them had limb amputation and 19 (35.2%) had fasciotomy on admission to PED.

The most common consultations in the PED were as follows: orthopedics and traumatology (n = 45; 83.3%), pediatric surgery (n = 33; 61.1%), plastic surgery (n = 29; 53.7%), pediatric nephrology (n = 22; 40.7%), cardiovascular surgery (n = 17; 31.5%), and neurosurgery (n = 9; 16.7%).

The most frequently observed cause of hospital admission was crush injury (62.2%; n = 33); the remaining reasons are provided in Table 2.

Forty-six children (85.2%) had crush injuries, 11 of them (24.4%) had injuries in more than one limb. In the first/field center, fasciotomy was performed in 19 patients (35.2%), and limb amputation was performed in six patients (11.1%). Of the 19 patients who underwent fasciotomy in the first center, nine underwent repeated fasciotomy after admission, and eight patients required amputation. Two patients who were transferred without fasciotomy or amputation at the first center required extremity amputation. The total number of children who had at least one extremity amputated was 13 (24%). The median TPR was longer in patients who required amputation (48 hours [IQR = 24-68] versus six hours [IQR = 2-12]; P < .001).

Crush syndrome developed in 46.3% (n = 25) of the children rescued from the rubble. Fifty-two percent of them (n = 13) were girls, mean age of 14.3 (IQR = 10.7-16.6) years and TPR of 10 hours (IQR = 6-48) and there were no statistically significant differences in the group who had no crush syndrome (62% of them [n = 18] were girls a median age of 11 [IQR = 7.3-11.8]; P >.05). The average PTS and ISS at presentation were 8.4 (SD = 1.9) and 19.4 (SD = 7.7), respectively, in children with crush syndrome, and this was statistically significant compared to children who had no crush syndrome (10.2 [SD = 1.9] and 6 [SD = 5.9]; P = .001 and P < .001). Nineteen children with crush syndrome (19/25; 76%) had developed AKI, and 14 of them (14/25; 56%) had needed dialysis due to the AKI. The characteristics of patients who required dialysis (RRT) and those who did not are shown in Table 3.

The relationship between the number of crushed extremities and complications is presented in Table 4. All children who had crush injuries or open wounds were administered antibiotics as a prophylaxis for secondary infections (n = 40; 74.1%). Ceftriaxone and clindamycin were used as the prophylactic antibiotics. Children who had undergone fasciotomy or amputation in the field hospitals (n = 22) had more infectious complications than the children (n = 29) who underwent surgery at the study center (68% versus 40%; P = .009).

The tetanus vaccine was administered to 36 children who were unvaccinated or whose information could not be accessed according to the scarce information obtained from the available medical records.

Twenty-eight (51.9%) children in this group lost their first-degree relatives, and 33 children (61.1%) had issues with sheltering and guardian problems after discharge.

Children Affected by Environmental Conditions of Disaster (Group 2)

In this group, 182 children were presented to the PED. The median age was four (IQR = 1.2-9.2) years; 50% were girls (n = 91). Twelve (6.7%) children were brought to ambulances, one of them had poor general condition. One-hundred-sixty-four (90.1%) children were discharged directly from the PED; 28 of them had short diagnostic tests and simple treatments (eg, urine analysis and/or wound care), five children were hospitalized in pediatric wards, and two children needed PICU care. The mean length of hospitalization was 3.3 (SD = 61.8) days (Table 5). Six (3.2%) children had been hospitalized before the earthquake and were transferred to the PED because of a damaged hospital.

Accommodation problems (eg, sheltering and poor sanitation; n = 49; 26.9%) and cold weather conditions (n = 29;

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Age (year)[a]	13 [8.7-16.3]
Sex (Girls), n (%)	31 (57.4)
Admission Type, n (%)	
Ambulance	37 (68.5)
Self-Presented	17 (31.5)
ESI	
ESI 1, n (%)	2 (3.7)
ESI 2, n (%)	32 (59.3)
ESI 3, n (%)	19 (35.2)
ESI 4, n (%)	1 (1.9)
PTS[b]	9.4 (SD = 2.1) (range: 4-12)
PTS ≥ 9, n (%)	38 (70.4)
9 > PTS ≥ 6, n (%)	14 (25.9)
PTS < 6, n (%)	2 (3.7)
ISS[b]	11.8 (SD = 9.6) (range: 0-36)
1 ≤ ISS ≤ 8, n (%)	22 (40.7)
9 ≤ ISS ≤ 15, n (%)	14 (25.9)
> 15, n (%)	18 (33.3)
TPR (hour) (n = 51)	10 [4-28]
Abnormal Physical Examination Findings, n (%)	
Head & Neck	12 (22.2)
Respiratory	8 (14.8)
Cardiovascular	2 (3.7)
Abdomen	13 (24.1)
Genitourinary	5 (9.3)
Neurologic	17 (31.5)
Extremity	48 (88.9)
Crush Injury, n (%)	46 (85.2)
Lower Extremity	32/46 (69.6)
Upper Extremity	16/46 (34.8)
Crush Syndrome, n (%)	25 (46.3)
AKI (-)	6/25 (24)
AKI (+)	19/25 (76)
Outcome, n (%)	
PICU	28 (51.9)
Ward[c]	19 (35.2)
Discharged from PED	7 (13)
Hospitalization (days)[a]	20 [8.2-35.2]

Table 1. Clinical characteristics of children rescued from the rubble (Group 1)

Abbreviations: PTS, Pediatric Trauma Score; ISS, Injury Severity Score; ESI, Emergency Severity Index; TPR, time period under the rubble; AKI, acute kidney injury; PED, pediatric emergency department; PICU, pediatric intensive care unit.

[a] Median [IQR].

[b] Mean (SD).

[c] Hospitalization longer than 24 hours is defined as inpatient unit.

15.9%) related diseases were the most common PED presentations. The most common diagnoses were upper respiratory tract infections (n = 69; 37.9%), acute gastroenteritis (n = 23; 12.6%), simple physical trauma that occurred while running from the earthquake (n = 16; 8.8%), and lower respiratory tract infections (n = 13; 7.1%).

Children with Chronic Illnesses (Group 3)

Sixteen children with chronic illnesses presented to the PED with non-urgent causes because the hospitals in the field were dealing with disaster victims or were damaged. Mean age was 6.4 (IQR = 1.8-13.8) years, 62.5% of whom were the boys (n = 10). The children were referred to pediatric neurology (33.3%; n = 5), pediatric oncology (25%; n = 4), pediatric nephrology (18.8%; n = 3), pediatric gastroenterology (12.5%; n = 2), pediatric allergy (6.3%; n = 1), or pediatric cardiology (6.3%; n = 1).

Discussion

Emergency departments are a critical component of the health care system because they provide care for patients who have life-threatening or other conditions that require emergency medical treatment. Access to emergency care is more important than ever in the event of natural or man-made disasters, because the world has witnessed an increase in the number of disasters in recent years.[11] Unfortunately, children are most affected by natural and man-made disasters because of their physical and psychosocial vulnerability, the disruption of services essential for their development, high dependency on parents and other caregivers, and limited voice and representation. Therefore, pediatric needs should be considered in all the disaster plans.

This study reports the PED presentations of 252 children affected by the earthquake during the first 30 days following this devastating event. A total of 70.3% of the first group and 37.6% of all victims were admitted to the PED in the first seven days after the disaster. This disaster once again showed that PEDs should be prepared for earthquake victims, especially within the first week after the disaster, and that academic centers have important responsibilities before, after, and during disasters, even if they are far from the disaster area.

The wide-reaching impact of a major disaster had resulted in inadequate search and rescue operations, transportation for those affected, and limited capacity for hospitals and medical staff. Moreover, reaching victims within the first golden hours proved extremely challenging because of several factors, including health care workers in the region being earthquake victims themselves, extensive damage to access roads, and the destruction of certain hospitals within the area.

Previous studies have indicated significant differences in the characteristics of earthquake-related patient influx and types of injuries between areas near the epicenter and less affected regions. Wen, et al[12] reported that the number of patients in frontline hospitals peaked on the first day, whereas referrals to second-line hospitals peaked on the second day, and remained constant throughout the month. In the Marmara earthquake in 1999, it was observed that 93.2% of patients were admitted within the first seven days.[13] A similar trend was also observed in this study, where 72% (n = 37) of children in the first group and 37.6% (n = 93) of all victims were admitted to the PED within the first seven days after the disaster. This indicates a substantial increase in patient influx, particularly during the initial week after disasters, and highlights the importance of differentiating between hospital types as the PED must be adequately prepared to handle such a high volume of patients. It is possible that ambulances may fall short in transporting the large number of individuals requiring assistance to health care facilities or in transporting numerous patients over long distances. In this study, ambulance transportation was the most prevalent method, with 68.5% (n = 37) of patients rescued from the rubble were

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	n (%)
Crush Injury	46 (85.2)
Extremity Trauma	43 (79.6)
AKI	19 (35.2)
Spine/Pelvic Injury	13 (24)
Head Trauma	6 (11.1)
Abdominal Trauma	6 (11.1)
Social Issues[a]	3 (5.5)
Thorax Injury	2 (3.7)

Table 2. Reasons for Hospitalization in Children Rescued from the Rubble

Abbreviation: AKI, acute kidney injury.

[a] No guardian.

transported to the PED by ambulance. Similarly in the Wen, et al study, 56.0% of the patients were transported by ambulance, 13.8% by helicopters, and 11.9% by trucks.[12]

Damaged health facilities and the increasing need for health care professionals have given rise to a need for field hospitals and voluntary health workers. As noted in the Haiti earthquake, well-organized teams from different countries created differences in mass-casualty events.[14,15] A team consisting of pediatricians, orthopedics, plastics, pediatric surgeons, and experienced team leaders is crucial for medical/surgical management of pediatric mass-causality events.[15] Many providers want to help where destruction is most severe, but it is important to keep in mind that there will also be significant medical needs in non-disaster areas where large numbers of people are transported or relocated by their own means or ambulances.[16]

Trauma caused by collapsed buildings is the main cause of morbidity and mortality following earthquakes. The most common injury sites are the extremities and spine,[5] the most common of which is a long bone fracture in the lower extremities, as reported in previous studies after earthquakes. Peek-Asa, et al[17] reported that 53.6% of hospitalized patients had lower extremity injuries, and Bulut, et al[18] reported extremity injuries in 66.6% of patients after the 1999 Marmara earthquake. In this series, for children who were rescued from the rubble, extremity injuries were the most common parts of the injured body (78.8%), which is consistent with previous reports. The most important reason for hospitalization was trauma to the extremities. Therefore, providing sufficient medical facilities, personnel, and equipment to manage acute injuries is important in future earthquakes.

The need for medical treatment and causes of hospitalization after a disaster can change depending on the days after the earthquake, the distance to field hospitals or hospitals located in remote unaffected regions, the mean age of the affected population, and the type of disaster. In the first two-to-three days after the earthquake, the victims presented with injuries due to the collapse of most buildings to the field hospital, while secondary medical problems, such as infectious diseases and exacerbation of chronic diseases, were the main reasons for admission in the following days, as shown in the Düzce and Adapazarı earthquakes in Türkiye.[19]

Early and large-volume administration of intravenous fluids is crucial for the prevention and treatment of acute renal failure in individuals with crush injuries.[7] In this study, it is difficult to comment on the role of fluid management in the PED during the course of crush syndrome and AKI. The reasons for this include the fact that the patients had no medical records during transport/transfer to determine data for fluid administration.

Compartment syndromes and crush injuries are a spectrum of diseases that develop because of muscle compression.[20] Reducing intracompartmental pressure is the most important mechanism for compartment syndrome, and early fasciotomy is recommended if it is certainly indicated and effective in reducing intracompartmental pressure.[7] However, the higher risk of secondary infections is another controversial problem associated with fasciotomy.[21] It has been observed in this series, the risk of infection was higher in children who underwent procedures such as fasciotomy or amputation in the field (68% versus 31%; P = .009). The main problem for patients with crush injuries is the development of crush syndrome. Metabolic acidosis, hyperkalemia, myoglobinuria, and AKI are common metabolic complications.[20] Hyperkalemia and acidosis were not detected in the patients. However, in another study, hyperkalemia was detected in four of 15 children with crush syndrome.[22] This may be because most patients were transferred after their first intervention at a health institution.

In the present study, it was shown that longer TPRs were correlated with amputation and dialysis requirements. In the Marmara Earthquake, a longer extraction time was shown to be related to the number of extremities undergoing fasciotomy and requiring amputation.[13]

As a tertiary center away from the epicenter of disaster, the patients taken from the rubble had severe injuries (41.1% of patients had severe and profound injuries, ISS score more than 15). They did not have life-threatening injuries that had to be treated within hours, owing to the long transport time requirement, as reported in distant centers during other disasters.[23] The absence of mortality is important, as it shows that the survival rate will be high when children, most of whom die in the field, reach a pediatric center where they can receive good care.

Children with respiratory infections, which are the most common cause of PED presentations, have replaced trauma presentations after the first few days. After the earthquake, the medical needs shifted from the physical effects of direct trauma to the effects of earthquake-related environmental hazards.[24] The fact that the children in the second group were mostly in their infancy (mean age 12.42 [SD = 6.3] months) supports the hypothesis that young children are more easily affected by environmental and hygienic conditions. As reported in other studies, respiratory and gastrointestinal infections are the leading causes in PED.[23] Infections observed after disasters are usually caused by massive population displacement, environmental changes, disruption of the supply of safe drinking water and food, poor hygiene, and overcrowding.[25,26] Infection control measures should be implemented in disaster control plans, and rapid implementation of these measures may decrease the frequency of infectious diseases after disasters.

During this period, children with chronic illnesses were admitted to the PED for treatment and equipment. Children with disabilities are usually not involved in disaster planning, although they are at higher risk of disasters and have a lower chance of evacuation.[27,28] Special action should be taken for these children.

Strengths

The strength of this study is that the experiences with children exposed to disasters are shared, which raises awareness about incorporating lessons learned into policies and practices to reduce

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	RRT (-) (n = 40)	RRT (+) (n = 14)	*P Value*
Age (year)[a]	12.2 [8.3-16.1]	15.9 [10.8-17]	.77
TPR (hours)[b]	12 [2-33]	6 [5.5-7.5]	.145
PTS[a]	10 (SD = 2)	8 (SD = 2)	.041
ISS[a]	**8 (SD = 7)**	**24 (SD = 8)**	**<.001**
Hb(gr/dL)[a]	**10.8 [8.9-12.3]**	**8.4 [8.1-9.6]**	**.001**
Leucocyte(x10^3/μL)[b]	**9.4 [7.4-12.7]**	**14.3 [9-19.3]**	**.037**
Platelet(x10^3/μL)[b]	**333 [257-438]**	**140 [125-186]**	**<.001**
pH[a]	7.44 (SD = 0.5)	7.43 (SD = 0.4)	.468
Lactate (mmol/L)[a]	**1.27 (SD = 0.65)**	**0.96 (SD = 0.24)**	**.025**
CK (U/L)[b]	**1112 [260-10552]**	**17113 [4511-30492]**	**.001**
Myoglobulin (μg/L)[b]	**52 [31.9-463]**	**2972 [520-4105]**	**<.001**
Creatinine (mg/dL)[b]	**0.36 [0.28-0.46]**	**3.55 [1.65-4.34]**	**<.001**
K (mEq/L)[a]	4.19 (SD = 0.45)	4.09 (SD = 0.7)	.617
Na(mEq/L)[a]	136 (SD = 3.6)	135 (SD = 4.9)	.617
AST (U/L)[b]	**76 [35-299]**	**398 [139-673]**	**.008**
ALT (U/L)[b]	68 [43-160]	127 [39-253]	.422
APTT (sec)[b]	24.1 [21.8-26]	23.7 [22.2-29.4]	.386
INR[a]	1.16 (SD = 0.43)	1.18 (SD = 0.19)	.053
Fibrinogen(mg/dL)[a]	425 [331-454]	452 [331-545]	.697
D-Dimer (mg/L)[b]	2.20 [1.08-3,68]	7.48 [3.77-35]	**<.001**
LOS (day)[b]	**15 [4-29]**	**30.5 [24-40]**	**.003**

Table 3. Comparison of Clinical and Laboratory Characteristics in Children Needing Hemodialysis
Abbreviations: RRT, patients who required dialysis; TPR, time period under rubble; PTS, Pediatric Trauma Score; ISS Injury Severity Score; LOS, length of stay,
[a] Mean (SD).
[b] Median [IQR].

	Number of Affected Extremities				
Complications, n (%)	**0**	**1**	**2**	**3**	***P Value***
Crush Syndrome (n = 25)	2 (8)	14 (56)	7 (28)	2 (8)	***.009***
AKI (n = 19)	2 (10.5)	11 (58)	5 (26.3)	2 (5.2)	*.287*
Infectious Complications (n = 25)	4 (8)	14 (56)	6 (24)	1 (4)	*.499*
Thromboembolic Complications (n = 5)	–	4 (75)	–	1 (25)	*.082*
Psychologic Complications (n = 26)	3 (11.5)	15 (57.7)	6 (23)	2 (7.8)	***.016***

Table 4. Number of Crushed Extremities and Complications
Abbreviation: AKI, acute kidney injury.

the effects of future disasters on children. From this disaster, the following lessons were learned:

- Children have better survival and morbidity rates when they receive appropriate care.
- Electronic or written recording systems must be used.
- Teams working in the field must be experienced with children from field triage to patient transport and communication.
- The needs of the teams going to the region must be determined, and sufficient medical equipment and personnel support should be provided.
- Pediatric emergency physicians and intensivists must play the role of leaders during such huge disasters. And,
- The transportation of patients from the affected area must be carefully planned.

Limitations

This study has several limitations. The most significant limitations of the study were that it was conducted at a single center and the information was collected retrospectively. Additionally, the inclusion of only patients who came to the hospital from the disaster area resulted in selection bias. And some patients did not have sufficient medical records, including medical treatment at the field, field hospital, and during transportation. The lack of knowledge about intravenous fluid administered before transportation makes it difficult to interpret the effects of fluid administration on the development of AKI.

Conclusion

This study reveals that health centers should be prepared to respond to large numbers of critically ill children during a disaster,

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Case Number	Age	Department	Length of Stay	Hospitalization Indication	Reason for Presenting
1	7 days	Ward	1 day	Indirect hyperbilirubinemia	Damaged hospital
2	4 days	Ward	1 day	Indirect hyperbilirubinemia	Relocation
3	10 days	Ward	10 days	Neonatal sepsis	Poor hygienic accommodation
4	20 months	Emergency Service	1 day	β-blocker intoxication	Inappropriate accommodation problem
5	3 months	ICU	43 days	Congenital heart disease and pneumonia	Transferred because of damaged hospital
6	46 months	Ward	4 days	Extremity fracture before the earthquake	No hospital in the area
7	151 months	ICU	8 days	Chronic kidney disease and hemodialysis	Hemodialysis program was interrupted due to relocation

Table 5. Reasons for Admission to the Hospital for the Second Group of Patients
Abbreviation: ICU, intensive care unit.

even if they are far from the affected area. In the early days, common problems were crush injuries, crush syndromes, and AKI. However, centers should also be prepared for patients affected by the environmental conditions created by the disaster, as well as patients in need of medical treatment due to chronic illnesses. The most crucial thing in the management of these patients was multidisciplinary teamwork. And a comprehensive disaster plan specific to children that can serve all these patient groups is needed to ensure rapid response and appropriate coordination of disaster management.

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