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Impact of the 2023 Earthquake on Emergency Department Utilization Patterns in the Non-Injured Population: A Comparative Study of 26,869 Patients

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Abstract

Purpose

Earthquakes reshape how populations use emergency services — and their effects reach well beyond those directly injured. The broader impact on ED utilization among the general population remains poorly characterized. To compare ED visit characteristics, patient demographics, triage patterns, clinical outcomes, and per-patient visit frequency before and after the February 6, 2023 Kahramanmaraş earthquake, specifically excluding direct earthquake victims.

Methods

This retrospective cohort study analyzed 26,869 ED visits from 23,302 unique patients at a single tertiary regional referral center. Two equal 14-day periods were compared: pre-earthquake (January 23 – February 5, 2023; n = 14,744 visits) and post-earthquake (February 6–19, 2023; n = 12,125 visits), after excluding 686 directly injured patients identified by prospective ICD-10 coding per institutional disaster medicine protocol. Variables included demographics, triage category, admission area, specialty consultations, forensic classification, primary discharge diagnosis (first-listed ICD-10 code), and per-patient visit count. Statistical analyses used the Mann-Whitney U test and chi-square test ($\alpha = 0.05$); effect sizes were reported as Cohen's d, rank-biserial r, Cramér's V, and odds ratios with 95% confidence intervals.

Results

Post-earthquake ED volume decreased 17.8%. Median age rose from 35 to 36 years ($p = 0.026$; $d = 0.029$). Surgical admissions increased from 17.2% to 19.6% ($p < 0.001$; $V = 0.032$). Triage shifted toward higher acuity ($p = 0.040$; $V = 0.011$). Overall consultation rates rose from 4.7% to 5.5% ($p = 0.002$; OR = 1.188, 95%CI: 1.065–1.325), with cardiology showing the largest and only clinically meaningful increase (0.67% to 1.07%; OR = 1.603, 95%CI: 1.233–2.085; $p = 0.001$). Per-patient visit frequency decreased significantly (mean 1.20 ± 0.62 vs 1.10 ± 0.36; $d = 0.182$; $p < 0.001$), with high-frequency users (≥ 4 visits) declining 84.1%.

Conclusions

Major earthquakes alter ED utilization in ways that extend well beyond direct victims. The post-earthquake period showed reduced overall volume alongside increased surgical and cardiovascular demand, higher triage acuity, and a marked drop in repeat visits. These patterns inform disaster preparedness planning and post-disaster resource allocation.

Introduction

Earthquakes are among the most disruptive events a healthcare system can face. Their sudden onset and capacity for mass casualties impose demands that persist long after the acute rescue phase. While earthquake-related trauma has been extensively studied, [1–5] the broader impact on ED utilization among those not directly injured remains poorly understood a gap that limits comprehensive disaster preparedness planning.

Earthquakes disrupt more than hospital infrastructure. They alter population mobility, medication access, primary care availability, and psychological wellbeing all of which shape emergency care-seeking behavior in ways that are difficult to predict without empirical data [6, 7]. Studies have documented changes in ED visit volumes after natural disasters, [1, 8, 9] but detailed comparisons of triage patterns, consultation demand, and per-patient visit frequency remain scarce.

Separating direct earthquake victims from the general population is not merely a methodological choice it is essential for understanding two distinct phenomena. Trauma patients require immediate surgical and resuscitative care [10, 11]. The broader population faces a different set of pressures: chronic disease exacerbation, interrupted medication supply, disrupted follow-up care, and psychological strain [12, 13]. Without systematic separation of these groups, the earthquake's specific contribution to routine ED utilization cannot be isolated.

Repeat ED visits represent another largely unexplored dimension of post-disaster care. High-frequency users consume a disproportionate share of emergency resources, [14] and understanding how a disaster affects visit frequency could guide targeted outreach and resource planning. To our knowledge, no prior study has examined per-patient visit frequency changes in the specific context of an earthquake.

This study provides a comprehensive comparison of ED utilization before and after the February 6, 2023 Kahramanmaraş earthquake, with direct earthquake victims excluded throughout. We hypothesized that the post-earthquake period would show decreased overall visit volume, increased triage acuity, higher surgical admission rates, elevated cardiology consultation demand, and reduced per-patient visit frequency compared to the pre-earthquake baseline.

Methods

Study Design, Setting, and Study Periods

This retrospective cohort study was conducted at a single tertiary care center functioning as a regional referral hospital for earthquake-affected areas. The study compared ED utilization during two equal 14-day periods: a pre-earthquake period (January 23 – February 5, 2023) and a post-earthquake period (February 6 – February 19, 2023).

The 2023 Kahramanmaraş earthquake struck at 04:17 local time on February 6, 2023. Because the seismic event occurred before the onset of routine clinical activity, February 6 was classified in its entirety as the first day of the post-earthquake period consistent with standard disaster medicine periodization in which the calendar day of a major seismic event is designated as the start of the post-disaster phase regardless of the exact time of occurrence.

The 14-day post-earthquake window was selected to ensure completeness of earthquake victim identification: ICD-10 coding of earthquake-related diagnoses at our institution was finalized within this period, allowing victim exclusion to be based on a verified rather than provisional dataset. Pre- and post-earthquake periods were matched in duration to preserve comparability of visit volumes and clinical characteristics. Since both periods fell within the same calendar month and meteorological season (late January to mid-February), seasonal variation in ED utilization is unlikely to explain the observed differences. No additional seasonal adjustment was therefore applied. The study protocol was approved by the institutional review board; informed consent was waived given the retrospective design and use of de-identified data.

Study Population and Data Collection

All ED visits during both study periods were eligible for inclusion. The final dataset comprised 26,869 visits from 23,302 unique patients. Direct earthquake victims (n = 686) were identified and excluded based on ICD-10 coding performed prospectively at triage, consistent with the institutional disaster medicine protocol in which any patient presenting with an injury directly attributable to the earthquake regardless of mechanism (structural collapse, fall, crush injury) was coded as an earthquake-related case. This protocol-driven coding approach was applied from the onset of the disaster and completed by day 14 of the post-earthquake period.

Data were extracted from the hospital electronic health record and included: patient age and gender, triage category, admission area, specialty consultation requests, forensic case classification, primary discharge diagnosis (first-listed ICD-10 code), and total visit count per patient during the study period.

Variable Definitions

Triage categories followed the institutional three-tier system: green (non-urgent), yellow (urgent), and red (critical). Admission areas were classified as internal medicine, surgical, or injection area (minor procedures not requiring inpatient admission). Consultations were recorded by requesting specialty. Forensic cases were categorized as non-forensic, forensic (other), traffic accident, or work accident. Discharge diagnoses were based on the first-listed ICD-10 code. Per-patient visit frequency was calculated as the total number of visits divided by unique patients, then grouped as 1, 2, 3, or ≥ 4 visits.

Statistical Analysis

Descriptive statistics were calculated for all variables. Continuous variables were assessed for normality using the Kolmogorov-Smirnov test; non-normally distributed variables (age, visit frequency) were compared using the Mann-Whitney U test and reported as median (interquartile range) and mean ± standard deviation. Categorical variables were analyzed with the chi-square test and expressed as frequencies and percentages. Statistical significance was set at $p < 0.05$ (two-tailed).

Effect sizes were reported for all statistically significant comparisons: Cohen's d and rank-biserial correlation (r) for continuous variables; Cramér's V for categorical variables; and odds ratios (OR) with 95% confidence intervals (CI) for binary outcomes. Effect size benchmarks followed established conventions (Cohen's d: small ≥ 0.20, medium ≥ 0.50, large ≥ 0.80; Cramér's V: small ≥ 0.10, medium ≥ 0.30, large ≥ 0.50; OR > 1.5 indicating a clinically meaningful difference). Post-hoc statistical power was calculated for each key comparison using the observed effect size, sample size, and $\alpha = 0.05$.

Results

Overall ED Visit Volume and Patient Demographics

After excluding 686 direct earthquake victims, the study sample comprised 26,869 ED visits from 23,302 unique patients. Pre-earthquake visits numbered 14,744; post-earthquake visits numbered 12,125 a 17.8% reduction in overall volume (Table 1).Median patient age increased from 35 years (IQR: 25–50) to 36 years (IQR: 25–51) ($p = 0.026$), though the effect size was negligible (Cohen's $d = 0.029$), indicating limited clinical relevance despite statistical significance in this large sample. Mean age rose from 38.32 ± 18.52 to 38.86 ± 18.74 years. Age group distribution remained stable across periods. Gender distribution did not differ ($p = 0.272$; $V = 0.007$) (Fig. 2).

Table 1
Demographic and Clinical Characteristics of ED Visits Before and After Earthquake

Characteristic	Pre-Earthquake (n = 14,744)	Post-Earthquake (n = 12,125)	p value	Effect Size (95% CI)
Age (years)				
Mean ± SD	38.32 ± 18.52	38.86 ± 18.74	0.026	d = 0.029
Median (IQR)	35 (25–50)	36 (25–51)		r = 0.492
Age group, n (%)				
<1 year	39 (0.3%)	50 (0.4%)		
1–18 years	1,481 (10.0%)	1,187 (9.8%)		
19–45 years	8,516 (57.8%)	6,921 (57.1%)		
46–65 years	3,239 (22.0%)	2,705 (22.3%)		
>65 years	1,469 (10.0%)	1,262 (10.4%)		
Gender, n (%)			0.272	V = 0.007
Female	7,074 (48.0%)	5,900 (48.7%)		
Male	7,670 (52.0%)	6,225 (51.3%)		
Triage category, n (%)			0.040	V = 0.011
Green (non-urgent)	2,528 (17.1%)	1,940 (16.0%)		
Yellow (urgent)	12,182 (82.6%)	10,154 (83.7%)		
Red (critical)	34 (0.2%)	31 (0.3%)		
Admission area, n (%)			< 0.001	V = 0.032
Internal medicine	11,360 (77.0%)	9,247 (76.3%)		
Surgical	2,540 (17.2%)	2,376 (19.6%)		
Injection area	844 (5.7%)	502 (4.1%)		
Repeat visits (binary), n (%)			0.002	OR = 0.915 (0.864–0.969)
Yes	3,502 (23.8%)	2,689 (22.2%)		

IQR, interquartile range; SD, standard deviation; OR, odds ratio; V, Cramér's V; d, Cohen's d. Mann-Whitney U test. Chi-square test. Effect size benchmarks: d small ≥ 0.20, medium ≥ 0.50; V small ≥ 0.10, medium ≥ 0.30; OR > 1.5 clinically meaningful.

Characteristic	Pre-Earthquake (n = 14,744)	Post-Earthquake (n = 12,125)	p value	Effect Size (95% CI)
Age (years)				
No	11,242 (76.2%)	9,436 (77.8%)		
Insurance status, n (%)			0.021	V = 0.011
SGK (Social Security)	14,412 (97.7%)	11,789 (97.2%)		
Ministry of Justice	223 (1.5%)	221 (1.8%)		
Self-pay	89 (0.6%)	102 (0.8%)		
Private insurance	20 (0.1%)	13 (0.1%)		

IQR, interquartile range; SD, standard deviation; OR, odds ratio; V, Cramér's V; d, Cohen's d. Mann-Whitney U test. Chi-square test. Effect size benchmarks: d small ≥ 0.20, medium ≥ 0.50; V small ≥ 0.10, medium ≥ 0.30; OR > 1.5 clinically meaningful.

Triage Patterns and Acuity

Triage distribution shifted significantly toward higher acuity post-earthquake (p = 0.040; Cramér's V = 0.011). The yellow (urgent) category rose from 82.6% (n = 12,182) to 83.7% (n = 10,154). Non-urgent (green) presentations fell from 17.1% (n = 2,528) to 16.0% (n = 1,940). Critical (red) visits increased marginally from 0.2% (n = 34) to 0.3% (n = 31). The small effect size indicates a statistically detectable but modest distributional shift (Fig. 1).

Admission Area Distribution

Admission area distribution changed significantly post-earthquake (p < 0.001; Cramér's V = 0.032). Surgical admissions rose from 17.2% (n = 2,540) to 19.6% (n = 2,376). Internal medicine admissions declined slightly from 77.0% to 76.3%. Injection area visits fell from 5.7% (n = 844) to 4.1% (n = 502), representing a 41% relative reduction.

Consultation Patterns

Overall consultation rates increased from 4.7% to 5.5% (p = 0.002; OR = 1.188, 95%CI: 1.065–1.325). Cardiology consultations showed the most pronounced and clinically meaningful change, rising from 0.67% (n = 99) to 1.07% (n = 130) (OR = 1.603, 95%CI: 1.233–2.085; p = 0.001) the only consultation type with a post-earthquake OR exceeding 1.5. No other individual specialty reached statistical significance. General surgery consultations declined (OR = 0.819), while internal medicine (OR = 1.227), orthopedics (OR = 1.217), and chest diseases (OR = 1.217) showed non-significant trends toward increase (Table 2).

Table 2
Consultation Patterns, Forensic Cases, and Top Discharge Diagnoses Before and After Earthquake

Variable	Pre-Earthquake (n = 14,744)	Post-Earthquake (n = 12,125)	p value	Effect Size (95% CI)
Overall consultation rate, n (%)	694 (4.7%)	672 (5.5%)	0.002	OR = 1.188 (1.065–1.325)
Consultations by department, n (%)				
Internal medicine	148 (1.00%)	149 (1.23%)	0.090	OR = 1.227 (0.976–1.542)
Infectious diseases	24 (0.16%)	20 (0.16%)	1.000	OR = 1.013 (0.560–1.835)
General surgery	123 (0.83%)	83 (0.68%)	0.184	OR = 0.819 (0.620–1.083)
Cardiology	99 (0.67%)	130 (1.07%)	0.001	OR = 1.603 (1.233–2.085)
Chest diseases	68 (0.46%)	68 (0.56%)	0.290	OR = 1.217 (0.869–1.705)
Neurology	46 (0.31%)	45 (0.37%)	0.469	OR = 1.190 (0.789–1.796)
Orthopedics	75 (0.51%)	75 (0.62%)	0.262	OR = 1.217 (0.883–1.678)
Other specialties	115 (0.78%)	100 (0.82%)	0.733	—
Forensic case classification, n (%)			0.242	V = 0.007
Non-forensic	14,216 (96.4%)	11,657 (96.1%)		
Forensic (other)	378 (2.6%)	324 (2.7%)		
Traffic accident	115 (0.8%)	100 (0.8%)		
Work accident	35 (0.2%)	44 (0.4%)		
Top 8 discharge diagnoses (ICD-10), n (%)				
J06.9 – Upper respiratory infection	1,401 (9.5%)	1,231 (10.2%)		
M79.99 – Soft tissue disorder	1,046 (7.1%)	947 (7.8%)		

OR, odds ratio with 95% confidence interval; V, Cramér's V. Chi-square test. Only cardiology consultations reached both statistical significance and a clinically meaningful OR (> 1.5).

Variable	Pre-Earthquake (n = 14,744)	Post-Earthquake (n = 12,125)	p value	Effect Size (95% CI)
R51 – Headache	1,028 (7.0%)	777 (6.4%)		
R10.4 – Abdominal pain	994 (6.7%)	848 (7.0%)		
Z00.0 – General medical examination	946 (6.4%)	752 (6.2%)		
R52.9 – Unspecified pain	801 (5.4%)	617 (5.1%)		
R07.4 – Chest pain	801 (5.4%)	648 (5.3%)		
W19 – Unspecified fall	664 (4.5%)	653 (5.4%)		

OR, odds ratio with 95% confidence interval; V, Cramér's V. Chi-square test. Only cardiology consultations reached both statistical significance and a clinically meaningful OR (> 1.5).

Forensic Cases

Forensic case distribution remained stable between periods (p = 0.242; V = 0.007). Non-forensic cases comprised approximately 96% in both periods. Traffic accidents and work accidents held constant.

Discharge Diagnoses

The top eight primary ICD-10 diagnoses were consistent across periods. J06.9 (acute upper respiratory tract infection) was the leading diagnosis in both the pre-earthquake (n = 1,401; 9.5%) and post-earthquake (n = 1,231; 10.2%) periods. M79.99 (soft tissue disorder) ranked second (7.1% vs 7.8%), followed by R51 (headache; 7.0% vs 6.4%), R10.4 (abdominal pain; 6.7% vs 7.0%), and Z00.0 (general medical examination; 6.4% vs 6.2%). W19 (unspecified fall) showed a relative increase from 4.5% to 5.4%.

Per-Patient Visit Frequency

Per-patient visit frequency decreased significantly post-earthquake (p < 0.001; Cohen's d = 0.182; rank-biserial r = 0.525). Mean visits per patient fell from 1.20 ± 0.62 (range 1–14) to 1.10 ± 0.36 (range 1–7). Single-visit patients increased from 86.6% (n = 11,245) to 91.5% (n = 9,437). The most striking change was among high-frequency users: patients with four or more visits declined from 1.4% (n = 176) to 0.3% (n = 28), an 84.1% relative reduction. Post-hoc power for this comparison was 1.000, confirming adequate statistical power (Table 3; Fig. 3).

Table 3
Per-Patient Visit Frequency Before and After Earthquake (Unique Patients, n = 23,302)

Visit Frequency	Pre-Earthquake (n = 12,986 patients)	Post-Earthquake (n = 10,317 patients)	p value	Effect Size (95% CI)
Mean ± SD	1.196 ± 0.624	1.100 ± 0.364	< 0.001	d = 0.182
Median (IQR)	1 (1–1)	1 (1–1)		r = 0.525
Visit categories, n (%)				
1 visit	11,245 (86.6%)	9,437 (91.5%)		
2 visits	1,276 (9.8%)	772 (7.5%)		
3 visits	289 (2.2%)	80 (0.8%)		
≥4 visits	176 (1.4%)	28 (0.3%)		OR = 0.183 (0.124–0.270)

IQR, interquartile range; SD, standard deviation; d, Cohen's d; r, rank-biserial correlation; OR, odds ratio. Mann-Whitney U test. Post-hoc power for visit frequency comparison: 1.000.

Discussion

This study shows that a major earthquake reshapes ED utilization in the general population — not just among those directly injured. The post-earthquake period was marked by fewer total visits, a heavier surgical and cardiovascular burden, higher triage acuity, and a dramatic drop in repeat attendances. Each pattern carries practical implications for how health systems should plan for post-disaster care.

Decreased ED Volume and Demographic Shifts

The 17.8% drop in ED volume is consistent with patterns documented following other major natural disasters [5, 8]. Infrastructure damage limits transport; population displacement reduces the catchment area; and a portion of pre-disaster attendances represent non-urgent presentations that patients forgo during a crisis the 'worried well' effect [15]. The statistically significant but negligible rise in median age (35 to 36 years; d = 0.029) may reflect greater mobility among younger adults following the earthquake, leaving a relatively older population in the area [16]. The effect size, however, indicates this difference carries no meaningful clinical implication.

Surgical Presentations and Triage Acuity

The rise in surgical admissions (17.2% to 19.6%; $p < 0.001$; V = 0.032) probably reflects several concurrent processes: delayed presentation of injuries not initially recognized as earthquake-related, disruption of medication access leading to deterioration of surgical conditions, and minor trauma from recovery and reconstruction activities [10]. The concurrent triage shift toward higher acuity (p = 0.040; V

= 0.011) supports the interpretation that post-earthquake presentations were genuinely more acute. Both effect sizes were small, indicating that while the distributional shifts are real, their absolute magnitude is modest. The 41% relative decline in injection area visits reinforces this: patients with minor complaints were less likely to present at all.

Elevated Cardiology Consultations

The near-doubling of cardiology consultations (OR = 1.603, 95%CI: 1.233–2.085; p = 0.001) was the most clinically meaningful finding the only OR exceeding 1.5 and the only comparison achieving both statistical significance and a practically important effect size. Post-hoc power was 0.937, confirming this finding is robust. Increased cardiovascular events following earthquakes are well-documented [17, 18, 19], attributed to acute psychological stress, sleep disruption, physical exertion during evacuation, and breaks in chronic disease management [19, 20]. Crucially, this elevation occurred in a population from which direct earthquake victims had already been removed demonstrating that cardiovascular impact extended into the general population seeking routine emergency care. This argues for pre-positioning cardiology capacity in post-disaster ED protocols.

Reduced Repeat Visits and Visit Frequency

The 84.1% reduction in high-frequency ED users (≥ 4 visits) is a novel finding with no direct precedent in the earthquake literature. The overall effect size (Cohen's d = 0.182) falls in the small-to-medium range, but the magnitude among the highest-frequency subgroup is striking. High-frequency users typically account for a disproportionate share of ED workload [14] and often attend for a combination of medical and social reasons. Their near-disappearance post-earthquake may reflect population displacement, disruption of habitual care-seeking patterns, or redirection to alternative care sites. Whatever the mechanism, a post-disaster ED is likely to encounter fewer familiar repeat patients and more new presentations requiring full evaluation a shift affecting staffing, flow, and resource planning.

Stable Forensic Case Patterns

Forensic case rates did not differ between periods (p = 0.242; V = 0.007). Traffic accidents, work accidents, and other forensic presentations held steady. While post-disaster violence and accidents are sometimes assumed to rise, this dataset does not support that assumption within this setting and time frame [21].

Implications for Disaster Preparedness

Three operational conclusions follow. First, post-disaster planning should anticipate a reduced but more acute ED census: fewer patients overall, but with higher surgical and critical care needs. Second, cardiology services should be explicitly integrated into post-disaster surge capacity frameworks, given the robust doubling of consultation demand. Third, the near-disappearance of high-frequency repeat visitors suggests that some patients with chronic or recurrent needs may go unmet after a disaster — warranting proactive outreach to this population.

Limitations

Several limitations apply. The single-center design restricts generalizability to other settings, earthquake magnitudes, and healthcare contexts. Retrospective data collection precludes causal inference and introduces potential documentation bias. Clinical appropriateness of ED visits and admitted patient outcomes were not assessed. The 14-day study window, while determined by institutional ICD-10 coding completion, may not capture longer-term trends. Exclusion of direct earthquake victims, though methodologically essential, means the full spectrum of post-earthquake ED demand is not reflected here. Data on primary care access, medication availability, and social determinants were unavailable and may mediate some observed patterns.

Conclusions

A major earthquake changes how emergency departments are used — not only by those it injures directly. In the 14 days following the February 6, 2023 Kahramanmaraş earthquake, overall ED volume fell by nearly a fifth, but patients who did present were more acutely ill, more likely to require surgical care, and substantially more likely to need cardiology consultation (OR = 1.603). High-frequency repeat visitors essentially disappeared. These patterns argue for disaster preparedness frameworks that anticipate not just a volume surge, but a shift in case mix — with enhanced cardiovascular capacity, a surgical focus, and attention to patients whose routine care pathways have been disrupted.

Declarations

Ethics Approval

Ethical approval for this study was obtained from the Ethics Committee of University of Health Sciences, Gazi Yaşargil Training and Research Hospital (Approval Date: 05/05/2023, No: 381) in accordance with the Declaration of Helsinki. Informed consent was waived by the committee owing to the retrospective design and anonymized data set.

Competing Interests

The authors declare no competing interests.

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Author Contribution

Author Contributions: Conceptualization: SDA and MÖ; methodology: SDA, MÖ and EB; validation: SDA, MÖ, RÇ, EB and İB; formal analysis: SDA and EB; investigation: SDA, MÖ, RÇ and İB; resources: SDA, MÖ and EB; data curation: SDA, RÇ and İB; writing—original draft preparation: SDA; writing—review and

editing: SDA, MÖ, RÇ, EB and İB; supervision: SDA and MÖ; project administration: SDA and MÖ. All authors have read and agreed to the final version of the manuscript.

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Data Availability

Data available from the corresponding author on reasonable request, subject to institutional data sharing policies.

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Figures



Figure 1

Six-panel comparative analysis of ED utilization metrics. Panel A: Triage category distribution (p=0.040; V=0.011). Panel B: Admission area distribution (p<0.001; V=0.032). Panel C: Age distribution density histograms, median 35 vs 36 years (p=0.026; d=0.029). Panel D: Consultation rates by specialty — cardiology showing the only clinically meaningful increase (OR=1.603; p=0.001). Panel E: Forensic case distribution (p=0.242; V=0.007). Panel F: Top 8 primary ICD-10 discharge diagnoses.

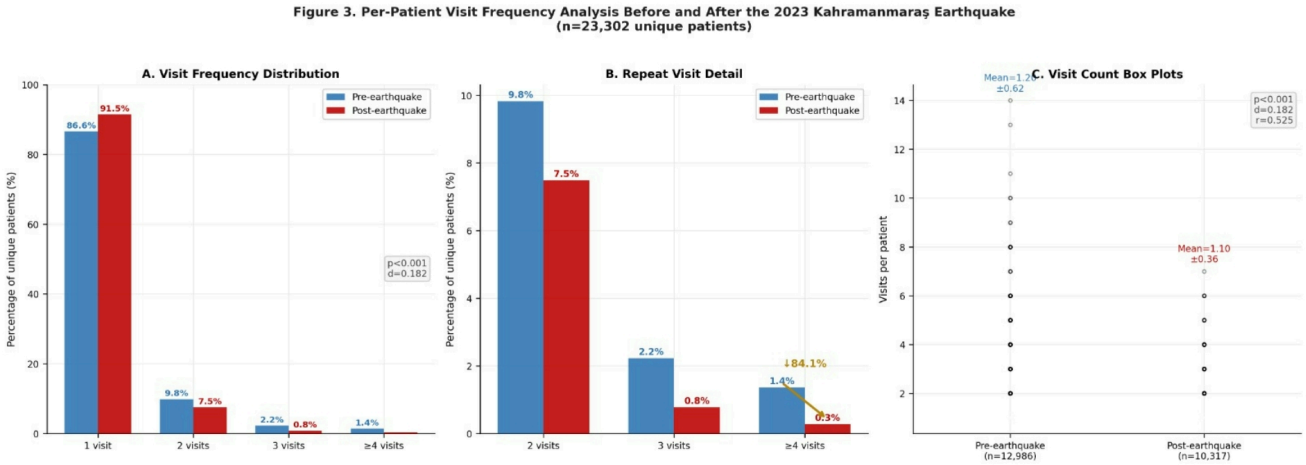


Figure 2

Per-patient visit frequency analysis (n=23,302 unique patients). Panel A: Overall frequency distribution. Panel B: Repeat-visit detail — 84.1% relative reduction in high-frequency users (≥4 visits). Panel C: Box plots of visit counts per patient (pre mean 1.20±0.62, range 1–14; post mean 1.10±0.36, range 1–7; p<0.001; Cohen's d=0.182).

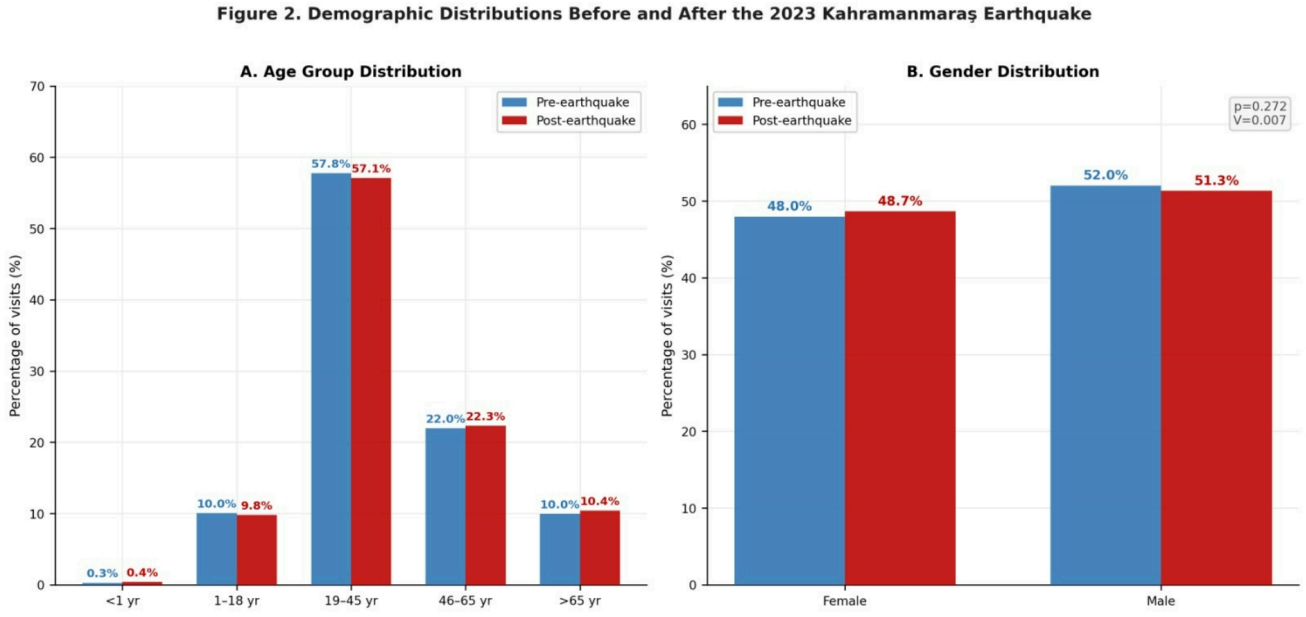


Figure 3

Demographic distributions. Panel A: Age group distribution. Panel B: Gender distribution (p=0.272; V=0.007).