Original Article

Analysis of Injuries Caused by Electric Scooters Admitted to the Emergency Department: A Prospective Observational Study

TC Ozturk, M Ekşioğlu, YE Sağmal

Department of Emergency Medicine, University of Health Sciences Fatih Sultan Mehmet Education and Research Hospital, Istanbul, Turkiye

Abstract

Objective: This study aims to investigate and analyze the patterns, types, and epidemiology of E-scooter-related injuries presenting to the emergency department as well as to determine possible factors that may affect the severity of injury. **Methods:** This is a prospective observational study conducted in an inner-city tertiary education and research hospital with 290,000 annual emergency admissions in tax in Istanbul, Turkiye. The study period was defined as 01.02.2022–01.02.2023. Patients presenting to the emergency department with an electrical scooter injury were included in the study. **Results:** A total of 137 electrical scooter cases were included in the study. Our results revealed a male predominance (73.7%), with the highest incidence observed in the 17–25 age group. Most accidents involved the electrical scooter rider (92.7%), occurring predominantly as falls (75.2%) and commonly on main roads (70.8%). Accidents were more prevalent during weekdays and between 07:00 and 18:00, aligning with commuting hours. In terms of severity, 83.9% were classified as minor (ISS < 9), 9.5% as moderate (ISS = 9–15), 2.9% as severe (ISS = 16–25), and 3.6% as critical (ISS > 25). Traumatic brain injuries were observed in 12 patients. 4.4% had concussion, and 4.4% intracranial hemorrhage. One of the patients with subarachnoid hemorrhage died in an intensive care unit. **Conclusion:** Although minor injuries are more common, the fact that we have a deceased case and patients with potentially fatal traumatic brain injuries suggests accidents involving electrical scooters should be carefully examined and preventive measures and regulations should be implemented by the governments.

Keywords: *Electric scooter, emergency department, E-scooter, injury severity, trauma*

Received: 11-Jun-2024;
Revision: 07-Jan-2025;
Accepted: 03-Mar-2025;
Published: 11-Apr-2025

Introduction

In recent years, electric scooters (E-scooters), have gained popularity as a useful and alternative way in urban transportation.[1] Vehicle rental companies, especially in metropolises, facilitate the access of these vehicles.[2,3] However, laws and regulations on E-scooters are not standardized and the adequacy of traffic rules regarding their use is still debated.

The use of E-scooters, including whether there is an age limit for use, whether there is an obligation to wear protective clothing, or whether a driving license is required, varies widely between countries. As an example, in the UK, E-scooters, like Segways, hoverboards, go-peds, and motorized unicycles, are recognized as 'powered transporters' and require a category Q license to operate.[4] Likewise, in the United States of America (USA), we see that different legal practices and regulations apply from state to state.[5] In Turkiye, an official regulation was issued by the government in April 2021.[6] The E-scooter has been defined as "a vertical scooter used in a standing position, with a maximum speed of 25 km/h, with wheels, a brake mechanism, a footboard and a handle". However, as is

Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/njcp.njcp_388_24

Address for correspondence: Dr. TC Ozturk, Department of Emergency Medicine, University of Health Sciences Fatih Sultan Mehmet Education and Research Hospital, 34470, Istanbul, Turkiye.
E-mail: tcimilliozturk@gmail.com

How to cite this article: Ozturk TC, Ekşioğlu M, Sağmal YE. Analysis of injuries caused by electric scooters admitted to the emergency department: A prospective observational study. Niger J Clin Pract 2025;28:385-92.

well known, there are vehicles on the market that are much more powerful and can reach a higher speed. There is no driving license requirement in Turkiye, and the age limit for riding an E-scooter is 16 years. Protective gear or even a helmet is not compulsory.[6,7] On the other hand, since none of these vehicles, especially those for personal use, have a 'vehicle license', it is not possible to carry out proper traffic checks.

As expected, all these have resulted in increased E-scooter injuries. Not only the riders but also pedestrians and other motor vehicle drivers are at risk. Injuries vary in nature and severity, ranging from minor abrasions to more critical trauma requiring immediate medical intervention. Data on injury patterns and injury severity are also limited and generally based on retrospective data.[8-10]

This study aims to investigate and analyze the patterns, types, and epidemiology of E-scooter-related injuries presenting to the emergency department (ED) of a tertiary care hospital. By discussing the available literature on this emerging public health issue, we aim to contribute to the understanding of the possible precipitating factors associated with E-scooter use, potential preventive measures, and the wider public health implications. To our knowledge, this is one of the few studies to prospectively evaluate the severity of E-scooter injuries.

Methodology

This study was conducted as a prospective observational study in an inner-city tertiary education and research hospital with 290,000 annual emergency department (ED) admissions in Istanbul, the largest metropolis in Turkiye between 01.02.2022 and 01.02.2023. Approval of the study was granted by the Ethics Review Committee at the University of Health Sciences Fatih Sultan Mehmet Education and Research Hospital (FSMEAH-KAEK 2022/6). Informed consent was obtained from all individual participants included in the study.

All patients who were pedestrians, riders, or passengers describing an injury with an E-scooter presenting to the ED were included. Patients who could not be followed up were planned to be excluded. The age groups were determined as ≤16, 17–25, 26–40, 41–64, and >65 years according to the article by Trivedi *et al*.[8] With a small difference, in our study, the age limit for children was accepted as 16 years since injury severity score (ISS) was calculated. In addition to demographic data, the injured and/or eyewitnesses were interviewed about the characteristics of the road where the accident occurred, the mechanism of injury, and riding habits. The results and outcomes of the patients' examinations, final diagnoses, severity of injury examinations, and operation records of the patients were later tracked by the hospital automation system. ISSs were determined using the Abbreviated Injury Scale (AIS). The AIS of each system was calculated according to the final diagnosis and radiological examinations and in consultation with the surgeons of the operated patients. Patients were classified as minor ISS (<9), moderate (9–15), severe (16–24), and critical (>25).[11] At the same time, calculations were made according to ISS 15, which was accepted as the threshold for severe trauma. Accordingly, ISS <16 was accepted as mild trauma and ISS ≥16 as severe or major trauma.[12] For children <16 years, the ISS was also used, but the threshold for severe or major trauma was accepted as >25.[13]

Statistical analyses

Statistical analyses of the study were performed using Statistical Package for Social Sciences for windows (IBM SPSS version 28.0, Armonk, NY, USA) software. The normality assumption of continuous quantitative variables was tested with the Kolmogorov–Smirnov test. Descriptive statistics of the variables are given as median (Min-Max) and frequencies as *n* (%). Pairwise group comparisons of continuous quantitative variables included in the study were made using the Mann–Whitney U test, and more than two group comparisons were made using the Kruskal–Wallis test. Pairwise comparisons of groups with significant differences as a result of the Kruskal–Wallis test were made using the Mann–Whitney U test and evaluated by applying the Bonferroni correction (0.05/number of groups). Analysis of categorical variables was made using Chi-square, Fisher Exact, and Fisher–Freeman–Halton Exact tests, taking into account the number of categories and expected values. Statistical significance was accepted as $P < 0.05$.

Results

A total of 137 E-scooter cases were included in the study. There were no patients who could not be followed up. Descriptive statistics of the victims are given in Table 1. 101 (73.7%) of the patients were male, and 36 (26.3%) were female. The median age of the patients was 26 years (4–72 years). According to age groups, the highest number of victims was observed in the 16–25 age group.

Accidents are more frequent in autumn and summer ($P = 0.000$). The number of cases during the weekdays (64.2%) was significantly higher than the number of cases at the weekend (35.8%) ($P = 0.000$). The majority of the cases presented between 07:00 and 18:00 [Figure 1].

Overall, 28.5% of the cases presented by ambulance. Riders were the most commonly injured (92.7%). The

Table 1: Patient demographics and outcome according to injury severity

Variables	All patients *n*=137	ISS		*P*
		Mild (ISS <16) *n*=128	Severe (ISS ≥16) *n*=9	
Gender, *n* (%)				0.445*
Male	101 (73.7%)	93 (72.7%)	8 (88.9%)	
Female	36 (26.3%)	35 (27.3%)	1 (11.1%)	
Age (Years) groups, *n* (%)				0.073*
≤16	10 (7.3%)	10 (7.8%)	0 (0.0%)	
17–25	54 (39.4%)	52 (40.6%)	2 (22.2%)	
26–40	49 (35.8%)	47 (36.7%)	2 (22.2%)	
41–64	23 (16.8%)	18 (14.1%)	5 (55.6%)	
65+	1 (0.7%)	1 (0.8%)	0 (0.0%)	
Injured person, *n* (%)				0.703*
Driver	127 (92.7%)	118 (92.2%)	9 (100.0%)	
Passenger	2 (1.5%)	2 (1.6%)	0 (0.0%)	
Pedestrian	8 (5.8%)	8 (6.3%)	0 (0.0%)	
Mechanism of accident, *n* (%)				0.106*
Fall from the E-scooter	103 (75.2%)	98 (76.6%)	5 (55.6%)	
Collision with a motor vehicle	21 (15.3%)	17 (13.3%)	4 (44.4%)	
Collision with another E-Scooter or E-bike	4 (2.9%)	4 (3.1%)	0 (0.0%)	
Hitting a pedestrian	9 (6.6%)	9 (7.0%)	0 (0.0%)	
Personal protective clothing, *n* (%)				0.509*
None	127 (92.7%)	119 (93.0%)	8 (88.9%)	
Only Clothing	7 (5.1%)	6 (4.7%)	1 (11.1%)	
Helmet	2 (1.5%)	2 (1.6%)	0 (0.0%)	
Helmet and clothing	1 (0.7)	1 (0.8%)	0 (0.0%)	
Alcohol/drug consumption, *n* (%)				0.460#
No	126 (92.0%)	117 (91.4%)	9 (100.0%)	
Yes	11 (8.0%)	11 (8.6%)	0 (0.0%)	
Brain hemorrhage, *n* (%)				0.000#
No	131 (95.6%)	128 (100.0%)	3 (33.3%)	
Yes	6 (4.4%)	0 (0.0%)	6 (66.7%)	
Outcome, *n* (%)				0.000*
Discharged from ED	113 (82.5%)	113 (88.%)	0 (0.0%)	
Operation	18 (13.1%)	13 (10.2%)	5 (55.6%)	
ICU admission	1 (0.7%)	0 (0.0%)	1 (11.1%)	
Ward admission	2 (1.5%)	0 (0.0%)	2 (22.2%)	
Leave against medical advice	2 (1.5%)	2 (1.6%)	0 (0.0%)	
Exitus in ICU	1 (0.7%)	0 (0.0%)	1 (100.0%)	

*Fisher–Freeman–Halton Exact test, #Fisher Exact test, *P* values indicate comparisons between groups according to ISS value. Significance was accepted as $P<0.05$. ED=Emergency department, ICU=Intensive care unit

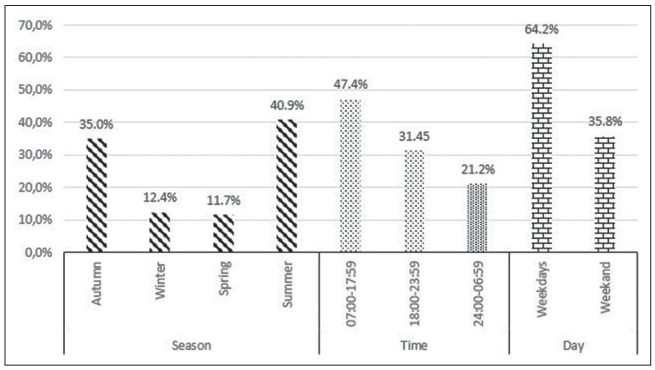

Figure 1: Percentage distribution of the emergency admissions according to the seasons, the time groups, and the day (weekdays: Monday–Friday, weekend: Saturday–Sunday). Statistical significance was accepted as $P<0.05$

passenger injury rate was 1.5%, and the pedestrian injury rate was 5.8% (P = 0.000). 75.2% of the cases were falls, 15.3% were collisions with motorized vehicles, 2.9% were collisions with electric vehicles, and 6.6% were collision with pedestrians. While 11.7% of those owned their own E-scooter, 85.4% had a rented E-scooter (P = 0.000).

Most of the victims were not wearing any protective gear (92.7%). 70.8% of the accidents occurred on the road, 21.9% on the pavement, 4.4% on the road closed to traffic, and 2.9% on the motorway (P = 0.000). A significant number of victims (64.2%) stated that they were using E-scooter for transport, while 8.0% of the victims had

Table 2: Accident characteristics according to injury severity

	All patients *n*=137	ISS		*P*
		Mild (ISS <16) *n*=128	Severe (ISS ≥16) *n*=9	
Season, *n* (%)				0.304*
Autumn	48 (35.0%)	47 (36.7%)	1 (11.1%)	
Winter	17 (12.4%)	15 (11.7%)	2 (22.2%)	
Spring	16 (11.7%)	15 (11.7%)	1 (11.1%)	
Summer	56 (40.9%)	51 (39.8%)	5 (55.6%)	
Day of the accident, *n* (%)				0.899*
Monday	19 (13.9%)	17 (13.3%)	2 (22.2%)	
Tuesday	17 (12.4%)	16 (12.5%)	1 (11.1%)	
Wednesday	14 (10.2%)	14 (10.9%)	0 (0.0%)	
Thursday	20 (14.6%)	19 (14.8%)	1 (11.1%)	
Friday	17 (12.4%)	15 (11.7%)	2 (22.2%)	
Saturday	25 (18.2%)	24 (18.8%)	1 (11.1%)	
Sunday	25 (18.2%)	23 (18.0%)	2 (22.2%)	
Day of the accident, *n* (%)				0.490#
Weekend (Saturday-Sunday)	49 (35.8%)	47 (36.7%)	2 (22.2%)	
Weekdays	88 (64.2%)	81 (63.3%)	7 (77.8%)	
Hour, *n* (%)				0.824*
07–18	65 (47.4%)	60 (46.9%)	5 (55.6%)	
18–24	43 (31.4%)	40 (31.3%)	3 (33.3%)	
24–07	29 (21.2%)	28 (21.9%)	1 (11.1%)	
Accident scene, *n* (%)				0.841*
Main Road/Street	97 (70.8%)	89 (69.5%)	8 (88.9%)	
Pavement	30 (21.9%)	29 (22.7%)	1 (11.1%)	
Road closed to traffic	6 (4.4%)	6 (4.7%)	0 (0.0%)	
Motorway	4 (2.9%)	4 (3.1%)	0 (0.0%)	
Who owns the E-scooter? *n* (%)				0.003*
Personally owned	16 (11.7%)	11 (8.6%)	5 (55.6%)	
E-scooter for rent	117 (85.4%)	113 (88.3%)	4 (44.4%)	
Unknown	4 (2.9%)	4 (3.1%)	0 (0.0%)	
Purpose of E-scooter use *n* (%)				0.574*
Transportation	88 (64.2%)	81 (63.3%)	7 (87.5%)	
Sightseeing/entertainment	39 (28.5%)	38 (29.7%)	1 (12.5%)	
Unknown	10 (7.3%)	9 (7.0%)	0 (0.0%)	
Frequency of using E-scooters, *n* (%)				0.969*
First time	8 (5.8%)	8 (6.3%)	0 (0.0%)	
Everyday	22 (16.1%)	20 (15.6%)	2 (22.2%)	
From time to time	62 (45.3%)	57 (44.5%)	5 (55.6%)	
Once a week	36 (26.3%)	34 (26.6%)	2 (22.2%)	
Unknown	9 (6.6%)	9 (7.0%)	0 (0.0%)	

*Fisher–Freeman–Halton Exact test, #Fisher Exact test, *P* values indicate comparisons between groups according to ISS value. Significance was accepted as $P<0.05$

consumed alcohol/substance. Traumatic brain injuries were observed in 12 patients. Intracerebral hemorrhage was found in 4.4% of victims ($P = 0.000$). 4.4% ($n = 6$) of the patients had concussion, and 4.4% ($n = 6$) of had intracranial hemorrhage (4 subarachnoid, 1 epidural, 1 subdural). Two of them required emergency surgery. Overall, 13.1% of victims underwent surgery ($P = 0.000$). Three of them were emergency surgeries. Of the victims admitted to ED, 82.5% were discharged from ED, 13.1% underwent surgery, 0.7% were admitted to ICU, and 1.5% were admitted to the ward. One of the patients who had subarachnoid hemorrhage died (0.7%) in ICU before undergoing surgery.

When the victims were grouped according to ISS scores, 83.9% were classified as minor (ISS < 9), 9.5% as moderate (ISS = 9–15), 2.9% as severe (ISS = 16–25), and 3.6% as critical (ISS > 25), ($P = 0.000$). When 16 is accepted as the cutoff value for injury severity, 93.4% of the victims fell into the mild group (ISS < 16) and 6.6% into the severe group (ISS ≥ 16) ($P = 0.000$). The

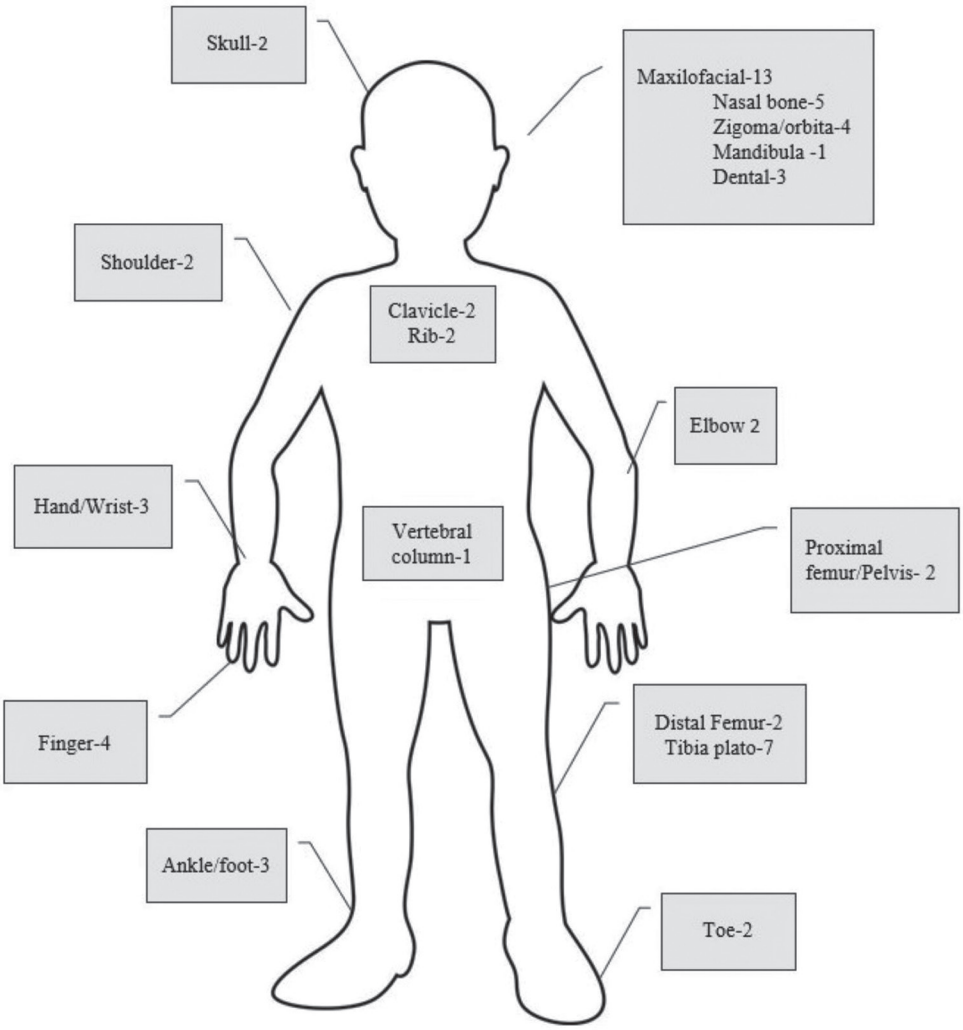

Figure 2: Distribution of fractures

median ISS of the victims was 2 (1–27). ISSs of 26–40 and 41–64 age groups were higher than those of other age groups ($P = 0.027$).

Table 1 shows the patient characteristics and outcome comparisons of mild (ISS < 16) or severe (ISS ≥ 16) groups. Table 2 presents the accident characteristics. According to these results, the relationship between ISS groups and E-scooter ownership was statistically significant ($P = 0.003$). While 8.6% of the victims in the mild group had an accident with their own E-scooter, 55.6% of the victims in the severe group had an accident with their own E-scooter. Intracranial hemorrhage occurred in 66.7% of the patients. In the severe group, 55.6% of the patients underwent surgery. Table 3 summarizes the injury characteristics. Figure 2 shows the distribution of fractures. Soft tissue injuries (abrasions, bruises, lacerations, grazes, contusions) are the most observed injuries. While the thorax and abdomen were relatively preserved, the injuries were mostly observed in the lower extremities, upper extremities, and head and maxillofacial areas, respectively.

Discussion

This study revealed a male predominance (73.7%) among E-scooter injury cases, with the highest incidence observed in the 16–25 age group. Predominance of males and young adults in our study is consistent with patterns observed in other trauma scenarios and the scooter-related traumas.[9,14,15] Young adults are often early adopters of emerging technologies, including electric scooters, and are more prone to risk-taking behaviors.[3,16]

The temporal distribution showed a significant association with seasons, peaking in autumn and summer, which is consistent with the studies conducted in Turkiye.[17,18] Notably, accidents were more prevalent during weekdays and between 07:00 and 18:00, aligning with commuting hours. The purpose of use

Table 3: Injury characteristics of the patients

Injury characteristics	Number of patients (*n*)	Percentage of total (%)
Any fracture	43	31.4%
Any soft tissue injury	122	89.1%
Any laceration	18	13.1%
Head		
Skull fracture	2	1.5%
Concussion	6	4.4%
Epidural, subdural, subarachnoid haemorrhage	6	4.4%
Vertebral column (sacrum fracture)	1	0.7%
Maxillofacial		
Zygomatic/orbital fracture	4	2.9%
Mandibula fracture	1	0.7%
Nasal fracture	5	3.6%
Dental fracture	3	2.2%
Thorax		
Rib fracture	2	1.5%
Clavicle fracture	2	1.5%
Pneumothorax/ pneumomediastinum	1	0.7%
Soft tissue injury	6	4.4%
Abdomen		
Organ damage	0	0%
Soft tissue injury	2	1.5%
Upper extremity		
Soft tissue injury and sprain other than fracture	36	26.3%
Finger fracture	4	2.9%
Hand-wrist fracture	3	2.2%
Elbow fracture	2	1.5%
Shoulder fracture	2	1.5%
Lower extremity		
Soft tissue injury and sprain other than fracture	48	35%
Toe fracture	2	1.5%
Foot/ankle fracture	3	2.2%
Knee (proximal tibia/distal femur) fracture	9	6.6%
Proximal femur/pelvis fracture	2	1.5%
Requiring surgery	18	13.1%
Orthopaedics	12	8.8%
Maxillofacial	4	2.9%
Neurosurgery	2	1.5%

Any soft tissue injury = abrasion, laceration, bruises, grazes, contusions

varied, with 64.2% for transportation and 28.5% for sightseeing/entertainment. This distribution highlights the importance of E-scooters in urban transport.

The majority of accidents involved the E-scooter rider (92.7%), occurring predominantly as falls (75.2%) and commonly on main roads (70.8%). The prevalence of falls as the most common type of accident aligns with studies by Beck *et al*. and Kılıç *et al*.[10,17] Collisions with a motorized vehicle were also recorded in a significant proportion of the cases (15.3%). Our results are emphasizing the importance of understanding the mechanisms of injury for targeted preventive measures. An important aspect of our study is that 5.8% of the injured were pedestrians (n = 8, 2 in the pediatric age group). Although it is forbidden to use E-scooters on the pavement in Turkiye, 21.9% of accidents occurred on the pavement. These results support that legal measures and inspections are inadequate and personal measures to be taken will not be sufficient.

The incidence of injuries associated with rented scooters, reported in this study, corresponds with the study by İğrek *et al*.,[15] which was also conducted in Turkiye and raises questions about the safety measures implemented by rental services. Besides, most of the studies have reported that the use of protective equipment is low as in our study.[8,9,17] The majority of accidents involving riders not wearing protective clothing or helmet and the high percentage of rented E-scooters raise concerns about user safety practices and also the influence of rental programs. One reason for this may be that riders hire the E-scooter, perhaps to avoid traffic jams, and often do not have protective clothing because it is an unplanned trip.

The injury severity spectrum in this ranged from minor to critical, with 93.4% classified as mild (ISS <16) and 6.6% as severe (ISS ≥16). There are very few studies investigating injury severity with ISS.

Igrek *et al*.,[15] in their study of orthopaedic cases only, reported minor trauma according to ISS in 38 (61.4%) patients, moderate trauma in 23 (37%) patients, and major trauma (ISS >15) in 1 (1.6%) patient, with a mean ISS of 4.2. This difference may be due to the fact that only orthopedic cases were included in the study. In another study presenting ISS data in e-scooter injuries, Yilmaz *et al*.[19] reported a median ISS of 2 (min 1–max 11). In contrast to our study, they did not report any severe or critical cases. In their study, it was reported that 85.5% of accidents occurred at the beach. In our study, most of the accidents occurred on main roads and streets, but there were also accidents on motorways. This difference may be related to the location of the hospitals. Indeed, there are also studies reporting critical trauma. Brownson *et al*.[9] reported ISS results in their study ranged from 1 to 29 (median 4, IQR 4). There were 8 patients (4.4%) with ISS >12. Cittadin *et al*.[20] reported the median ISS in their study cohort as 3 (IQR, 1–5). In our study, the ISS was also compared according to age and it was found that the ISS medians were statistically different according to age (P = 0.027).

Accordingly, the ISS scores of the 26–40 and 41–64 age groups were higher than those of other age groups. When the data were analyzed in terms of possible factors determining severe injury, no statistically significant result was found except for age. This may be due to the low number of severe cases in our patient group. In summary, the literature suggests that most e-scooter injuries are minor, but fatal injuries do occur, especially at older ages, although rarely.

In terms of injury characteristics, our results were consistent with the literature. Minor soft tissue injuries are the most common injuries. The most commonly injured areas are lower extremities. Most common fractures were observed in the knee (the most common was tibial plateau fracture). This is followed by upper extremities and head-face. Injuries to the torso and spine were relatively rare.[9,14,21]

Traumatic brain injuries were observed in 12 patients. 4.4% (n = 6) of our patients had concussion, and 4.4% (n = 6) had intracranial hemorrhage (4 subarachnoid, 1 epidural, 1 subdural). Two of them required emergency surgery. One of the patients who had subarachnoid hemorrhage died in the intensive care unit before undergoing surgery. Similarly, Trivedi *et al*. reported 2.2% and Brownson *et al.*[8,9] reported 4.4% intracranial hemorrhage. Suominen *et al*.,[22] in their 2-year study conducted in Finland, reported a total of 104 cases of traumatic brain injury due to E-scooter injuries and found intracranial hemorrhage in 18 of the cases. In their study, 71.2% of patients reported alcohol use. It is likely that this high rate of intracranial hemorrhage is also associated with high alcohol consumption. In our study, only 8% of patients declared alcohol and/or illicit drug use. No association was found between alcohol use and the severity of trauma in this study, but this may become more apparent in larger populations.

The single-center design may limit the generalizability of findings to other urban settings. Although it is not compulsory in Turkiye, the presence of a driving license was not questioned in this study. Even the possession of driving license of any type can contribute to awareness of traffic rules. Also, the speed of the scooters and road conditions could not be detailed. There may also be a potential bias in the self-reporting of protective equipment and helmet use.

Conclusion

This study contributes to the limited pool of prospective research on E-scooter injuries. Our results show that E-scooters are frequently used by young people in a metropolis like Istanbul for transportation during working hours. Although these vehicles are not capable of traveling at relatively high speeds and most injuries are minor, injuries with the potential to result in fatal or permanent disability can also occur. The presence of serious head traumas suggests that the use of a helmet should be taken into consideration and the use of protective clothing may be useful in preventing possible extremity fractures. The risk factors and injury patterns identified emphasize the need for comprehensive regulatory measures to improve safety practices.

Acknowledgements

We would like to thank Emergency Medicine Department Residents for their valuable support in the collection of patient data.

Author contributions

All authors whose names appear on the submission made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data; or the creation of new software used in the work; drafted the work or revised it critically for important intellectual content; approved the version to be published; and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethics approval and consent to participate

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Review Committee at the University of Health Sciences Fatih Sultan Mehmet Education and Research Hospital (FSMEAH-KAEK 2022/6). Informed consent was obtained from all individual participants included in the study.

Financial support and sponsorship

None.

Conflicts of interest

The authors declare no competing interests.

References

1. Liao F, Correia G. Electric carsharing and micromobility: A literature review on their usage pattern, demand, and potential impacts. Int J Sustain Transp 2022;16:269-86. doi: 10.1080/15568318.2020.1861394.
2. Bozzi AD, Aguilera A. Shared E-scooters: A review of uses, health and environmental impacts, and policy implications of a new micro-mobility service. Sustainability 2021;13:8676. doi: 10.3390/su13168676.
3. Roig-Costa O, Miralles-Guasch C, Marquet O. Shared bikes vs. private e-scooters. Understanding patterns of use and demand in a policy-constrained micromobility environment. Transp Policy 2024;146:116-25. doi: 10.1016/j.tranpol.2023.11.010.
4. E-scooter Trials: Guidance for Users. Available from: https://www.gov.uk/guidance/e-scooter-trials-guidance-for-

users#driving-licences. [Last accessed on 2023 Dec 10].
5. Operating an Electric Scooter or Bicycle with Electric Assist. New York State Department of Motor Vehicles. Available from: https://dmv.ny.gov/registration/electric-scooters-and-bicycles-and-other-unregistered-vehicles. [Last accessed on 2023 Dec 10].
6. Elektrikli Skuter Yönetmeliği. Available from: https://www.resmigazete.gov.tr/eskiler/2021/04/20210414-3.htm. [Last accessed on 2023 Dec 19].
7. Elektrikli Skuter Yönetmeliği. T. C. Ulaştırma ve Altyapı Bakanlığı. Available from: https://www.uab.gov.tr/uploads/pages/mevzuatlar/01-uab-eskuter-katalog-a4-130421.pdf. [Last accessed on 2023 Dec 19].
8. Trivedi TK, Liu C, Antonio ALM, Wheaton N, Kreger V, Yap A, *et al*. Injuries associated with standing electric scooter use. JAMA Netw Open 2019;2:e187381. doi: 10.1001/jamanetworkopen.2018.7381.
9. Brownson ABs, Fagan, PVb, Dickson S, Civil LDs. Electric scooter injuries at Auckland City Hospital. NZ Med J 2019;132:62-72.
10. Beck S, Barker L, Chan A, Stanbridge, S. Emergency department impact following the introduction of an electric scooter sharing service. Emerg Med Australas 2020;32:409-15. doi: 10.1111/1742-6723.13419.
11. Bolorunduro OB, Villegas C, Oyetunji TA, Haut ER, Stevens KA, Chang DC, *et al*. Validating the Injury Severity Score (ISS) in different populations: ISS predicts mortality better among Hispanics and females. J Surg Res 2011;166:40-4. doi: 10.1016/j.jss. 2010.04.012.
12. Merrik C. Chief editor. Trauma Scores. In Advanced Trauma Life Support. 10th ed. Chicago, IL: American College of Surgeons;2018. p.392-4.
13. Braun JB, Gestring ML, Leeper CM, Speery JL, Peitzman AB, Biliar TR, *et al*. The value of the injury severity score in pediatric trauma: Time for a new definition of severe injury? J Trauma Acute Care Surg 2017;82:995-1001. doi: 10.1097/TA.0000000000001440.
14. Yavuz BG, Temel TZ, Satilmis D, Güven R, Çolak Ş. Analysis of electric scooter injuries admitted to the emergency service. Ir J Med Sci 2022;191:915-8. doi: 10.1007/s11845-021-02628-w.
15. İğrek S, Ulusoy İ. E-scooter-related orthopedic injuries and the treatments applied: Are these scooters a new means of transportation or a new source of trauma? BMC Emerg Med 2023;23:110. doi: 10.1186/s12873-023-00873-z.
16. Ma C, Yang D, Zhou J, Feng Z, Yuan Q. Risk riding behaviors of urban e-bikes: A literature review. Int J Environ Res Public Health 2019;16:2308. doi: 10.3390/ijerph 16132308.
17. Kılıç S, Yüksel M, Şahin M, Oto A, Eraybar S, Durak VA, *et al*. The investigation of electric scooter accident cases admitted to the emergency department: A multicenter study. Med Sci Discov 2023;10:640-6. doi: 10.36472/msd.v10i8.1026.
18. Büyükceran İ, Ersoy A, Şay CŞ, Coşkun HS, Tomak Y. The epidemiology and the treatment of fractures due to electric scooters: A comparison of pediatric and adult age groups. Cureus 2023;15:e37807. doi: 10.7759/cureus. 37807.
19. Yılmaz S, Akman G, Ustaalioğlu İ, Kılıç M, Emem Mk. Examination of emergency department patients involved in E-scooter related accidents. South Clin Istanb Eurasia 2022;33:281-5. doi: 10.14744/scie.2022.25901.
20. Cittadini F, Aulino G, Petrucci M, Valentini S, Covino M. Electric scooter–related accidents: A possible protective effect of helmet use on the head injury severity. Forensic Sci Med Pathol 2023;19:319-24. doi: 10.1007/s12024-022-00546-6.
21. Uluk D, Lindner T, Dahne M, Bickelmayer JW, Beyer K, Slagman A, *et al*. E-scooter incidents in Berlin: An evaluation of risk factors and injury patterns. Emerg Med J 2022;39:295-300. doi: 10.1136/emermed-2020-210268.
22. Suominen EN, Sajanti AJ, Silver EA, Koivunen V, Bondfolk AS, Koskimaki J, *et al*. Alcohol intoxication and lack of helmet use are common in electric scooter-related traumatic brain injuries: A consecutive patient series from a tertiary university hospital. Acta Neurochir (Wien) 2022;164:643-53. doi: 10.1007/s00701-021-05098-2.