The Intercontinental Journal of Emergency Medicine

Original Article

DOI: 10.51271/ICJEM-0080

Temporal and regional patterns of aeromedical evacuation after the 6 February 2023 Kahramanmaraş earthquakes

Emrah Arı*[1], Eray Çınar[2], Eren Usul[3], Şükrü Yorulmaz[4], Kerem Dost Bilmez[5]

[1]Department of Emergency Medicine, Mamak State Hospital, Ankara, Turkiye
[2]Department of Thoracic Surgery, Ankara Bilkent City Hospital, Ankara, Turkiye
[3]Department of Emergency Medicine, Ankara Etlik City Hospital, Ankara, Turkiye
[4]Department of Emergency Medicine, Ankara Training and Research Hospital, University of Health Sciences, Ankara, Turkiye
[5]Department of 112 Emergency Health Services, Ministry of Health, Ankara, Turkiye

Cite this article: Arı E, Çınar E, Usul E, Yorulmaz Ş, Dost Bilmez K. Temporal and regional patterns of aeromedical evacuation after the 6 February 2023 Kahramanmaraş earthquakes. *Intercont J Emerg Med*. 2026;4(3):53-58. doi:10.51271/ICJEM-0080

***Corresponding Author:** Emrah Arı, dremrahari25@gmail.com

Received: 16/04/2026 ◆ **Accepted**: 03/07/2026 ◆ **Published**: 19/09/2026

ABSTRACT

Aims: To assess the demographic and clinical profiles of earthquake survivors airlifted after the 6 February 2023 Kahramanmaraş earthquakes and to examine the temporal and regional patterns of aeromedical transfers in the initial 20 days post-disaster

Methods: This descriptive retrospective study analyzed data from the Emergency Health Automation System (EHAS) concerning patients evacuated by fixed-wing and helicopter air ambulances following the 6 February 2023 Kahramanmaraş earthquakes. Descriptive statistics were used to evaluate demographic characteristics, transfer indications, air ambulance type, referring and receiving provinces, and the daily distribution of transfers.

Results: Fixed-wing air ambulances accounted for 2.248 transfers, while helicopters accounted for 333. Adults (≥18 years) comprised 69.4% of fixed-wing and 62.8% of helicopter transfers, with a comparable gender distribution. Transfers during the early post-earthquake phase were predominantly related to severe trauma, including crush injuries and surgical emergencies, whereas non-traumatic conditions—particularly cardiovascular, neurological, and infectious diagnoses—became more prominent in subsequent days. Most fixed-wing transfers originated from Kahramanmaraş, Adıyaman, and Adana, with receiving centers concentrated in Ankara and İstanbul. Helicopter retrievals were initially clustered in Kahramanmaraş before shifting to Hatay, while Adana emerged as the most frequent destination. Overall, transfer patterns reflected a temporal shift from acute trauma evacuation to broader medical referral needs.

Conclusion: Aeromedical evacuations were shaped by evolving clinical priorities and constraints in regional healthcare capacity. The coordinated use of fixed-wing and helicopter platforms enabled rapid patient redistribution, underscoring the importance of flexible transfer planning and integrated command structures in large-scale disasters.

Keywords: Earthquake, aeromedical evacuation, mass casualty incident, disaster response, emergency medical services

INTRODUCTION

Because of its geology and tectonics, Turkiye is among the countries most prone to natural disasters, with earthquakes, floods, landslides, and avalanches occurring frequently across the country.[1] National awareness and institutional ability in disaster management have continuously evolved, particularly following the 1999 Gölcük and 2011 Van earthquakes. The twin earthquakes that struck Kahramanmaraş on 6 February 2023, with epicenters in Pazarcık (Mw 7.7) and Elbistan (Mw 7.6), affected 11 provinces (Kahramanmaraş, Hatay, Adıyaman, Malatya, Gaziantep, Kilis, Osmaniye, Adana, Diyarbakır, Şanlıurfa, and Elazığ) and further underscored the necessity of risk-based approaches in disaster preparedness and response.[1]

Large-scale disasters generate a sudden surge in medical need that can rapidly exceed the capacity of the healthcare system, increasing morbidity and mortality when treatment is delayed.[2] Following an earthquake, damage to healthcare facilities and disruption of ground transportation routes typically necessitate the rapid relocation of patients to less-affected areas. In disaster scenarios, the prehospital phase may be prolonged due to security concerns, restricted access, and triage difficulties, with evidence indicating that the interval from event notification to hospital arrival is longer than under normal conditions.[3,4] Concurrently, hospitals may lack sufficient beds, intensive care capacity, staff, or technical resources, necessitating transfer of patients to referral centers with greater capacity.[5,6] In this context, air

ambulance systems constitute an essential component of disaster response, particularly when rapid evacuation is required and ground transportation is insufficient, enabling both patient evacuation and interfacility transfer over time.

Air ambulance systems comprise two principal platforms: helicopter emergency medical services and fixed-wing aircraft. Helicopters are better suited to short-distance transfers and evacuations from areas that are difficult to access or severely damaged, whereas fixed-wing aircraft are more appropriate for long-distance transfers and large-scale interfacility transport.[7]

Air ambulance systems worldwide vary in organizational structure, fleet composition, mission profile, and degree of integration with the broader healthcare system. Despite this variability, appropriate patient selection and effective transfer planning remain consistently critical determinants of system performance.[8] Position statements and consensus agreements have delineated the criteria for suitable air ambulance utilization, underscoring that excessive use or improper deployment may jeopardize patient safety and system viability.[9] The Ministry of Health in Turkiye coordinates air ambulance services, which are provided by both helicopters and fixed-wing planes.[10]

Following the 2010 Yushu earthquake in China, thousands of patients were rapidly evacuated by air to hospitals across different regions, an approach reported to have played a critical role in the disaster response.[11] A similar necessity arose during the 6 February 2023 Kahramanmaraş earthquakes, which rendered several hospitals in the affected area non-functional and resulted in substantial casualties among healthcare personnel, causing major disruptions in service delivery. In these conditions, large-scale aeromedical evacuation operations were conducted with the participation of national and multinational teams, employing air ambulance systems to transfer patients to operational centers.[12]

This study seeks to assess the demographic and clinical profiles of earthquake survivors airlifted after the February 6, 2023, Kahramanmaraş Earthquakes, as well as to examine the receiving healthcare facilities, the types of air ambulances employed, and the temporal distribution of the transfers. The results are anticipated to elucidate the operational difficulties faced in aeromedical transfer planning during disaster response and to guide organizational improvements for future large-scale disasters.

METHODS

This study was approved by the Ankara Etlik City Hospital Scientific Researches Evaluation and Ethics Committee (Date: 22.10.2025, Decision No: AESH-BADEK1-2025-580). All procedures were carried out in accordance with ethical guidelines and the principles of the Declaration of Helsinki.

This descriptive retrospective study analyzed data from earthquake survivors who were transported by air ambulance following the 6 February 2023 Kahramanmaraş Earthquakes. The study evaluated patients' age, gender, clinical characteristics, dates of air transfer, referring and receiving provinces, and their distribution according to air ambulance type. Data were retrospectively obtained from the Emergency Health Automation System (EHAS), operated by the Ministry of Health of Turkiye.

Clinical diagnoses were derived from transfer documentation recorded in the EHAS. As transfer records frequently contained descriptive clinical summaries rather than standardized ICD-10 codes, a thematic classification was applied by the authors, grouping cases into traumatic (e.g., crush syndrome, compartment syndrome, amputation) and non-traumatic categories (e.g., cardiovascular, neurological, infectious diseases). This classification represents an approximation based on available documentation and constitutes a limitation of the study.

Missing data were observed primarily in the early post-earthquake phase, during which the surge in patient volume exceeded local healthcare capacity and resulted in incomplete documentation. Gaps were noted in exact patient age, laboratory findings, and advanced imaging results, whereas data on patient gender, referring province, and receiving province were complete across all records. Due to missing age data in a subset of records, age analysis was limited to a binary classification of adult (≥18 years) versus pediatric patients rather than a continuous variable. Documentation quality improved progressively as local healthcare infrastructure was restored in the days following the initial impact.

The unit of analysis in this study was the transfer event rather than the individual patient. In some cases, patients may have undergone more than one air ambulance transfer during the study period; for example, an initial helicopter transfer from a district to a provincial center, followed by a subsequent fixed-wing transfer to a tertiary facility after a period of stabilization. As EHAS records each transfer event independently, it was not possible to link multiple transfers belonging to the same patient. This represents a limitation of the study, as the total number of transfer events may exceed the number of individual patients treated. A total of 32 transfers were identified as sequential air ambulance transfers, initially by helicopter to a provincial center followed by fixed-wing transfer to a tertiary facility after stabilization. No sequential helicopter-to-helicopter transfers were identified.

The analysis included patients transferred by helicopter and/or fixed-wing air ambulance due to traumatic injuries, non-traumatic acute medical conditions, or disruption of healthcare access resulting from the disaster, which prevented the safe continuation of ongoing monitoring or treatment. Inclusion criteria comprised being affected by the 6 February 2023 Kahramanmaraş Earthquakes and having been transported by helicopter and/or fixed-wing air ambulance. Patients transferred by means other than air ambulance, such as ground ambulance or private vehicles, were excluded. Additionally, cases with incomplete or insufficient key demographic or clinical data in the EHAS records were excluded from the analysis.

Statistical Analysis

The date was performed using descriptive methods. Continuous variables were reported as mean±standard deviation according to their distribution, while categorical variables were expressed as frequencies and percentages (%).

Demographic characteristics, transfer indications, and temporal patterns were compared according to air ambulance

type (fixed-wing versus helicopter). The daily distribution of referring and receiving provinces was evaluated for the first 20 days following the 6 February 2023 earthquakes and is presented graphically.

All analyses were performed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). As this was a descriptive study, analyses were limited to descriptive statistics.

RESULTS

During the study period, 1.561 of 2.248 fixed-wing transfers (69.4%) and 209 of 333 helicopter transfers (62.8%) involved adult patients (≥18 years). The gender distribution was comparable between male and female patients across both transfer types.

Analysis of transfer indications over time showed that evacuations during the early post-earthquake phase were predominantly attributable to severe traumatic injuries, including crush syndrome, compartment syndrome, and amputation. In subsequent days, non-traumatic conditions—including cardiovascular, neurological, and infectious diagnoses—became more prevalent. This temporal pattern is illustrated in **Figure 1**, which presents the daily distribution of traumatic and non-traumatic transfers throughout the study period.

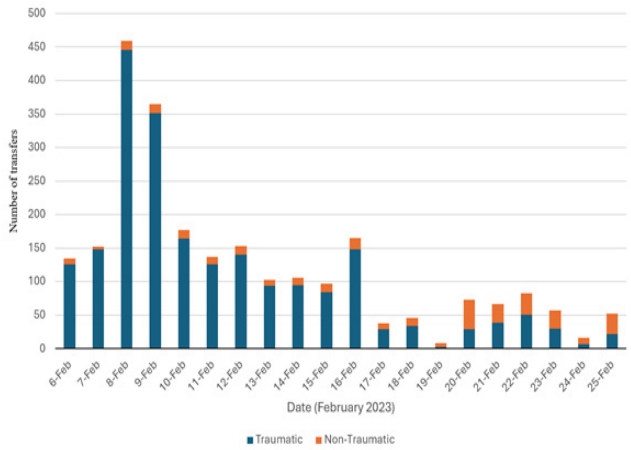

Figure 1. Daily distribution of traumatic and non-traumatic air ambulance transfers (fixed-wing and helicopter) following the 6 February 2023 Kahramanmaraş earthquakes

Among fixed-wing transfers, the referring provinces were predominantly concentrated in the early phase of the study period, led by Kahramanmaraş, Adıyaman, and Adana (**Figure 2**).

During the same period, the daily distribution of receiving provinces showed that most fixed-wing transfers were directed to Ankara and İstanbul, particularly during the early stages of the disaster (**Figure 3**). In contrast, transfers to İzmir and Antalya were infrequent and largely confined to the first several days after the earthquakes.

Figure 4 presents the daily distribution of referring provinces for helicopter transfers during the same period. In the early days following the earthquakes, most retrievals originated from Kahramanmaraş, whereas in subsequent days, Hatay became the predominant referring province.

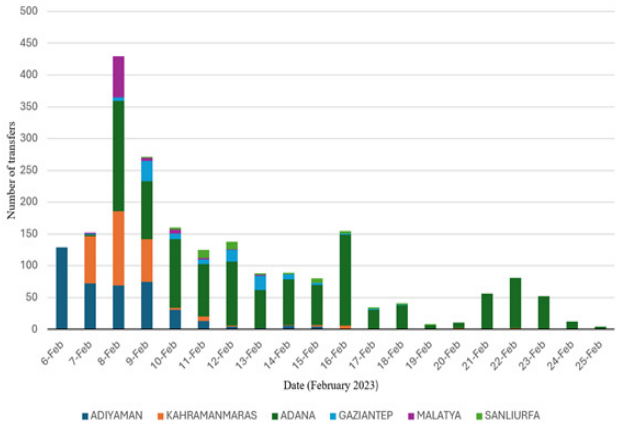

Figure 2. Daily distribution of referring provinces for fixed-wing air ambulance transfers in the initial 20 days after the 6 February 2023 earthquakes

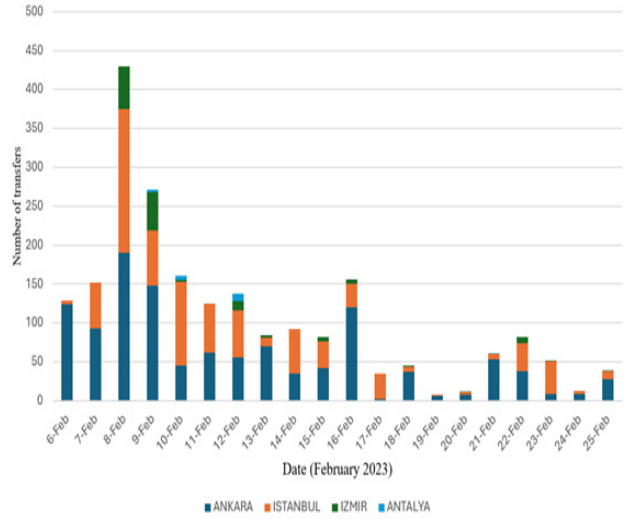

Figure 3. daily distribution of receiving provinces for fixed-wing air ambulance transfers in the initial 20 days after the 6 February 2023 earthquakes

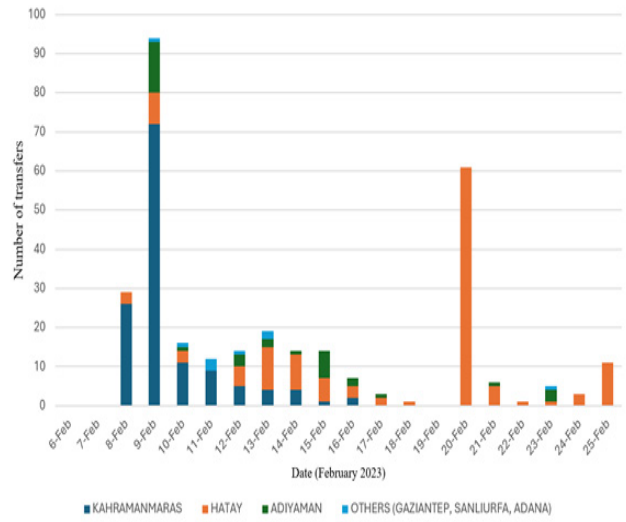

Figure 4. Daily distribution of referring provinces for helicopter ambulance transfers in the initial 20 days after the 6 February 2023 earthquakes

Figure 5 presents the daily distribution of receiving provinces for helicopter transfers during the same period. Adana was the most frequent destination, emerging as the predominant receiving province for helicopter transfers (**Figure 5**).

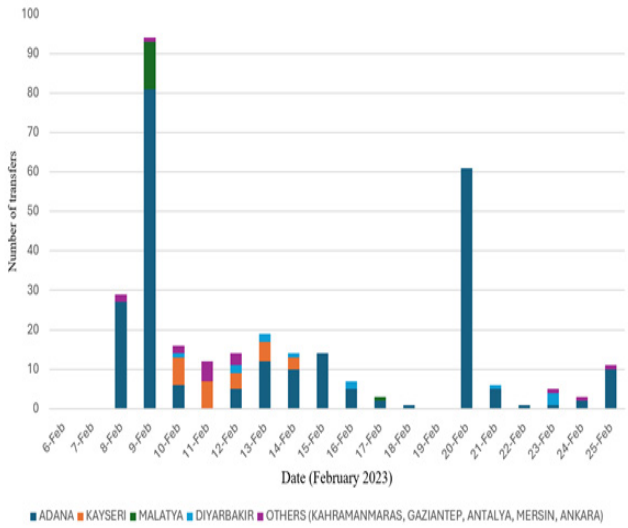

Figure 5. Daily distribution of receiving provinces for helicopter ambulance transfers in the initial 20 days after the 6 February 2023 earthquakes

DISCUSSION

This study assessed patient demographics, transfer trends, and the temporal distribution of aeromedical evacuations conducted by air ambulance following the 6 February 2023 Kahramanmaraş earthquakes. Our findings indicate that, during the early stages of the disaster, air ambulance transfers were predominantly attributable to severe traumatic injuries, whereas cardiovascular, neurological, and infectious diagnoses became increasingly common in subsequent days. Fixed-wing transfers were most frequent during the first several days, with receiving centers concentrated in Ankara and İstanbul, while helicopter retrievals were initially concentrated in Kahramanmaraş before shifting predominantly to Hatay.

These findings indicate that during large-scale disasters, aeromedical evacuation is essential not only for managing patient volume but also for coordinating clinical prioritization and reallocating regional healthcare capacity.

A study examining the aeromedical evacuation operations of the Norwegian Armed Forces reported the transport of 184 patients—all secondary transfers—many of whom presented with significant physiological derangement, notably crush injuries.[13] Similarly, a field report from an EMT type 1 unit stationed in Türkoğlu[14] noted that, beginning in the first week after the earthquake, admissions increasingly comprised infectious diseases and exacerbations of chronic conditions, while trauma-related presentations declined.

These findings collectively suggest that the clinical profile of disaster-affected populations evolves over time, consistent with the pattern observed in our study: an early phase dominated by trauma, followed by a gradual increase in non-traumatic medical conditions. Experience from the Great East Japan earthquake similarly demonstrates that aeromedical evacuation extends beyond patient transport alone. Consistent with our findings on clinical prioritization and regional clustering of transfers, these reports underscore the importance of centralized command structures, efficient information dissemination, and synchronized referral-receiving networks for comprehensive capacity management during large-scale disasters.[15]

In disaster-affected regions, local healthcare infrastructure is typically overwhelmed or rendered partially non-functional. Helicopter ambulances served a dual role, providing rapid retrieval of patients from earthquake-affected districts with limited road accessibility, as well as interfacility transfers to nearby, less-affected provinces. Fixed-wing aircraft, in turn, enabled long-distance transfer of patients from capacity-constrained local hospitals to tertiary referral centers. Together, these two platforms operated in a complementary manner, helping to alleviate the burden on the overwhelmed regional healthcare system during the disaster response.

The evaluation and management of pediatric patients in disaster scenarios is recognized as more complex than for adults, owing to physiological differences, age-specific triage criteria, and potential constraints in accessing adequately equipped facilities.[16] In our study, pediatric patients accounted for 30.6% of fixed-wing transfers and 37.2% of helicopter transfers, underscoring the substantial role of air ambulance systems in the evacuation of children during disasters. These findings suggest that the inclusion of pediatric patients in aeromedical systems warrants consideration not only from a triage perspective but also in relation to advanced transfer planning and the capacity of referral centers to deliver age-appropriate care.

Assa et al.[17] reported that air ambulance systems support disaster response by enabling balanced distribution of patients across facilities, thereby preventing overcrowding of peripheral healthcare centers. Consistent with this, our findings provide observational data on the temporal and spatial deployment of air ambulances following the 6 February 2023 earthquakes, highlighting the operational roles of both fixed-wing and helicopter platforms in the field.

Our findings indicate that transfers were initially concentrated in high-capacity tertiary centers, notably Ankara and İstanbul. In subsequent days, transfer volume declined and referrals became more evenly distributed, reflecting a transition from acute crisis management to more organized interfacility transfers alongside the gradual restoration of local healthcare services. This pattern underscores the importance of coordinated, nationally structured transfer planning in large-scale disaster management.

Experience from disasters in Japan has demonstrated that centralized command structures and inter-agency collaboration are critical to the effective functioning of air ambulance systems.[18] During the Kumamoto earthquake, air medical transport operations highlighted the efficient utilization of helicopter ambulances during the initial phase of the disaster, alleviating strain on the healthcare system in the early hours.[18]

The shift in clinical profile observed in our study, from trauma-predominant transfers in the early phase to non-traumatic conditions in the later phase, has direct implications for regional healthcare capacity planning. Disaster response systems should anticipate this temporal evolution and pre-position resources accordingly, ensuring that receiving centers are equipped not only for acute trauma management but also for the surge in cardiovascular, neurological, and infectious disease cases that follows.

In our study, the early concentration and regional clustering of both fixed-wing and helicopter transfers exhibit a similar pattern,

underscoring the necessity of swift and coordinated aeromedical evacuation during the acute phase of large-scale disasters.

In our study, fixed-wing retrievals during the initial days after the earthquake originated primarily from Adıyaman and Kahramanmaraş, whereas in subsequent days, a larger proportion of transfers originated from Adana. This pattern cannot be attributed solely to clinical demand; it also reflects operational constraints affecting aviation infrastructure within the disaster zone. Hatay Airport reportedly became non-operational following the earthquake, requiring aircraft to land at alternative, smaller airports.[19] Malatya Airport was also temporarily closed due to structural damage to its terminal building, with flights operating on a limited basis thereafter.[19] These findings indicate that aeromedical transfer planning during disasters is influenced not only by patient volume and clinical urgency but also by the accessibility and operational status of airport infrastructure.

These findings highlight that aeromedical evacuation planning should incorporate not only clinical demand projections but also infrastructure vulnerability assessments, including airport operability, to ensure uninterrupted patient transfer capacity during large-scale disasters.

Limitations

This study has several constraints. First, the retrospective and descriptive design precludes causal inference. Because the analysis was restricted to patients transported by air ambulance, exclusion of those transferred by ground ambulance may have introduced selection bias with respect to illness severity. In addition, reliance on administrative registry data limits the availability of detailed clinical information and renders the accuracy of transfer indications dependent on coding practices. The absence of long-term outcome data further prevents assessment of the direct impact of aeromedical evacuation on mortality and morbidity.

Furthermore, detailed clinical indications could not be systematically extracted due to the descriptive and inconsistent nature of transfer documentation within EHAS, where records frequently contained narrative clinical summaries rather than standardized diagnostic codes. As a result, clinical classification was limited to a broad traumatic versus non-traumatic categorization. Future studies incorporating standardized clinical coding systems would enable more granular analysis of aeromedical evacuation indications. Due to limitations in the administrative registry data, a detailed breakdown of clinical indications by aircraft type could not be performed. This represents an area for future investigation.

Despite these limitations, the study provides valuable observational insights by encompassing a large, nationwide cohort and by delineating the temporal and spatial patterns of air ambulance utilization under disaster conditions, thereby contributing meaningful evidence to the existing literature.

CONCLUSION

This study demonstrates that effective utilization of air ambulance systems in large-scale disasters requires adaptive planning aligned with evolving clinical demands, supported by strong interinstitutional coordination. Structuring aeromedical evacuation strategies to address the transition from an acute trauma-dominated phase to a broader burden of non-traumatic medical conditions may enhance overall system performance. Future prospective, multicenter studies are warranted to better define the impact of aeromedical evacuations on clinical outcomes.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study was approved by the Ankara Etlik City Hospital Scientific Researches Evaluation and Ethics Committee (Date: 22.10.2025, Decision No: AESH-BADEK1-2025-580).

Informed Consent

This retrospective study used pre-existing anonymized patient data. No additional intervention was performed, and there was no direct patient contact. The study was approved by the Ethics Committee, and the requirement for written informed consent was waived by the ethics committee.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Financial Disclosure

The authors received no financial support for the conduct or publication of this research.

Author Contributions

Concept: EA, EU; Design: EÇ; Control: ŞY; Resources: EA, EU; Data Collection and/or Processing: KDB; Analysis and/or Interpretation: EA; Literature Review: EA, ŞY; Writing the Article: EA, EU, EÇ; Critical Review: KDB.

REFERENCES

1. Disaster and Emergency Management Authority (AFAD). Kahramanmaraş earthquakes report. Published June 2, 2023. Accessed February 20, 2026.
2. Sahebi A, Ghomian Z, Sarvar M. Helicopter emergency medical services in 2017 Kermanshah earthquake: a qualitative study. *Arch Acad Emerg Med*. 2019;7(1):e31.
3. Alruqi F, Aglago EK, Cole E, Brohi K. Factors associated with delayed pre-hospital times during trauma-related mass casualty incidents: a systematic review. *Disaster Med Public Health Prep*. 2023;17:e525. doi:10.1017/dmp.2023.187
4. Heemskerk JL, Abode-Iyamah KO, Quinones-Hinojosa A, Weinstein ES. Prehospital response time of the emergency medical service during mass casualty incidents and the effect of triage: a retrospective study. *Disaster Med Public Health Prep*. 2022;16(3):1091-1098. doi:10.1017/dmp.2021.40
5. Khajehaminian MR, Ardalan A, Keshtkar A, et al. A systematic literature review of criteria and models for casualty distribution in trauma-related mass casualty incidents. *Injury*. 2018;49(11):1959-1968. doi:10.1016/j.injury.2018.09.005
6. Sarı H, Özel M, Akkoç MF, Şen A. First-week analysis after the Turkiye earthquakes: demographic and clinical outcomes of victims. *Prehosp Disaster Med*. 2023;38(3):294-300. doi:10.1017/S1049023X23000493
7. Loyd JW, Larsen T, Kuhl EA, Swanson D. Aeromedical transport. In: StatPearls [Internet]. StatPearls Publishing; 2025. Updated May 1, 2024. Accessed February 20, 2026.
8. Muyambi K, Gardiner F, Sollid S, et al. Aeromedical retrieval services characteristics globally: a scoping review. *Scand J Trauma Resusc Emerg Med*. 2022;30(1):71. doi:10.1186/s13049-022-01053-x
9. Lyng JW, Braithwaite S, Abraham H, et al. Appropriate air medical services utilization and recommendations for integration of air medical services resources into the EMS system of care: a joint position statement and resource document of NAEMSP, ACEP, and AMPA. *Prehosp Emerg Care*. 2021;25(6):854-873. doi:10.1080/10903127.2021.1967534
10. Republic of Turkiye Ministry of Health. Air ambulance services. Accessed May 16, 2023.

11. Liu X, Liu Y, Zhang L, et al. Mass aeromedical evacuation of patients in an emergency: experience following the 2010 Yushu earthquake. *J Emerg Med*. 2013;45(6):865-871. doi:10.1016/j.jemermed.2013.05.054
12. Kahraman S. A comprehensive health economic analysis of the 2023 Turkiye earthquake. *Disaster Med Public Health Prep*. 2023;17:e503. doi:10.1017/dmp.2023.160
13. Andresen ÅEL, Brynildsen H, Loe T, Eidissen B, Grindheim H, Asak H. The Norwegian Armed Forces aeromedical evacuation response to the 2023 earthquake in Turkiye. *Air Med J*. 2025;44(6):505-510. doi:10.1016/j.amj.2025.08.001
14. Maddah D, Vadi R, Aloğlu N, et al. What do patients seek care for at a health facility in the aftermath of an earthquake? Experiences from an emergency medical team in Türkoğlu, Turkiye, 2023. *Disaster Med Public Health Prep*. 2025;19:e12. doi:10.1017/dmp.2024.343
15. Matsumoto H, Motomura T, Hara Y, et al. Lessons learned from the aeromedical disaster relief activities following the Great East Japan earthquake. *Prehosp Disaster Med*. 2013;28(2):166-169. doi:10.1017/S1049023X12001835
16. Costa VSLP, Stéfani GM, Ferenhof HA, Lima FS, Cola M. Children's health care in mass-casualty incidents: a systematic literature review. *Prehosp Disaster Med*. 2021;36(6):739-746. doi:10.1017/S1049023X21001060
17. Assa A, Landau DA, Barenboim E, Goldstein L. Role of air-medical evacuation in mass-casualty incidents-a train collision experience. *Prehosp Disaster Med*. 2009;24(3):271-276. doi:10.1017/s1049023x00006920
18. Motomura T, Hirabayashi A, Matsumoto H, et al. Aeromedical transport operations using helicopters during the 2016 Kumamoto earthquake in Japan. *J Nippon Med Sch*. 2018;85(2):124-130. doi:10.1272/jnms.2018_85-19
19. Rakipoğlu C. 6 Şubat 2023 depremleri özelinde havacılık sektörünün incelenmesi. *J Aerospace Sci Manag*. 2024;2(2):42-66.