

The Escalating Burden of E-Scooter-Related Injuries: A Two-Year Comparative Analysis

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Abstract

Aim

Electric scooter (e-scooter) injuries represent an emerging challenge in Emergency Departments due to their rising incidence and associated resource demands. This study is a follow up from our previous study which demonstrated that 50% of e-scooter injuries required specialist orthopaedic referral ¹. This study aims to analyse trends in e-scooter-related injuries presenting to a tertiary referral centre and to evaluate the clinical outcomes, management strategies, and compare service impact over a two-year period.

Methods

This is a retrospective analysis of all patients presenting to our hospital between 1st August 2023 and 31st July 2024. We compared our data to our previous study which analysed e-scooter presentations between 1st August 2021 and 31st July 2022. Datapoints measured included mechanism of injury, type of injury, use of safety equipment, outcome of emergency presentation, admission length, surgery performed, and follow-up.

Results

A total of 306 patients were included, increasing from 105 in Phase 1 (1st August 2021 – 31st July 2022) to 201 in Phase 2 (1st August 2023 – 31st July 2024) ($p = 0.157$). Fractures were identified in 134 e-scooter presentations (43%), and 27 patients (8.9%) required emergency fixation. Physiotherapy referrals rose from 4.8% to 34.3% ($p = 0.001$), and wound care needs increased from 6.7% to 14.4% ($p = 0.07$). Orthopaedic clinic visits rose (mean 1.96 to 3.1), while admission (13.3% vs. 13.4%, $p = 1.0$) and surgery rates (9.5% vs. 8.5%, $p = 0.92$) remained stable.

Discussion/Conclusion

This study highlights a significant increase in both the frequency and complexity of e-scooter-related trauma over two years, with rising rates of vertebral and hip fractures, wound care needs, and physiotherapy referrals. Despite stable admission and surgical rates,

outpatient and allied health burdens have escalated. These findings underscore the need for targeted public health interventions to mitigate injury severity and reduce preventable harm.

Introduction

The widespread adoption of electric scooters (e-scooters) as a mode of urban transport has led to a significant rise in injury presentations to Emergency Departments worldwide ². Marketed as convenient and environmentally friendly, e-scooters are often used without adequate regulation or safety measures, contributing to an increasing incidence of trauma ³.

E-scooter-related injuries can range from minor abrasions to complex fractures and head trauma, often requiring multidisciplinary input including emergency, orthopaedic, and rehabilitation services ². The unpredictable nature of these injuries, combined with limited use of protective equipment and frequent involvement of intoxicated riders, poses a growing challenge for the healthcare system ⁴.

Despite the rising use of e-scooters, longitudinal data on injury trends, healthcare resource utilisation, and patient outcomes remain limited. This study builds on our 2024 publication by comparing two consecutive years of e-scooter-related presentations at a level 3 tertiary referral centre, assessing changes in injury patterns, management strategies, and the downstream healthcare impact.

In line with recent national developments, the National Office of Clinical Audit (NOCA) has announced that data on e-scooter-related trauma will be incorporated into future Major Trauma Audit (MTA) reports ⁵. The MTA, which monitors care for severely injured patients across Ireland, aims to enhance trauma system quality through detailed audit and benchmarking. This growing national focus on e-scooter safety underscores the importance of institutional data, such as ours, in identifying trends and informing evidence-based policy.

Methods

We performed a retrospective analysis of all patients presenting to our adult emergency department with e-scooter-related injuries. Our hospital is a university teaching hospital located in a suburban catchment area serving a population of over 450,000 people ⁶. We searched our electronic triage database for all triage notes containing the words 'scooter', 'e-scooter', or 'escooter' during Phase 1 (1st August 2021 – 31st July 2022) and Phase 2 (1st August 2023 – 31st July 2024). The records of those identified were reviewed and excluded if their injury was not associated with e-scooter use. Datapoints measured included

mechanism of injury, type of injury, collision vs fall, use of safety equipment, outcome of emergency presentation, admission length (if admitted), surgery (if required), and follow-up.

Ethical approval was sought for this study and was approved by our institution's ethics board to be completed as a clinical audit.

This is a descriptive study of a case series. We report proportions, calculate means and standard deviations for normally distributed data, and calculate medians with interquartile ranges for non-normally distributed data. Comparisons between Phase 1 and Phase 2 were performed using the Chi-square or Fisher's exact test for categorical variables and the Student's *t*-test or Mann–Whitney *U* test for continuous variables, as appropriate. A *p*-value of <0.05 was considered statistically significant.

Results

A total of 306 patients met the inclusion criteria over the two-year study period, with cases increasing from 105 to 201 between Phase 1 and Phase 2 ($p = 0.157$). The majority of patients were male, rising from 63% ($n = 66$) to 83% ($n = 167$) ($p = 0.001$), and the mean age remained stable (33.6 vs. 34 years, $p = 0.796$) (Table 1). Falls were the predominant mechanism of injury, increasing from 71.4% ($n = 75$) to 85% ($n = 171$), $p = 0.001$.

While there was a paucity of documentation regarding whether the patient was under the influence of alcohol or recreational drugs, recorded alcohol-related incidents nearly doubled between phases, increasing from 3.8% ($n = 6$) to 7% ($n = 14$) ($p = 0.86$). Use of helmets or protective gear remained low, rising only from 0.95% ($n = 1$) to 3% ($n = 6$) ($p = 0.47$).

	Phase 1	Phase 2
	(1 st August 2021 – 31 st July 2022)	(1 st August 2023 to 31 st July 2024)
Number of patients meeting inclusion criteria	105	201
Mean age	33.6 years	34 years
Gender	63% male ($n = 66$)	83% male ($n = 167$)
Fall vs collision	71.4% fall ($n = 75$)	85% fall ($n = 171$)

Table 1: Demographics.

The injuries received by the e-scooter patients are outlined in Table 2. The format of the table has been adapted from Trivedi et al. ⁷. The most common injury was a fracture, accounting for 37.3% (n = 75) of patients. This was followed by soft tissue injuries, with 14.4% (n = 29) of patients presenting with an isolated contusion, sprain, or laceration. Head injuries were recorded in three patients (1.5%), including one case (0.5%) of intracranial haemorrhage. Vertebral column fractures were noted in 5 patients (6.7%), and dislocations were uncommon, occurring in only three cases (1.5%) overall.

Injury type ^a	Patients (n = 105) No. (%)	Patients (n = 201) No. (%)
Fracture	59 (56.2%)	75 (37.3%)
Upper extremity	34 (32.4%)	39 (52%)
Distal	29 (27.6%)	29 (38.7%)
Proximal	5 (4.8%)	10 (13.3%)
Lower extremity	17 (16.2%)	19 (25.3%)
Distal	11 (10.5%)	16 (21.3%)
Proximal	0	3 (4%)
Facial	6 (5.7%)	4 (5.3%)
Vertebral Column	0	5 (6.7%)
Thoracic	2 (1.9%)	8 (10.7%)
Head Injury		
Minor ^b	4 (3.8%)	2 (0.9%)
Intracranial haemorrhage	2 (1.9%)	1 (0.5%)
Contusions / sprains / lacerations with no fracture or head injury	39 (37.1%)	29 (14.4%)
Dislocations		
Major	2 (1.9%)	1(0.5%)
Minor ^c	1 (0.9%)	2 (0.9%)
Major intra- abdominal/intrathoracic injuries ^d	1 (0.9%)	1 (0.5%)
^a Categories are not mutually exclusive		
^b Minor head injuries are classified as all recorded head injuries that did not result		

in fracture or haemorrhage c"Minor dislocations are those of the fingers and toes d"Major intra-abdominal or intrathoracic injuries are defined as any internal injury of the thorax, abdomen, and pelvis represented by the <i>International Classification of Diseases, Ninth Revision</i>, codes 860 to 869". The case included was a splenic laceration. Adapted from Trivedi et al. ⁷	
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Table 2: Breakdown of injury types

	1 st August 2021 – 31 st July 2022	1st August 2023 to 31st July 2024
	Patients (n = 105)	Patients (n = 201)
Patients	No. (%)	No. (%)
Ortho clinic / VFAC	44 (41.9%)	83 (41.3%)
Average number of clinic visits	1.96	3.1
Admitted	14 (13.3%)	27 (13.4%)
Average LOS	3.3 days	2.8 days
Transferred to other specialist unit	4 (3.8%)	3 (1.49%)
Physiotherapy/ OT	5 (4.8%)	69 (34.3%)
Wound management	7 (6.7%)	29 (14.4%)
Requiring Orthopaedic Theatre	10 (9.52%)	17 (8.46%)

Table 3: Outcome from ED referral. (Patients with stable or minor injuries were referred to the Virtual Fracture Assessment Clinic (VFAC), a service allowing remote review of imaging and triage for appropriate management or discharge. This model facilitates efficient follow-up while reducing unnecessary face-to-face appointments.)

The outcome for each patient's emergency attendance is summarised in Table 3. Admission rates remained consistent across both phases, with 13.3% (n = 14) in Phase 1 and 13.4% (n = 27) in Phase 2 requiring inpatient care (p = 1.0). However, the mean length of stay decreased from 3.3 days (range 1–11 days) to 2.8 days (range 1–12 days). Specialist unit transfers were less frequent in Phase 2 (1.49% vs. 3.8%) (p = 0.377), with fewer patients requiring escalation to tertiary care. Notably, referrals to physiotherapy/occupational therapy increased significantly from 4.8% (n = 5) in Phase 1 to 34.3% (n = 69) in Phase 2 (p = 0.001).

Over the two years, 27 patients (8.8%) required orthopaedic surgery, with comparable rates across both phases (9.5% in Phase 1 vs. 8.5% in Phase 2) ($p = 0.92$). Three hip fractures were recorded in Phase 2, representing a higher energy injury pattern, with associated morbidity not observed in Phase 1, and were associated with prolonged hospital stays and greater rehabilitation needs. Wound care needs more than doubled (6.7% vs. 14.4%, $p = 0.07$). Additionally, the average number of orthopaedic clinic visits increased markedly from 1.96 to 3.1, indicating a rise in the complexity of follow-up care. These trends collectively point toward a growing burden on outpatient and allied health services, despite stable rates of admission and operative management.

Discussion

Since their introduction in 2017, the global use of e-scooters has grown steadily in popularity³. This rise has been accompanied by an increasing incidence of e-scooter-related injuries worldwide^{3,8}. The growing population of e-scooters is likely influenced by multiple factors, including the rising cost of car ownership, elevated fuel prices, and inadequate access to dependable public transport¹.

As of May 2024, e-scooters have been legalised for use on Irish roads under the Road Traffic and Roads Act 2023. Riders must be over 16 years-old, and devices are limited to 20 km/h with a maximum motor power of 400 W⁹. E-scooters are permitted on cycle lanes and roads but remain prohibited on footpaths, motorways, and pedestrian zones⁹. There is no requirement for protective equipment, a driving licence, insurance, or road tax, nor are there specific restrictions related to driving under the influence. In contrast, countries like Germany and France require insurance for e-scooters, and in parts of Australia, helmet wearing is mandatory^{10,11}.

To our knowledge, our study represents the most extensive study on e-scooter injuries conducted in an Irish population. This study demonstrates a marked rise in both the frequency and complexity of e-scooter-related trauma presenting to a tertiary emergency department, with the number of presentations nearly doubling over the two years—reflecting increased usage and associated risk. While the overall proportion of patients requiring surgical intervention remained stable at 8.8%, there was a notable increase in higher energy injury pattern, with associated morbidity, including vertebral and hip fractures. Hip fractures were seen exclusively in Phase 2, are associated with significantly higher rates of morbidity and mortality compared to other fractures¹².

The pattern of injuries observed—predominantly upper limb fractures—aligns with international literature and reflects the common mechanism of low-impact falls¹³. While human behaviour is a prominent factor in e-scooter injuries, the structural design of e-

scooters, including a compact base, limited suspension, and an upright stance, likely contributes to loss of balance, especially when navigating uneven surfaces or during sharp turns ^{13, 14}.

Although admission rates (13.3% vs. 13.4%) and operative intervention (9.5% vs. 8.5%) remained comparable between phases, the complexity of follow-up care increased significantly. We again reported lower operative rates compared to previous Irish studies which demonstrated rates ranging from 36% to 60% ¹⁵⁻¹⁷. This is in comparison to an international systematic review of 34 studies showed an operative rate of 16% ⁴. A total of 340 orthopaedic clinic visits were recorded over the study period, with the average number of visits per patient rising from 1.96 to 3.1. Referrals to physiotherapy and occupational therapy also surged, from 4.8% in Phase 1 to 34.3% in Phase 2, indicating more prolonged functional impairment and the need for extended multidisciplinary input. Wound management requirements more than doubled (6.7% vs. 14.4%). Fractures were the most common injury type (43.8%), and over 13% of patients required inpatient admission. Despite the stable surgical workload, the demands on allied health and follow-up services are intensifying.

Limitations of this study include its retrospective nature as well as the paucity of documentation regarding safety equipment and intoxication rates.

In conclusion, this study demonstrates a significant rise in both the volume and complexity of e-scooter-related injuries presenting to a tertiary Emergency Department. Alcohol-related incidents nearly doubled, while protective equipment use remained critically low, despite the rising injury rate. These findings underscore the need for proactive public health strategies to mitigate injury severity, including stricter enforcement of helmet use, targeted public education campaigns, and reform of urban transport policies.

Declarations of Conflicts of Interest:

None declared.

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References:

1. Rigney B, Mahoney R, Quinlan J, McGoldrick N. A one year analysis of e-scooter injuries: more than half require specialist follow-up. *Irish medical journal*. 2024;117(10):1050.
2. Kobayashi LM, Williams E, Brown CV, Emigh BJ, Bansal V, Badiie J, et al. The e-merging e-pidemic of e-scooters. *Trauma surgery & acute care open*. 2019;4(1):e000337.
3. Barker R. Electric scooters. *Emergency medicine Australasia*. 2019;31(6):914-5.
4. Singh P, Jami M, Geller J, Granger C, Geaney L, Aiyer A. The impact of e-scooter injuries: a systematic review of 34 studies. *Bone & joint open*. 2022;3(9):674-83.
5. Lynch D. E-scooter data to be included in trauma audit reports - NOCA The Medical Independent
6. HSE. Dublin Midlands Hospital Group Homepage: Tallaght University Hospital. Accessed 29th May 2023 [Available from: <https://www.hse.ie/eng/about/who/acute-hospitals-division/hospital-groups/dublin-midlands-hospital-group/our-hospitals/tallaght-university-hospital/>].
7. Trivedi TK, Liu C, Antonio ALM, Wheaton N, Kreger V, Yap A, et al. Injuries Associated With Standing Electric Scooter Use. *JAMA Network Open*. 2019;2(1):e187381-e.
8. Bloom MB, Noorzad A, Lin C, Little M, Lee EY, Margulies DR, et al. Standing electric scooter injuries: Impact on a community. *The American Journal of Surgery*. 2021;221(1):227-32.
9. Road Safety Authority I. New laws on the use of e-scooters in Ireland. 2024.
10. Sokolowski MM. Laws and policies on electric scooters in the european union: A ride to the micromobility directive? *European Energy and Environmental Law Review*. 2020;29(4).
11. Zhang Y, Nelson JD, Mulley C. Learning from the evidence: Insights for regulating e-scooters. *Transport policy*. 2024;151:63-74.
12. de Grae MNM, Marland H, Murphy C, Kearns S. Anticoagulation-Associated Delays in Acute Hip Fractures. *Ir Med J*. 2024;117(7):P1001.
13. Mehranfar V, Jones C. Exploring implications and current practices in e-scooter safety: A systematic review. *Transportation Research Part F: Traffic Psychology and Behaviour*. 2024;107:321-82.
14. Paudel M, Fah Yap F. Front steering design guidelines formulation for e-scooters considering the influence of sitting and standing riders on self-stability and safety

- performance. Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering. 2021;235(9):2551-67.
15. O'Halloran A, Tyrell O, Correia P, Fox C. An analysis of e-scooter-related trauma in Ireland: an update. Irish Journal of Medical Science (1971-). 2025;194(1):371-4.
 16. O'Halloran A, Cunniffe G, O'hEireamhoin S, Colgan G, Moroney P, O'Briain D, et al. Orthopaedic Injury Patterns Associated with Electric-Scooter Use.
 17. Grace M, Fahy S, Farrell A, Fox C. An analysis of e-scooter related trauma. Ir Med J. 2021;114:387.