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RESEARCH ARTICLE

An Evaluation of Firearm Injury Cases in Emergency Medical Services

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ABSTRACT

Objective: This study retrospectively evaluates Ankara Emergency Medical Services' (EMS) prehospital responses to firearm injuries concerning demographic characteristics, response times, and outcomes.

Materials and Methods: Data were extracted from the Ankara EMS database (ASOS) encompassing firearm injury cases from January 1, 2019, to December 31, 2023, totaling 2,764 cases. Descriptive statistics were analyzed across years, focusing on EMS response times.

Results: Of the 2,764 cases analyzed, 92.1% involved male patients and 7.9% female patients. Most incidents (71.2%) occurred on weekdays compared to weekends (28.8%). Soft tissue traumas accounted for 53.5% of cases, followed by interhospital transports (21.3%), medical cases (13.7%), and suicides (11.4%). Regarding outcomes, 65.6% of cases were transported to a hospital, 21.3% underwent interhospital transfers, and 11.4% were declared dead on arrival. The average call center response time was 324.6 seconds, ambulance team response time was 45.1 seconds, and time to scene arrival averaged 502.9 seconds.

Conclusion: Ankara EMS demonstrated prompt and effective responses to firearm injuries, predominantly involving male patients. Most cases were directed to training and research hospitals, highlighting these institutions' pivotal role in EMS operations. These findings provide valuable insights for enhancing EMS protocols and future research. This study aims to inform and guide future investigations in this field.

Keywords: Emergency medicine, firearm injury, prehospital care

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INTRODUCTION

Countries have developed different systems for delivering emergency medical services (EMS), with the Franco-German and Anglo-American systems being among the most significant. The primary distinction lies in how patients access medical care.[1] Türkiye employs the Anglo-American system, which prioritizes expeditious transport of patients to facilities for definitive treatment.[2] In cases of trauma, timely responses from the call center, prompt ambulance departure and arrival times, vital interventions at the scene, and efficient transport to hospitals are crucial. Swift interventions enhance survival rates and minimize long-term complications. Moreover, well-functioning EMS systems and rapid diagnostic and treatment processes generally improve efficiency and optimize resource utilization.[3]

There is limited literature, particularly in Türkiye, on prehospital management of firearm injuries. Our study addresses this gap by retrospectively analyzing a substantial number of cases over a 5-year period. We aim to contribute significantly to the literature by evaluating firearm injuries based on demographic characteristics, time of occurrence, EMS call center response times, ambulance departure and arrival times, vital interventions at the scene, and transportation duration to hospitals. This evaluation aims to assess the current state of EMS and inform necessary adjustments based on our findings and other studies.

MATERIALS and METHODS

Our study is a retrospective analysis of firearm injury cases recorded in the Ankara EMS database (ASOS) from January 1,

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2019, to December 31, 2023. The study protocol was approved by the Ankara Bilkent City Hospital Ethics Committee (approval date: June 12, 2024; approval number: TABED-2-24-296). Patient consent for the review of medical records was waived by the ethics committee, and the study adhered to the principles outlined in the Declaration of Helsinki.

A total of 2,764 cases from the ASOS database within the specified timeframe were included in the study. The study encompassed all age groups and patient demographics within the EMS structure. Cases with incomplete data or missing any of the research parameters were excluded from the analysis.

Statistical Analysis

All data were analyzed using the Statistical Package for the Social Sciences for Windows, version 27.0 (IBM Corp., Armonk, NY). Descriptive statistical methods including frequency, percentage, mean, standard deviation, median, and quartiles were employed to analyze the study data. The Chi-Square test was utilized to compare categorical data, and where differences were found in multiple comparisons, post-hoc Bonferroni correction was applied to determine specific variations. Normal distribution of quantitative data was assessed using the Kolmogorov-Smirnov test, Skewness-Kurtosis analysis, and graphical methods such as histograms, Q-Q plots, stem-and-leaf plots, and boxplots. Quantitative data demonstrating normal distribution across groups were compared using one-way Analysis of Variance (ANOVA). Following identification of significant differences in this test, post-hoc Tukey tests were conducted. Statistical significance was set at $p<0.05$.

RESULTS

A total of 2,764 cases from the ASOS database spanning five years were included in our study. Of these cases, 92.1% (n=2.545) were men and 7.9% (n=219) were women. The majority of incidents occurred on weekdays (71.2%, n=1.968) compared to weekends (28.8%, n=796). The mean age of participants was 32.7±12.9 years (Table 1).

The distribution of cases by type included 53.5% (n=1,480) soft tissue traumas, 21.3% (n=590) interhospital transports, 13.7% (n=380) medical cases, and 11.4% (n=314) suicides. In terms of outcomes, 65.6% (n=1.814) of cases were transported to hospitals, 1.6% (n=44) refused transport, 21.3% (n=590) were transferred between hospitals, and 11.4% (n=316) were pronounced dead on arrival. Among those transported to hospitals, 72.7% (n=1.319) went to training and research hospitals, 15.8% (n=287) to public hospitals, 9.5% (n=172) to university hospitals, and 2% (n=36) to private hospitals. For interhospital transfers, 93.1% (n=549) were directed to training and research hospitals and 5.3% (n=31) to university hospitals, primarily due to the need for specialist care (77.1%, n=455) (Table 1).

The mean call center response time was 324.6±348.2 seconds, ambulance team response time was 45.1±36.6 seconds, and scene arrival time was 502.9±434.8 seconds (Table 2). Yearly comparisons revealed significant differences in cases within ambulance teams' operating areas ($p=0.017$) and urban versus rural cases ($p=0.012$) in 2023 compared to previous years. Significant differences were also noted in the distribution of patients transported to different types of hospitals across different years. Call center response times differed significantly between 2020 and other years, while ambulance team response times showed variance between earlier and later years (Table 3).

No significant differences were found between years concerning gender, nationality, or reasons for transportation needs (Table 3).

DISCUSSION

Firearm injuries constitute significant causes of mortality and morbidity in Türkiye and globally.[4] Understanding and evaluating this issue is crucial for both the economy and societal quality of life. This retrospective study assesses Ankara EMS's response to prehospital firearm injuries, focusing on response times, and demographic characteristics. The study aims to not only evaluate the current situation but also provide insights for future research and EMS development.

Our study identified several key findings regarding response times and demographic characteristics. The majority of cases (92.1%) involved men, consistent with findings by Fowler et al.[4] and Klassen et al.,[5] suggesting a higher prevalence of firearm injuries among men.

Most incidents occurred on weekdays, with no significant variation across different days. The high rate of hospital transports observed can be attributed to Türkiye's adoption of the Anglo-American EMS model, facilitating prompt transfer to definitive care centers. Zenginol et al.[6] similarly noted predominant transports to public hospitals in Gaziantep EMS, whereas our study highlighted training and research hospitals as primary recipients.

In our study, the main reason for interhospital transports was the need for a specialist physician. Similar to our study, Dal et al.[7] reported that the need for a specialist physician was the primary reason for interhospital transports. This

Table 1. Characteristics of cases

	n=2.764	%
Year		
2019	425	15.4
2020	464	16.8
2021	537	19.4
2022	653	23.6
2023	685	24.8
Months		
January	129	4.7
February	174	6.3
March	181	6.5
April	185	6.7
May	276	10
June	288	10.4
July	292	10.6
August	291	10.5
September	255	9.2
October	276	10
November	197	7.1
December	220	8
Seasons		
Spring	642	23.2
Summer	871	31.5
Autumn	728	26.3
Winter	523	18.9
Days of week		
Monday	408	14.8
Tuesday	389	14.1
Wednesday	408	14.8
Thursday	387	14
Friday	376	13.6
Saturday	388	14
Sunday	408	14.8
Time interval		
00:00–07:59	581	21
08:00–15:59	850	30.8
16:00–23:59	1.333	48.2
Working hours		
In working hours	1.028	37.2
Out of working hours	1.736	62.8
Patient Nationality		
Turkish	2.704	97.8
Others	60	2.2
By operating area		
In operating area of the ambulance team	1.532	55.4
Out of operating area of the ambulance team	1.232	44.6

Table 1. Cont.

	n=2.764	%
By urban/rural area		
In Urban area	2.424	87.7
In Rural area	340	12.3
By ambulance assignment results		
Transported to a hospital	1.814	65.6
Training and Research Hospitals	1.319	72.7
Public Hospitals	287	15.8
University Hospitals	172	9.5
Private Hospitals	36	2
Transported between hospitals	590	21.3
By Referrer/Sender hospital		
Training and Research Hospitals	107	18.1
Public Hospitals	463	78.5
University Hospitals	14	2.4
Private Hospitals	6	1
By receiver hospital (inter-hospital patient transport)		
Training and Research Hospitals	549	93.1
Public Hospitals	2	0.3
University Hospitals	31	5.3
Private Hospitals	8	1.4
Reason for transport		
Need for specialist physician care	455	77.1
Need for intensive care	75	12.7
No available beds in the hospital	25	4.2
Need for Advanced Medical Equipment	24	4.1%
Patient's own demand for transport	11	1.9
Dead on Arrival	316	11.4
Patient refused to be transported to a hospital	44	1.6

Table 2. Response times

	Mean±SD	Median (IQR)
Call center response time (in seconds)	324.6±348.2	195.0 (112.0–385.8)
Response time of the ambulance unit (in seconds)	45.1±36.6	38.0 (19.0–58.0)
Arrival at scene time (in seconds)	502.9±434.8	339.0 (220.0–564.0)

SD: Standard deviation; IQR: Interquartile range

verifies that the biggest problem of sender hospitals is the lack of specialist physicians.

Regarding response times, the ambulance units' response time was determined to be 45.1 seconds, significantly below the Turkish Ministry of Health's standard limit of responding in less than 90 seconds. Küçükkelepçe et al.[8] similarly found that ambulance units in the Adıyaman EMS achieved a response time of 43.9 seconds. These findings collectively affirm the effective functioning of EMS overall.

In Türkiye's EMS, patients are transported promptly to the healthcare facility where they can receive definitive treatment. This approach is based on the Golden Hour concept,

Table 3. Comparisons of cases by year

	2019 (n=425)	2020 (n=464)	2021 (n=537)	2022 (n=653)	2023 (n=685)	p	Difference
	n (%)	n (%)	n (%)	n (%)	n (%)		
Gender							
Women	39 (9.2)	37 8	46 (8.6)	49 (7.5)	48 7	0.705[a]	–
Men	386 (90.8)	427 (92)	491 (91.4)	604 (92.5)	637 (93)		
Patient Nationality							
Turkish	412 (96.9)	455 (98.1)	522 (97.2)	642 (98.3)	673 (98.2)	0.410[a]	–
Others	13 (3.1)	9 (1.9)	15 (2.8)	11 (1.7)	12 (1.8)		
By operating area							
In operating area	249 (58.6)	234 (50.4)	266 (49.5)	354 (54.2)	429 (62.6)	0.017[a]	Between 2023 and
Out of operating area of the ambulance team	176 (41.4)	230 (49.6)	271 (50.5)	299 (45.8)	256 (37.4)		2020-2021-2022
By urban/rural area							
In Urban area	366 (86.1)	413 (89)	450 (83.8)	563 (86.2)	632 (92.3)	0.012[a]	Between 2023 and
In Rural area	59 (13.9)	51 (11)	87 (16.2)	90 (13.8)	53 (7.7)		2019-2021-2022
Transported to...							
Training and Research Hospitals	216 (70.4)	278 (76.6)	221 (67.4)	287 (73.8)	317 (74.2)	0.239[a]	–
Public Hospitals	55 (17.9)	52 (14.3)	66 (20.1)	59 (15.2)	55 (12.9)		–
University Hospitals	30 (9.8)	28 (7.7)	31 (9.5)	37 (9.5)	46 (10.8)		–
Private Hospitals	6 (2)	5 (1.4)	10 (3)	6 (1.5)	9 (2.1)		–
By receiver hospital (inter-hospital patient transport)							
Training and Research Hospitals	14 (24.6)	20 (33.9)	21 (16.2)	24 (13.1)	28 (17.4)	0.048[a]	Between 2020 and 2022
Public Hospitals	41 (71.9)	37 (62.7)	104 (80)	155 (84.7)	126 (78.3)		Between 2020 and 2022
University Hospitals	2 (3.5)	2 (3.4)	4 (3.1)	1 (0.5)	5 (3.1)		–
Private Hospitals	0 (0.00)	0 (0.00)	1 (0.8)	3 (1.6)	2 (1.2)		–
By receiver hospital (inter-hospital patient transport)							
Training and Research Hospitals	50 (87.7)	49 (83.1)	123 (94.6)	171 (93.4)	156 (96.9)	0.001[a]	Between 2020 and 2023
Public Hospitals	0 (0.00)	0 (0.00)	2 (1.5)	0 (0.00)	0 (0.00)		–
University Hospitals	6 (10.5)	8 (13.6)	4 (3.1)	12 (6.6)	1 (0.6)		Between 2023 and 2019–2020–2022
Private Hospitals	1 (1.8)	2 (3.4)	1 (0.8)	0 (0.00)	4 (2.5)		–
Reason for transport							
Need for specialist physician care	42 (73.7)	44 (74.6)	93 (71.5)	141 (77)	135 (83.9)	0.123[a]	–
Need for intensive care	7 (12.3)	4 (6.8)	26 (20)	24 (13.1)	14 (8.7)		–
No available beds in the hospital	4 (7)	4 (6.8)	5 (3.8)	9 (4.9)	3 (1.9)		–
Need for Advanced Medical Equipment	2 (3.5)	4 (6.8)	4 (3.1)	6 (3.3)	8 (5)		–
Patient's own demand	2 (3.5)	3 (5.1)	2 (1.5)	3 (1.6)	1 (0.6)		–
Call center response time (in seconds)	334.1±381.8	406.9±398.3	270.4±279.0	337.3±393.9	293.3±274.0	<0.001[b]	Between 2020 and other years
Response time of the ambulance unit (in seconds)	37.9±28.8	38.6±30.9	45.5±36.5	53.9±44.0	45.3±34.9	<0.001[b]	Between 2019-2020 and 2021-2022-2023
Arrival at scene time (in seconds)	459.0±406.6	493.6±422.2	537.3±463.5	554.9±462.6	459.7±402.0	<0.001[b]	Between 2019-2023 and 2021-2022

[a]: Chi-Square test; [b]: One-way ANOVA test. ANOVA: Analysis of Variance

which aims to provide definitive care within 60 minutes to enhance survival rates.[9] Shortening response times can particularly benefit trauma patients.[10,11]

Over time, ambulance teams have had fewer cases assigned outside their designated operating areas. With the increase in the number of stations, the necessity for ambulance teams to respond outside their operational zones has decreased. We propose that rapid response times to trauma cases such as firearm injuries will positively impact patient outcomes. Hatten and Wolff[12] noted that the distance between the incident location and the medical center influenced mortality rates in firearm injuries.

In 2023, there was a notable rise in urban areas compared to rural areas, which may be attributed to urban population growth. A similar observation was documented by Patel et al.[13] in a Lancet study, where they noted that firearm injuries were most prevalent in urban settings.

From 2020 to 2023, there was an increase in transports to training and research hospitals, whereas transports to university hospitals decreased. The demand for university hospitals surged during the pandemic period in 2020, resulting in higher volumes of patient transfers to these facilities. The rise in transfers to training and research hospitals may be attributed to their status as the highest-level institutions within the healthcare system. Gönçer Demiral and Özen[14] similarly noted that a majority of cases were transferred to higher-level hospitals.

When considering the originating hospitals in inter-hospital transports, a significant difference was observed in the number of cases transferred from training and research hospitals versus public hospitals between 2020 and 2022. There was an increase in the number of patients transported from both types of hospitals. This suggests that directing patients from the scene to hospitals where definitive treatment is available may enhance survival rates. Waalwijk et al.[15] similarly concluded that transporting patients to high-level trauma hospitals improves 24-hour survival rates.

When call center response times were analyzed across different years, a significant difference was noted between 2020 and the preceding years. The longer response times observed in 2020 may be attributed to the impact of the pandemic. Saberian et al.[16] similarly reported a three-fold increase in case volumes during the pandemic period compared to before.

There was a significant difference in ambulance units' response times between 2019–2020 and 2021–2022–2023. The reduction in response times over the years may be attributed to the expansion of ambulance units and personnel. Response times play a crucial role in transporting patients to hospitals, and shorter times are associated with lower mortality and morbidity rates. Nasser et al.[17] similarly reported that each additional minute in response time increased mortality by 2%. Likewise, Crandall et al.[18] concluded that the risk of death was higher for incidents occurring more than 5 miles from a trauma center.

No significant differences were observed between years regarding gender, nationality, and reasons for transportation needs. This stability suggests a consistent demographic structure in the region over the study period. Similar findings were reported by Zeineddin et al.[19] in their study on firearm injuries from 2003 to 2015, where they also noted no significant variations in demographic characteristics among affected groups.

A primary limitation of our study is its single-center design. While conducted over an extensive period, more comprehensive and generalizable results could be achieved by incorporating data from multiple provinces. Evaluating cases based on treatment outcomes at the receiving hospital could further enhance EMS improvement efforts.

CONCLUSION

This study presents a critical evaluation of Ankara EMS's management of firearm injuries. Our findings underscore the essential steps needed for advancing EMS capabilities and offer valuable insights for future research. The study emphasizes the crucial nature of rapid and efficient EMS responses. In cases like firearm injuries, where every second counts, reducing response times is imperative. This can be achieved through technological advancements, enhanced staff training, and strategic resource allocation.

Disclosures

Ethics Committee Approval: The study was approved by the Ankara Bilkent City Hospital Ethics Committee (No: TABED-2-24-296, Date: 12/06/2024).

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