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Silent threat: The deadly face of acute respiratory symptoms in earthquake survivors

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Abstract:

OBJECTIVE: This study aims to evaluate the underlying causes and clinical outcomes of acute respiratory symptoms in critically ill pediatric patients who survived the February 6, 2023, earthquake and were admitted to the pediatric intensive care unit (PICU) of a designated disaster hospital.

METHODS: This retrospective, longitudinal observational study included pediatric patients aged 1 month to 18 years admitted to the PICU of Mersin City Training and Research Hospital due to respiratory symptoms following the earthquake. Clinical, radiological, and laboratory data and treatment outcomes were analyzed. Ethics committee approval was obtained from the Toros University. Group comparisons were made between patients with and without respiratory involvement. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated for key associations.

RESULTS: Of 140 children, 48 (34.3%) had respiratory involvement (mean age: 10.2 ± 5.2 years, 54.2% of males, and 67% admitted within 72 h). Major etiologies were chest trauma (41.7%), acute kidney injury-related pulmonary edema (14.6%), combined chest trauma + acute kidney injury (27.1%), and neurological causes (10.4%); infections (4.2%) and allergic reactions (2.1%) were less common. Respiratory support was needed in 19 (39.6%) patients. Respiratory involvement correlated with multisystem trauma (63% vs. 11%, $P < 0.001$), chest trauma (69% vs. 0%, $P < 0.001$), and acute kidney injury (50% vs. 32%, $P = 0.048$). PICU stay was longer (2.9 ± 2.2 vs. 2.2 ± 1.4 days, $P = 0.014$), while mortality was low (2% vs. 0%, $P = 0.740$). In multivariable analysis, acute kidney injury (OR: 5.2, 95% CI: 2.0–13.1, $P < 0.001$) and central nervous system injury (OR: 3.1, 95% CI: 1.2–8.0, $P = 0.018$) independently predicted respiratory involvement.

CONCLUSION: In pediatric earthquake survivors, respiratory symptoms often indicate multisystem involvement. Beyond chest trauma, acute kidney injury and neurological causes are major contributors to respiratory compromise. A comprehensive, integrative approach is essential for timely diagnosis and intervention.

Keywords:

Acute kidney injury, chest trauma, disaster medicine, earthquake, pediatric intensive care, respiratory failure

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Introduction

Earthquakes have historically caused significant loss of life and infrastructure. One of the most devastating events occurred on February 6, 2023, at 04:17 a.m., affecting 11 provinces in Türkiye and resulting in 50,783 deaths. Although the number of child fatalities remains unknown, approximately 4.5 million children resided in the affected regions, highlighting the vulnerability of the pediatric population. Earthquake-related

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Box-ED section

What is already known on the study topic?

- Pediatric earthquake survivors often suffer multisystem trauma
- Respiratory distress is usually linked to chest trauma but may reflect systemic causes.

What is the conflict on the issue? Has it importance for readers?

- The underlying causes of acute respiratory symptoms in pediatric earthquake victims are multifactorial and underexplored
- Distinguishing between pulmonary and systemic contributors is crucial
- Recognizing these hidden factors may change triage and early intervention strategies in disaster medicine.

How is this study structured?

- Single-center, retrospective, observational study conducted in a designated disaster hospital
- Included 140 pediatric earthquake survivors, focusing on those with respiratory involvement.

What does this study tell us?

- Respiratory distress in earthquake survivors is often linked to multisystem involvement not only chest trauma.
- Acute kidney injury and Central nervous system injury are independent risk factors for respiratory symptoms.
- One-dimensional clinical interpretations focusing only on pulmonary findings may lead to fatal outcomes.
- Early recognition of these systemic contributors may improve triage, management, and outcomes in disaster settings.

trauma can impact multiple systems, with respiratory symptoms being particularly prominent.[1] Chest trauma may lead to lung contusion and hemopneumothorax, manifesting as dyspnea and tachypnea. Crush injuries can result in acute kidney injury (AKI), causing pulmonary edema and acute respiratory distress syndrome (ARDS). Head trauma may induce respiratory irregularities due to increased intracranial pressure. In addition, factors such as dust exposure, infections, pain, and psychological stress may act both as primary causes of respiratory symptoms and as exacerbating elements that worsen preexisting respiratory condition.[2-13] Life-threatening conditions such as tension pneumothorax or AKI-induced pulmonary edema require rapid recognition and intervention. These priorities are also reflected in the Sphere humanitarian standards, which underscore that disaster response must ensure the early recognition and management of life-threatening conditions.[14] While previous studies have addressed trauma patterns, infection-related respiratory conditions, and long-term outcomes, the complex and overlapping causes of acute respiratory symptoms in earthquake-affected children remain underexplored.[11,15-20] In our disaster-designated hospital, critically ill pediatric earthquake survivors were admitted to the pediatric intensive care unit (PICU) immediately after rescue. This study aims to present the respiratory findings in these patients and emphasize their diagnostic, triage, and prognostic importance. We hypothesize that these acute respiratory symptoms are not merely the result of isolated pulmonary pathology, but more often occur in the context of multisystem trauma – particularly in association with severe conditions such as AKI and central nervous system (CNS) injury. To our knowledge, this is the first study to highlight the diverse and potentially fatal causes of respiratory symptoms in pediatric earthquake victims.

Methods

Study design and setting

This retrospective, longitudinal observational study was conducted in the PICU of Mersin City Training and Research Hospital, which was designated as a disaster hospital following the earthquake that struck Pazarcık, Türkiye, on February 6, 2023. The PICU serves as a tertiary referral unit and was actively involved in the emergency response, receiving critically ill children rescued from affected regions.

Selection of participants

We included pediatric earthquake survivors aged 1 month to 18 years who were admitted to the PICU between February 6 and March 6, 2023, with clinical and/or radiological signs of respiratory system involvement. Patients with incomplete medical records were excluded. Clinical records were reviewed retrospectively to identify eligible patients. The inclusion criteria were: (1) direct exposure to the earthquake, (2) admission to the PICU due to respiratory symptoms, and (3) availability of complete medical records.

Sample size estimation

As this was a retrospective observational study based on a natural disaster, a formal *a priori* sample size calculation was not feasible. All eligible patients admitted during the study period were included.

Interventions

This was an observational study; no investigational interventions were applied. Treatment was delivered per institutional and national disaster-response protocols. Mechanical ventilation (MV) and noninvasive MV, fluid therapy, and renal replacement therapy were administered as needed. No randomization or blinding was used.

Methods and measurements

Data were extracted from the hospital's electronic medical records by the investigators using a structured data abstraction form. Collected data included demographic characteristics, admission timing, respiratory symptoms, radiological findings (e.g., air leak syndromes, contusions, and ARDS), etiologies (e.g., chest trauma, AKI, and CNS trauma), and need for respiratory or cardiovascular support. Laboratory parameters included renal function, muscle breakdown markers, and inflammatory markers. Data were verified through cross-checking by two independent researchers.

Outcomes

The primary outcome was the presence and underlying etiology of respiratory symptoms. Secondary outcomes included the need for respiratory support (invasive or noninvasive), length of PICU stay, and inhospital mortality. Clinical outcomes were compared between patients with and without respiratory system involvement.

Potential confounders and sources of bias

Given the retrospective design and the emergency context of a mass-casualty disaster, several potential confounders and biases were considered. Confounding variables such as age, sex, timing of admission (within or after 72 h postearthquake), and presence of multisystem trauma or comorbidities may have influenced the associations between respiratory involvement and clinical outcomes. Selection bias could have occurred if patients with milder symptoms were managed in non-PICU settings, thereby overrepresenting more severe cases in our cohort. Information bias was possible due to incomplete documentation during the acute disaster phase; this was mitigated by excluding cases with missing key medical data and by cross-checking all extracted information by two independent investigators. No imputation was performed for missing values.

Statistical analysis

Data analysis was performed using SPSS version 21.0 (IBM Corp., Chicago, IL, USA). The normality of continuous variables was assessed using the Shapiro–Wilk test and further inspected visually by histograms and Q–Q plots. Normally distributed variables were expressed as mean ± standard deviation (SD), while nonnormally distributed variables were presented as median (interquartile range [IQR]). Categorical variables were compared using the Chi-square or Fisher's exact test, as appropriate. Continuous variables were compared using the Student's *t*-test or the Mann–Whitney *U*-test, depending on data distribution. To account for multiple comparisons, the Bonferroni correction was applied where appropriate. Variables with $P < 0.10$ in univariate analyses were entered into a multivariate logistic regression model to identify independent predictors of respiratory involvement, with results reported as odds ratios (ORs) and 95% confidence intervals (CIs). Effect sizes and 95% CIs were calculated for relevant comparisons, in line with Strengthening the Reporting of Observational Studies in Epidemiology guidelines. Multicollinearity was checked using the variance inflation factor, and model fit was assessed by the Hosmer–Lemeshow test and Nagelkerke's R^2. Missing data were handled by listwise deletion; no variable had more than 11.1% missing values, and sensitivity analyses confirmed that missingness did not affect the results. A two-tailed $P < 0.05$ was considered statistically significant.

Results

Of the 140 pediatric earthquake victims admitted to the PICU, 48 (34.3%) presented with clinical and/or radiological respiratory system involvement. The flow of participants through the study is shown in Figure 1. The mean age of these patients was 10.2 ± 5.2 years, and 54.2% were male. Two-thirds (67%) were admitted within the first 72 h after the earthquake. The leading etiologies of respiratory symptoms were chest trauma (41.7%; 95% CI: 28.8–55.7), AKI-related pulmonary edema (14.6%; 95% CI: 6.5–27.8), and the combination of both (27.1%; 95% CI: 16.1–41.0). Less frequent causes included neurological conditions (10.4%), infections (4.2%), and allergic reactions (2.1%).

Radiological findings in the respiratory group most commonly included lung contusion (52.1%), air leak syndromes (25.0%), pleural effusion (27.1%), and atelectasis (16.7%). The most common clinical symptom was tachypnea (89.6%). Nineteen (39.6%) patients with respiratory involvement required

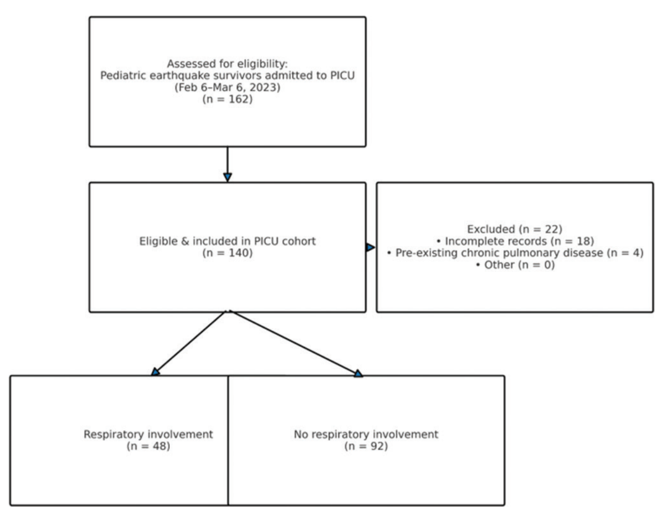

Figure 1: Participant flow diagram for the pediatric intensive care unit earthquake cohort

respiratory support: 11 (22.9%) invasive MV – mainly for AKI-related pulmonary edema (*n* = 6) and neurological compromise (*n* = 5), and 8 (16.7%) noninvasive ventilation, primarily for pulmonary edema (*n* = 5) and lung contusion (*n* = 2). Patients' demographics and characteristics are summarized in Table 1.

Patients with respiratory involvement had a significantly higher rate of multiple trauma (63% vs. 11%, $P < 0.001$), while those without respiratory involvement more frequently presented with isolated trauma (79% vs. 33%, $P < 0.001$). Chest trauma was strongly associated with respiratory involvement (69% vs. 0%, $P < 0.001$). Cranial trauma (29% vs. 14%, $P = 0.056$) and spinal trauma (13% vs. 3%, $P = 0.08$) showed borderline associations. AKI was more common in patients with respiratory involvement (50% vs. 32%, $P = 0.048$). AKI was significantly more frequent in patients with crush syndrome compared to those without (41% vs. 7%, OR = 9.1, $P = 0.027$), confirming that crush syndrome is a strong risk factor for renal injury. The median length of stay in the PICU was also longer in this group (2.9 ± 2.2 vs. 2.2 ± 1.4 days, $P = 0.014$). Mortality was rare and did not differ significantly between the groups (2% vs. 0%, $P = 0.74$). The comparative analysis of groups has been detailed in Table 2.

Table 1: Clinical characteristics and respiratory etiologies in pediatric earthquake survivors

Parameter	*n* (%)/mean±SD
Patient number	48
Age (years)	10.2±5.2
Gender (male/female)	26 (54)/22 (46)
Admission within 72 h	32 (67)
Admission after 72 h	16 (33)
Causes of respiratory symptoms	
Chest trauma	20 (42)
AKI-related pulmonary edema	7 (15)
Combination of chest trauma + AKI	13 (27)
Neurological causes	5 (10)
Infection	2 (4)
Allergic reaction	1 (2)
Radiological findings	
Lung contusion	25 (52)
Air leak syndrome	12 (25)
Pneumothorax	8 (17)
Pneumomediastinum	6 (13)
Subcutaneous emphysema	4 (8)
Pleural effusion	13 (27)
Atelectasis	8 (17)
Ground-glass opacity	7 (15)
Concomitant traumas	
Orthopedic trauma	36 (75)
Chest trauma	33 (69)
Craniospinal trauma	17 (35)
Intra-abdominal injury	5 (10)
Crush syndrome	36 (75)
Fasciotomy (among crush cases)	25 (66)
Respiratory support	
Required respiratory support	19 (35)
Mechanical ventilation	11 (23)
AKI-related pulmonary edema	6 (13)
Neurological causes	5 (10)
Mean MV duration (days)	5.7±3.2
Noninvasive ventilation	8 (17)
AKI-related pulmonary edema	5 (10)
Lung contusion	2 (4)
Infection	1 (2)
Mean NIMV duration (days)	5.3±2.1
Outcomes	
Mean PICU stay (days)	2.9±2.2
Mortality	1 (2)

SD: Standard deviation, AKI: Acute kidney injury, h: hour, MV: Mechanical ventilation, NIMV: Noninvasive mechanical ventilation, PICU: Pediatric intensive care unit

Among patients with AKI (*n* = 53), 45.3% also had respiratory symptoms; of these, 29.2% were attributed solely to AKI-related pulmonary edema, 54.2% to combined chest trauma and AKI, and 16.6% to other causes. In the univariate analysis, cranial trauma ($P = 0.056$) and spinal trauma ($P = 0.08$) did not individually reach statistical significance, whereas AKI showed a borderline association ($P = 0.048$). However, when cranial and spinal injuries were combined into a single category of CNS injury, a stronger association emerged. In the multivariable logistic regression model, both AKI and CNS injury were identified as independent risk factors for respiratory involvement. AKI was associated with a more than fivefold increase in the odds of respiratory symptoms (OR: 5.2, 95% CI: 2.0–13.1, $P < 0.001$), while CNS injury conferred a threefold increase (OR: 3.1, 95% CI: 1.2–8.0, $P = 0.018$). In contrast, age and sex were not significantly associated with respiratory symptoms in either univariate or multivariable analyses.

At PICU admission, laboratory parameters with nonnormal distribution (renal and muscle injury markers, electrolytes, C-reactive protein, and lactate dehydrogenase) were expressed as median (IQR) values, while hematological and coagulation parameters with approximately normal distribution were expressed as mean ± SD. Patients with respiratory symptoms had higher blood urea nitrogen, creatinine, potassium, phosphorus, alkaline phosphatase, and muscle injury markers (creatine kinase and aspartate Aminotransferase), while calcium levels were lower. Laboratory parameters of the groups at PICU admission are listed in Table 3.

Discussion

The postearthquake emergency medical rescue and intensive care process is not limited to initial interventions but rather represents a multilayered

Table 2: Comparison of patients with versus without respiratory involvement

	With respiratory involvement, *n* (%)	Without respiratory involvement, *n* (%)	*P*
Age (mean±SD)	10.2±5.2	10.1±4.5	0.910
Gender (female/male)	22/26	44/48	0.963
Admission of PICU			
Within 72 h of the earthquake	32 (67)	67 (73)	0.572
After 72 h of the earthquake	16 (33)	25 (27)	0.550
Number of trauma			
Only one trauma	16 (33)	73 (79)	<0.001
Multiple trauma	30 (63)	10 (11)	<0.001
Type of trauma			
CNS injury (cranial or spinal)	19 (40)	15 (16)	0.004
Cranial	14 (29)	13 (14)	0.056
Spinal	6 (13)	3 (3)	0.080
Chest	33 (69)	0	<0.001
Abdominal	5 (10)	3 (3)	0.178
Orthopedic	36 (75)	76 (83)	0.398
Acute kidney failure	24 (50)	29 (32)	0.050
Length of stay in the PICU (mean±SD)	2.9±2.2	2.2±1.4	0.049
Outcome			
Discharged	24 (50)	40 (43)	0.578
Transfer	23 (48)	52 (57)	0.429
Mortality	1 (2)	0	0.740

PICU: Pediatric intensive care unit, CNS: Central nervous system, SD: Standard deviation, h: hour

Table 3: Laboratory parameters of pediatric earthquake survivors with and without respiratory involvement at pediatric intensive care unit admission

Parameters	With respiratory involvement, mean±SD	Without respiratory involvement, mean±SD	*P*
WBC count (4–10×10^3/uL)	16,010±8418.0	16,913.0±8927.0	0.068
Hemoglobin (9–14 g/dL)	11.7±3.3	11.9±3.24	0.079
Platelet (150–450×10^3/uL)	267,891.0±117,603.0	286,000.0±134,493.0	0.062
ANC (2000–6000 uL)	13,700.0±12,337.0	14,053.0±10,986.0	0.084
ALC (1500–3500 uL)	1987.0±1414.0	2002.0±1525.0	0.092
CRP (0–0.5 mg/dL)*	9.1 (3.0–14.0)	7.7 (2.5–12.5)	0.120
BUN (5–8 mg/dL)*	40 (15–65)	27 (10–45)	0.041
Creatinine (0.2–0.7 mg/dL)*	1.4 (0.4–2.4)	1.1 (0.3–1.9)	0.030
Na (132–146 mmol/L)	134.1±5.11	135.4±5.4	0.211
K (3.5–5 mmol/L)	5.2±1.4	4.7±1.1	0.045
Ca (8.5–10.5 g/dL)	7.51±1.29	7.93±0.95	0.048
P (2.4–5.1 mg/dL)	5.73±2.69	5.32±2.45	0.031
ALP (10–49 u/L)	151.4±51.0	127.3±82.4	0.046
Albumin (3.4–4.8 g/dL)	3.0±0.54	3.0±0.66	0.950
Creatine kinase (0–200 U/L)*	40267 (100–100,000)	34835 (150–95,000)	0.041
Aspartate transaminase (<40 U/L)*	813 (100–1500)	689 (90–1400)	0.045
Alanine transaminase (<49 U/L)*	379 (65–700)	291 (50–600)	0.043
Lactate dehydrogenase (120–246 U/L)*	3264 (125–9500)	6236 (220–12,000)	0.210
Troponin I (0–47 ng/L)*	1389 (0–3000)	2635 (500–4500)	0.221
Myoglobin (0–110 ng/mL)*	4703 (50–8000)	14,044 (55–30,000)	0.375
Ck–MB (0–5 ng/mL)*	244 (0–600)	197 (0–500)	0.290
aPTT (22–35 s)	27.5±10.3	29.3±20.2	0.413
PT (10.5–14.5 s)	15.2±2.7	15.6±3.6	0.530
INR (0.8–1.2)	1.29±0.28	1.32±0.74	0.770
Fibrinogen (180–350 mg/dL)	445.8±161.0	425.4±136.3	0.584

*Variables with nonnormal distribution are presented as median (IQR). PICU: Pediatric intensive care unit, SD: Standard deviation, WBC: White blood cell, ANC: Absolute neutrophil count, ALC: Absolute lymphocyte count, CRP: C-reactive protein, BUN: Blood urea nitrogen, Na: Sodium, K: Potassium, Ca: Calcium, P: Phosphorus, ALP: Alkaline phosphatase, aPTT: Activated partial thromboplastin time, PT: Prothrombin time, INR: International normalized ratio, LDH: Lactate dehydrogenase, CK: Creatine kinase, Ck-MB: Creatine kinase – MB Isoenzyme, IQR: Interquartile range

and continuously evolving course. Individuals who survive the initial impact of an earthquake remain at risk for life-threatening complications in the subsequent hours and days. This underscores the importance of both structural organization and the transfer of clinical expertise. As the PICU team of a designated disaster hospital, our most critical observation was that respiratory symptoms in earthquake survivors must be addressed with a comprehensive, multisystem-oriented approach. Even seemingly minor respiratory complaints may indicate serious underlying pathologies involving the renal, neurological, or other organ systems. Existing literature has largely focused on chest trauma, infectious respiratory diseases, and long-term pulmonary sequelae. However, the diverse etiologies of respiratory symptoms that emerge in the acute phase, and their crucial role in early diagnosis and management, have not been sufficiently addressed to date.[2,11,15,16,21] To the best of our knowledge, this study is the first relevant article that highlights the differential diagnosis, triage, and vital significance of respiratory symptoms.

According to current literature, chest trauma – particularly when combined with multiple injuries – is considered one of the most important determinants of mortality and morbidity in earthquake-related injuries.[2,3,22-24] Our study supports these findings, but also provides new clinical insights into the complex interactions underlying respiratory symptoms.

The key findings of our study can be summarized as follows: (i) respiratory involvement was detected in approximately one-third of pediatric earthquake survivors admitted to the PICU, with most cases occurring within the first 72 h. This underscores the critical importance of early recognition and urgent intervention during the acute phase. (ii) Etiological analyses revealed chest trauma, pulmonary edema secondary to AKI, and the coexistence of these conditions as the most common causes; less frequent etiologies included neurological complications, infections, and allergic reactions. This distribution suggests that respiratory symptoms are not merely isolated pulmonary pathologies but may serve as early warning signs of systemic compromise. Indeed, multisystem trauma, AKI, and CNS injury were significantly more frequent among patients with respiratory involvement. Furthermore, multivariable logistic regression identified CNS injury (OR: 3.1) and AKI (OR: 5.2) as independent risk factors for respiratory symptoms, underscoring the strong association between respiratory compromise and systemic involvement. (iii) No patient required intubation solely due to chest trauma; rather, the need for intubation and MV was primarily linked to pulmonary complications secondary to AKI or neurological compromise. This finding highlights that respiratory failure cannot be explained by trauma alone, but often reflects underlying systemic pathologies. (iv) Notably, only half of the patients with AKI exhibited respiratory symptoms, and in most of these cases, symptoms were not attributable to AKI alone but to coexisting chest trauma or other systemic injuries. This emphasizes that respiratory involvement should not be considered a one-dimensional phenomenon but rather a marker of multisystem interaction. (v) Crush syndrome was identified as an independent and strong risk factor for AKI, increasing the likelihood of renal injury nearly ninefold compared to patients without crush injury. However, no direct association was found between crush syndrome and respiratory symptoms, suggesting that its impact is primarily mediated through renal involvement. Therefore, children with crush syndrome should be closely monitored for AKI and managed proactively in the early phase. (vi) Patients with respiratory symptoms had significantly longer PICU stays compared with those without. This prolongation likely reflects the additional burden of AKI and CNS injury, underscoring the need for early AKI screening, thorough neurological evaluation, and proactive fluid–electrolyte and ventilatory management in clinical practice. (vii) Although no statistically significant difference in mortality was found, the only patient who died had concurrent AKI and chest trauma, highlighting the prognostic risk posed by this combination. (viii) At PICU admission, patients with respiratory symptoms had significantly higher renal function markers and muscle enzymes and lower calcium levels. These biochemical findings further support the notion that respiratory symptoms are closely linked to systemic involvement.

All these findings demonstrate that respiratory symptoms cannot be explained as a one-dimensional pathology; rather, they represent a strong indicator of systemic involvement. This multidimensional nature is strikingly illustrated by a dramatic case from our cohort: A child who developed pneumothora × 12 h after the earthquake underwent chest tube insertion and was subsequently intubated due to worsening respiratory distress. Initially, the clinical picture was attributed solely to chest trauma; however, the patient had underlying AKI with severe pulmonary edema and profound hyperkalemia ($K = 9$), which culminated in sudden cardiac arrest despite intensive interventions. This case clearly underscores how one-dimensional clinical interpretations may lead to fatal outcomes.

It must be emphasized that unless the underlying causes are promptly identified and adequately managed, the clinical course can rapidly deteriorate into irreversible and potentially fatal outcomes. Hemothorax or pneumothorax following chest trauma, pulmonary edema, and electrolyte imbalances secondary to AKI, or an acute asthma attack manifesting as the "silent lung" phenomenon, may rapidly progress to life-threatening conditions. Similarly, neurological complications such as cerebral edema, intracranial hemorrhage, or status epilepticus may impair the respiratory centers, leading to apnea, bradypnea, and irregular breathing patterns. Therefore, in disaster settings, respiratory symptoms should not be regarded merely as isolated pulmonary pathology, but rather as early manifestations of complex, life-threatening systemic processes. It is crucial to emphasize that delayed recognition or inadequate management of the underlying causes may lead to a rapid progression toward irreversible and fatal outcomes.[25-30]

As the health cluster lead for global emergencies, the World Health Organization emphasizes that in health facilities, not only physical resilience but also the strengthening of multidisciplinary clinical management capacity and the comprehensive assessment of findings during early triage are of critical importance.[31] Our study supports this approach by demonstrating that respiratory symptoms in children after earthquakes cannot be explained solely by chest trauma and highlights the vital importance of comprehensive evaluation. Furthermore, our findings support the Sphere humanitarian standards, which emphasize the early recognition and management of life-threatening conditions in disaster setting.[14]

Strengths and limitations

Our study has several noteworthy strengths. To the best of our knowledge, this is the first series focusing specifically on acute respiratory symptoms in pediatric earthquake survivors, thereby filling an important gap in the disaster medicine literature. Furthermore, our findings demonstrate that respiratory symptoms reflect not merely isolated pulmonary pathology but rather multisystem trauma – particularly AKI and CNS injury. Notably, our multivariate logistic regression analysis identified AKI and CNS injury as independent risk factors, which strengthens the reliability of our results and reinforces their clinical significance. An additional strength is that the study was conducted in the PICU of a designated disaster hospital, where critically ill pediatric patients with complex, multisystem involvement were systematically evaluated. Finally, the systematic integration of clinical, radiological, and laboratory data enhances the internal validity of the study and provides concrete implications for triage and intensive care management in disaster settings.

Nevertheless, this study has several limitations. First, its retrospective and single-center design restricts the generalizability of the findings. The relatively small sample size, particularly within subgroups, may have limited the power of certain statistical analyses. In addition, the study focused exclusively on acute-phase outcomes and therefore does not provide information on long-term respiratory sequelae. Importantly, several types of bias inherent to retrospective studies should be acknowledged. Selection bias may have occurred, as only patients admitted to the PICU were included, potentially excluding less severe cases and thereby limiting external validity. Misclassification bias is also possible, since respiratory involvement was determined based on available documentation, which may not have fully captured the clinical spectrum. Finally, documentation bias should be considered, given that emergency conditions and high patient load may have led to incomplete or inconsistent recording of clinical and laboratory data. Despite these limitations, the study provides important and novel insights into the complex interplay between respiratory symptoms, AKI, and CNS injury in pediatric earthquake survivors.

Clinical implications

The findings of this study provide several practical insights for the management of pediatric patients in disaster settings:

- Multisystem approach in triage: In the evaluation of children presenting with respiratory distress, focusing solely on pulmonary findings is misleading and inadequate; renal and neurological assessments should be routinely incorporated into triage algorithms
- Early detection of AKI: Simple and accessible methods such as hourly urine output monitoring, early serum creatinine and potassium measurement, and arterial blood gas analysis should be routinely used for the early recognition of AKI. Children with crush syndrome are at particularly high risk for AKI and therefore require close monitoring and early intervention
- Protocol development: Disaster-specific PICU protocols should integrate respiratory, renal, and neurological assessment, and a multidisciplinary approach involving intensivists, nephrologists, neurologists, and trauma specialists should be standardized
- Field applications: Standardized triage protocols should be incorporated into disaster drills, and healthcare providers should be trained in these protocols and reinforced through regular exercises. This approach will improve preparedness, optimize resource utilization, and enhance survival in mass-casualty scenarios.

Conclusion

In the acute postearthquake phase, respiratory manifestations may arise from diverse etiologies and can rapidly become life-threatening. Focusing solely on chest trauma risks neglecting potential AKI or CNS involvement. Therefore, even mild symptoms warrant thorough evaluation. Incorporating routine renal and neurological assessments into postearthquake triage may facilitate early identification of high-risk patients and improve clinical outcomes.

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Author contribution statement

- BK: Conceptualization (lead), investigation (lead), writing – original draft (lead), writing – review and editing (equal), and formal analysis (lead)
- ÖKÇ: Writing – review and editing (equal) and methodology (supporting)
- MT: Data curation, resources, and writing – review and editing
- İK: Data curation and writing – review and editing
- ÜK: Supervision, project administration, and writing – review and editing.

Conflicts of interest
None Declared.

Ethics approval
Ethical approval was obtained from the Ethics Committee of Toros University (Approval No.: 2023/0142, Date: March 10, 2023).

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