

Original Article

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Injuries following accidents with electric scooters

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ABSTRACT

INTRODUCTION: Since the introduction of electric scooter (e-scooter) rental services in Denmark in January 2019, injuries following accidents involving e-scooters have increased. Internationally, a few studies have been published examining patient and injury characteristics following accidents involving e-scooters. However, data are limited. The purpose of this study was to describe the injuries, treatment and hospital course following accidents involving e-scooters.

METHODS: Prospective collection of data on all persons involved in accidents related to e-scooters who were examined and treated at the Emergency Department of Bispebjerg and Frederiksberg, Denmark, during the period from 30 June 2019 to 30 September 2019.

RESULTS: A total of 49 patients, 37 (75.5%) male, 46 riders and three non-riders, with a median age of 26 years (range: 8-56 years) were admitted to the emergency department. Common injuries were head injuries (46.9%) and fractures (26.5%). Most patients (79.6%) were discharged to their home from the emergency department after treatment without further hospital follow-up.

CONCLUSIONS: The majority of persons involved in e-scooter accidents are young men. Our results revealed a high frequency of head injuries and fractures. Most patients were discharged to their home after treatment in the emergency department.

FUNDING: none.

TRIAL REGISTRATION: The study was approved as a quality control project by the Head of the Department of Emergency Medicine and the Head of the Hospital Administration.

Electric scooter (e-scooter) rental services were introduced in Denmark in January 2019 [1]. Since then, their availability has increased considerably [2]. The e-scooters are inexpensive and easily accessible, and paid for by using a mobile application. An e-scooter is a motorised vehicle with a narrow deck and a steering column and handlebar. The rider controls the scooter using triggers or buttons on the handlebar to accelerate and brake. The speed limit is 20 km/h [3].

There are a few international studies on the injury and patient characteristics. Trivedi et al published a study on the injuries associated with e-scooter use in the US. They reported a high frequency of head injuries and fractures [4]. Another study from New Zealand analysed data on 54 cases of e-scooter-related injuries; 46% had isolated minor musculoskeletal injuries, 32% had a fracture or a dislocation and 26% had a head injury [5].

Studies on injuries related to e-scooter accidents in Denmark are sparse. A recently published Danish

retrospective study by Blomberg et al described the prehospital evaluation of injuries associated with electric and manual scooter use. The authors concluded that patients who were injured following e-scooter accidents were young adults often under the influence of alcohol or drugs and that the injuries were usually facial trauma [6]. However, the data were not verified by data from the emergency departments (ED) and therefore possibly under-reporting certain injuries.

Given the increasing popularity of e-scooters, more detailed information on the types of injuries and further insight into the treatment of the patients in the ED is warranted. The purpose of this study was therefore to provide a detailed description of the injuries and hospital course following accidents with e-scooters.

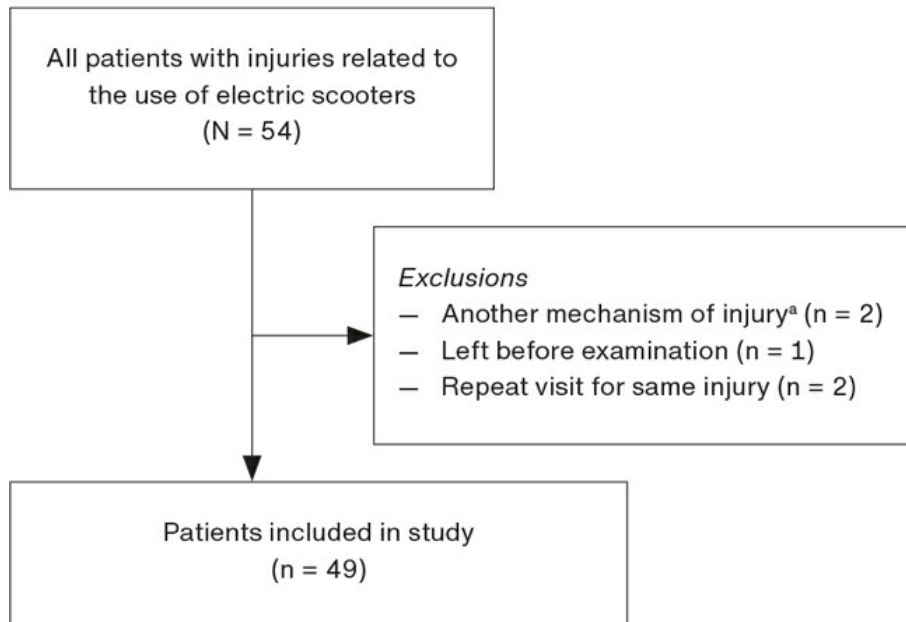
METHODS

This study was conducted as a population-based cohort study based on prospective collection of data on patients with injuries related to the use of e-scooters presenting to the Emergency Department of the Bispebjerg and Frederiksberg Hospital. The study period was from 30 June 2019 to 30 September 2019. A copy of the electronic medical record and data on patients with e-scooter accidents were archived by the secretary staff after the visit to the ED. Secretary staff were regularly reminded during morning briefings to collect the relevant documentation. The medical records were reviewed by an author (KN) to assess eligibility and collect data on patient characteristics, mechanism of injury, types of injuries and if the patients were discharged home or hospitalised for further examination and treatment. Information on helmet use and alcohol intake was obtained from the medical records if such information was available. The Injury Severity Score (ISS) was calculated based on the Abbreviated Injury Scale. An ISS score of 1-8 is defined as minor trauma, 9-15 as moderate trauma and greater than 15 as major or polytrauma.

Inclusion and exclusion criteria

The injuries had to be caused by an e-scooter, e.g., falling while riding, colliding, tripping over the scooters or being hit by an e-scooter. Patients were subsequently classified as either riders or non-riders. Injuries related to use of other modes of transportation, e.g., electric longboard, manual scooters or Segways were not included. Repeat visits to the ED concerning the same injury were not included. Any patients treated previously for the same injury at another ED were not included. See flow chart in **Figure 1**.

FIGURE 1 Flow chart



a) Another mode of transportation (n = 1) and no trauma involved (n = 1).

Data analysis

Categorical variables are reported as counts and percentages. Continuous data are presented as medians with interquartile ranges (IQR) and range.

Trial registration: The study was approved as a quality control project by the head of the department of emergency medicine and the head of the hospital administration.

RESULTS

Population

A total of 54 patients were admitted to the ED with injuries related to the use of e-scooters. Five were excluded and 49 patients were included in the cohort, see flow chart in Figure 1.

Table 1 presents the patient characteristics. The median age was 26 years (IQR: 22-41 years, range: 8-65 years) and the majority of patients were male (75.5%). A total of 46 (93.9%) patients were classified as riders and three (6.1%) as non-riders. Helmet use or disuse was generally not reported by the treating physicians, and only one patient was reported as “not wearing a helmet”.

TABLE 1 Patient characteristics (N = 49).

	n (%)	Median (IQR), yrs
<i>Gender</i>		
Male	37 (75.5)	
<i>Age</i>		26 (22-41)
< 18 yrs	5 (10.2)	
18-30 yrs	23 (46.9)	
31-50 yrs	15 (28.6)	
> 50 yrs	6 (12.2)	
Tourist	7 (14.3)	

IQR = interquartile range.

Mechanism of injury

Among the riders, 43 (93.5%) fell while riding the e-scooter, two (4.3%) collided with an object and one patient (2.2%) was injured using the kick stand. The non-riders were two pedestrians and one cyclist, all of whom were hit by an e-scooter.

Injury pattern and treatment

Table 2 shows the frequencies of different injury types, allowing for more than one injury per patient. Head injury was the most common injury. A total of 23 (46.9%) patients sustained one or more injuries to the head and/or facial region. In most cases, head injuries were minor, 12 (24.5%) had wounds that required sutures, eight (16.3%) had a closed-head injury without concomitant symptoms of concussion, four (8.2%) had dental fractures and three (6.1%) patients experienced symptoms of concussion. One patient had multiple intracranial haemorrhages and an orbital fracture that did not require surgical intervention. Loss of consciousness was reported in one patient. Brain CT was performed in three patients, and an S100B blood test was measured in one patient.

A total of 17 (34.7%) patients sustained a contusion, sprain or wound without a concomitant fracture or head injury. None of the wounds required sutures.

Thirteen (26.5%) patients had fractures, the most common being a closed fracture of the upper extremity. Indication for surgical treatment was found in a single case of a metacarpal fracture. All other fractures were managed conservatively. Fracture reduction was performed only once to treat a metacarpal fracture.

The median ISS was 1, ranging 1-13. Thus, none of the patients suffered major trauma.

TABLE 2 Pattern of injuries.

	n (%)
<i>Head injury</i>	
Intracranial haemorrhage	1 (2.0)
Minor ^a	22 (44.9)
Subtotal	23 (46.9)
<i>Dental fractures</i>	
Dental fractures	4 (8.2)
<i>Any fracture</i>	
Facial	1 (2.0)
Caput radii	3 (6.1)
Distal radius	1 (2)
Carpal	2 (4.1)
Metacarpal	4 (8.2)
Phalanx:	
Hand	2 (4.1)
Foot	1 (2.0)
Subtotal	13 ^b (26.5)
Contusions, lacerations and sprains without head injury or fracture	17 (34.7)

a) Concussions, lacerations and contusions.

b) 1 patient had 2 fractures.

Hospital course

Most patients (79.6%) were discharged to their home from the ED after primary examination and treatment without planned follow-up. Nine patients (18.4%) were referred for further management in an outpatient clinic or referred to the private sector, e.g. otologist or dentist. The patient with intracranial haemorrhage was admitted to the ICU and was discharged in good clinical condition after a hospital stay of less than one week.

DISCUSSION

Our study produced three main results: 1) The injured patients are typically younger men. 2) Head injury and fractures are a common finding in patients injured while riding an e-scooter. 3) Only one patient was admitted to a hospital ward.

Firstly, our findings of gender and age distribution are similar to those of a recent retrospective study from Southern California including 249 patients. In that study, most patients (61.0%) were between the ages of 18-40 years, ranging 8-89 years, and the majority of the patients were male (58.2%) [4].

Secondly, our findings regarding the pattern of injuries are also comparable with those of other studies from EDs in the US by Trivedi et al and by the Epidemiology and Disease Surveillance Unit from Austin Public Health, reporting head injury in 40-48% of the patients and fractures in 31-35% of the patients [4, 7].

A recent Danish study based on prehospital medical records by Blomberg et al reported fractures in 11.6% of

patients injured while riding an e-scooter [6]. The difference is likely based on a prehospital versus in-hospital evaluation of injuries, as subtle fractures may not be obvious upon pre-hospital clinical examination. Indeed, the majority of fractures in our study required no reduction or surgery and were managed conservatively. Nonetheless, timely diagnosis and proper fracture management remain important since conservative measures, such as cast immobilisation, can be essential in preventing complications [8].

Lastly, while most injuries required limited medical intervention and resources, long-term effects following trauma to the head cannot be assessed at the patient's first contact to the ED. Persisting debilitating effects, such as chronic headaches and fatigue as seen in post-concussion syndrome, may be seen in up to 38% of patients following a head trauma with a brief disturbance of consciousness [9]. These sequelae usually resolve after 3-6 months, while persistent symptoms may occur in a minority of patients [10]. Future studies should include a follow-up study on persisting symptoms and disabilities after accidents on e-scooters.

Implications

The risk of accidents has been reported to be up to seven times higher per travelled kilometre using an e-scooter compared with a bicycle [11]. Keeping the increasing popularity and availability of e-scooters in mind, we may expect to see considerably more patients in the future.

Helmet use or disuse was scarcely reported in the electronic medical record. In other studies, helmet use among riders of e-scooters has been reported to be low at 4.4% and less than 1% [4, 7]. It is well established that bicycle helmets prevent or reduce head and facial injuries in bicycle accidents [12, 13]. Given that head injury is so frequent following accidents on e-scooters, initiatives to increase helmet use may also reduce or prevent head and facial injuries in these patients.

Limitations

Since the sample size is limited, there is a risk of underreporting rare injuries and that the reported frequencies may be imprecise. The three-month data collection period does not account for seasonal variation in the number of accidents. In another study, it was reported that for cyclists a greater share of accidents are severe in the winter [14].

Although the secretary staff were regularly reminded to collect a copy of the electronic medical record on patients with e-scooter accidents, we cannot exclude that some patients may have been missed. Even so, we believe that bias due to incomplete inclusion at our hospitals is not of major concern in our study. However, this study included patients only from two hospitals in Central Copenhagen (Frederiksberg and Bispebjerg Hospital). Any patients who were severely traumatised may have been admitted to a higher-level trauma centre (Rigshospitalet), causing selection bias in the study and partially obscuring the true range of injuries.

CONCLUSIONS

The majority of patients admitted to the ED following accidents on e-scooters are young and male. Head injuries and fractures were common injuries. Most patients were discharged after initial management in the ED without further hospital follow-up.

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