

At-a-glance

Characteristics of outdoor motorized scooter-related injuries: analysis of data from the electronic Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP)

Sofia Desiateryk, BSc (1); Sarah Zutrauen, BHSc (1); Ze Wang, BSc (1); Ithayavani Iynkkaran, PhD (1); Lina Ghandour, MSc (2); Steven R. McFaull, MSc (3); Greg Butler, MSc (3); James Cheesman (3); Andre Champagne, MPH (3); Minh T. Do, PhD (1,2,4)

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Abstract

Introduction: The use of motorized scooters is gaining popularity in Canada and elsewhere. This study aims to summarize characteristics of injuries related to use of motorized scooters using data from the electronic Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP) and to analyze trends. The eCHIRPP collects information associated with the injury event and clinical information related to treatment (the injured body part, the nature of the injury, injury intent and treatment received) from 11 pediatric and 9 general hospitals across Canada.

Results: A free-text search using keywords identified 523 cases related to motorized scooter injuries between January 2012 and December 2019. Most of the injuries reported were among males (62.7%). Fracture/dislocation was the most frequent injury (36.9%), and 14.3% of all patients were admitted to hospital. Joinpoint regression showed a statistically significant increase in injuries related to motorized scooter use between 2012 and 2017 (annual percent change of 18.4%).

Conclusion: Study findings indicate the need for continued preventive efforts and improved educational messages on safe riding and the importance of the use of protective equipment to prevent injuries among riders.

Keywords: *e-scooter, self-balancing scooter, hoverboard, powered scooter, injury, emergency department, eCHIRPP, protective equipment*

Introduction

Scooters are portable mobility devices designed either as a footboard mounted on two wheels with a long steering handle or as a self-balancing unit. They are moved by pushing with one foot against the ground, or else they are powered by a motor.

The availability of motorized micromobility rental networks is increasing in Canada. The launch of a rental network in

Calgary, Alberta, in July 2019 was the third most popular launch after ones in Tel-Aviv, Israel, and Paris, France.¹⁻³ These devices are affordable to rent, accessible for most people and considered environmentally friendly; these characteristics, together with the reduced parking fees and traffic time that scooter use offers, are appealing factors.³⁻⁵

The increased use of motorized scooters, some with speeds of up to about 50 km/h

Highlights

- We used data from the electronic Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP) to analyze electric scooter incident injuries in Canada.
- Injuries related to motorized scooter use increased statistically significantly between 2012 and 2017, and almost two-thirds of the people seen in participating emergency departments underwent treatment or observation, with one-third requiring follow-up treatment.
- Over half of the injuries were the result of a fall, and more than one-quarter occurred in traffic.
- Over one-third of the cases involved injury to more than one body part, with head injuries the most common (25% of reported incidents).
- Almost half of those who gave information on protective equipment use reported using it, most often a helmet.

(≈ 30 miles/hour), has resulted in an increase in the number of traffic incidents associated with them.⁶⁻⁸ People riding motorized scooters in bicycle lanes are more likely than car drivers to suffer non-fatal and fatal injuries following a traffic collision.⁶ A recent study analyzing data from the National Electronic Injury

Author references:

1. Department of Health Sciences, Carleton University, Ottawa, Ontario, Canada
2. Consumer and Hazardous Products Safety Directorate, Health Canada, Ottawa, Ontario, Canada
3. Public Health Agency of Canada, Ottawa, Ontario, Canada
4. Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada

Correspondence: Minh T. Do, Department of Health Sciences, Carleton University, 2305 Health Sciences Building, 1125 Colonel By Drive, Ottawa, ON K1S 5B6; Tel: 613-901-9632; Email: minh.do@carleton.ca

Surveillance System (NEISS) found over two-fold increases (222%, $p = 0.01$) in electric scooter injuries and hospital admissions in the United States between 2014 and 2018.⁹

A 2021 review of the literature on motorized scooter injuries by the Ontario Agency for Health Protection and Promotion¹⁰ and a multicentre evaluation of emergency department data from Calgary³ suggest there is a need for evidence specific to the mechanism (cause) of injury and type of injuries from motorized scooter use to inform and evaluate potential pilot programs and to develop recommendations. The increase in motorized scooter availability highlights the need for surveillance of injuries related to their use to better understand the nature of injury occurrence and to establish and evaluate effective preventive methods.

As such, the objective of this analysis is to describe injuries related to motorized scooter use.

Methods

Data source

Data for this study were collected by the electronic Canadian Hospitals Injury Reporting Prevention Program (eCHIRPP). eCHIRPP is a sentinel injury and poisoning surveillance system that collects data on injured individuals of all ages presenting to an emergency department at 11 pediatric and 9 general hospitals across Canada.¹¹ In the emergency department, the injured person or accompanying caregiver is asked to complete a questionnaire including the details associated with the injury event (i.e. “what went wrong?”). The hospital staff add clinical information—the injured body part; the nature of the injury (e.g. fracture, concussion, poisoning); whether the injury was intentional, accidental or undetermined/unknown; where the injury occurred (geographical location); and the treatment received, if any. All these details, together with extracts from patients’ health information, are entered into the eCHIRPP database by trained data coders.

Extraction of cases

We searched the eCHIRPP database for all incidents of injuries related to use of motorized scooters recorded between April 2011 and September 2020. We used a

free-text search feature with the keywords “motorized scooter,” “e-scooter,” “self-balancing scooter,” “trotinette,” “micro scooter,” “powered scooter,” “hoverboard” and “Segway.” Only 9 months of data were available for 2011 and 2020, so incidents from 2011 ($n = 48$) and 2020 ($n = 77$) were excluded. Incidents that occurred indoors ($n = 151$) were also excluded as these occurred during misuse. In total, 523 motorized scooter incidents from between 2012 and 2019 were included in this study.

Variables of interest

Variables of interest included age group, sex, location, protective equipment, substance use, external cause, time, injury characteristics (body part injured and nature of injury) and treatment received in the emergency department.

Statistical analysis

Descriptive analyses were conducted to summarize patient demographics and injury characteristics overall and stratified by sex. Frequency distributions in the form of counts and percentages were generated for all variables. Proportions of motorized scooter-related injuries per 100000 eCHIRPP records, stratified by sex, age group and year were generated. Injury trends over time were explored.

Data analysis was conducted using Excel 2010 (Microsoft Corp., Redmond, WA, US) and Joinpoint Regression Program version 4.8.0.1 (SEERStat, NCI, Bethesda, MD, US).

Results

Demographic characteristics

A total of 523 cases of motorized scooter injuries were identified over the study period. The majority of people injured were male (62.7%) and between 10 and 14 years old (34.4%) (see Table 1).

Of the 426 patients (81.5%) who gave information on protective equipment use, 235 (44.9%) reported using it (47.3% of males and 41.0% of females); in 99.8% of these cases, this was a helmet. Over half (56.0%) of the injuries were the result of a fall, and more than one-quarter (28.5%) of incidents occurred in traffic. Injuries resulting from falls and getting struck by/against objects were more common among

females (65.6% and 6.2%, respectively) than males (50.3% and 2.7%, respectively). A greater proportion of males (33.8%) than females (19.5%) were injured in traffic.

Of the 523 incidents analyzed, information on substance use at the time of the injury was provided in 239 (45.7%) cases; of these, 6 (2.5%), all of whom were male, reported that they had used a substance.

The highest number of incidents occurred during the summer months, with 15.3% in June, 13.4% in July and 16.6% in August, coinciding with the warmer months of the Canadian climate. The overall yearly trend of injuries increased between April 2011 and September 2020. Analyses of annual trends showed that the highest reported incidence occurred in 2017 (21.2%) and 2018 (21.0%) (data not shown).

Proportionally, age-specific injuries were most common in adults between 40 and 49 years old (89.6 per 100 000 eCHIRPP incidents). Children between the ages of 2 and 9 years had the lowest proportion of injuries related to motorized scooter use (28.5 per 100 000 eCHIRPP incidents).

Injury characteristics and outcome

Of the patients with motorized scooter injuries reporting to participating emergency departments, 35% injured more than one body part (Table 2). Head injuries, including of the face and mouth, were reported in a quarter (25.2%) of incidents, followed by injuries to the wrist (18.2%) and forearm (15.5%).

The most common injury diagnosis reported was fracture or dislocation (36.9%) followed by superficial (18.0%) and soft tissue (13.2%) injuries. A higher proportion of males than females experienced open wounds including minor cuts and lacerations (9.4% vs. 6.9%) and superficial injuries (20.7% vs. 13.0%). Females experienced twice as many sprains or strain injuries (11.1% vs. 4.6%), more fractures and dislocations (41.0% vs. 34.7%) and more soft tissue injuries (13.8% vs. 12.9%).

Almost two-thirds of patients (63.7%) underwent treatment or observation in the emergency department, with 33.1% requiring follow-up and 30.6% recommended follow-up as needed. Hospital admission

TABLE 1
Demographic and injury characteristics of incidents related to motorized scooter^a use, eCHIRPP, 2012–2019

Characteristic	n (%)		
	Male (n = 328)	Female (n = 195)	Total (n = 523)
Age group in years			
2–9	68 (20.7)	51 (26.2)	119 (22.8)
10–14	100 (30.5)	80 (41.0)	180 (34.4)
15–19	68 (20.7)	24 (12.3)	92 (17.6)
20–29	16 (4.9)	4 (2.1)	20 (3.8)
30–39	11 (3.4)	3 (1.5)	14 (2.7)
40–49	18 (5.5)	13 (6.7)	31 (5.9)
50+	46 (14.0)	20 (10.3)	66 (12.6)
Protective equipment use^b			
Yes	155 (47.3)	80 (41.0)	235 (44.9)
No	115 (35.1)	76 (39.0)	191 (36.5)
Unknown	58 (17.7)	39 (20.0)	97 (18.5)
Self-reported substance use			
Yes	6 (1.8)	–	6 (1.1)
No	144 (43.9)	89 (45.6)	233 (44.6)
Unknown	178 (54.3)	106 (54.4)	284 (54.3)
External cause			
Falls	165 (50.3)	128 (65.6)	293 (56.0)
Transport injuries in traffic	111 (33.8)	38 (19.5)	149 (28.5)
Struck by or against objects	9 (2.7)	12 (6.2)	21 (4.0)
Other or unknown unintentional injury	8 (2.4)	3 (1.5)	11 (2.1)
Missing	35 (10.7)	14 (7.2)	49 (9.4)

Abbreviation: eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program.

Note: All percentages are column percentages.

^a Motorized scooter incidents are defined as those that resulted in injury of the riders who were seen at participating hospital emergency departments.

^b In 99.8% of cases where protective equipment was used, this was a helmet.

was reported for 14.3% of patients (n = 75; 70.6% males).

Joinpoint regression showed a statistically significant increase in injuries related to motorized scooter use between 2012 and 2017 (annual percent change of 18.4%, $p = 0.019$).

Discussion

The objective of this study was to examine injuries related to motorized scooter use in terms of the demographic, and injury cause, nature and outcome characteristics. The number of injuries related to motorized scooter use indicate an increasing trend from 2012 to 2017 with an 18.4% annual percent change. The literature suggests that the increasing number of injuries

was directly related to a rise in sales and use of motorized scooters.^{9,15}

Injuries most commonly occurred among children between 10 and 14 years old (34.4%). Further, the most common causes of injuries were falls (56.0%), which is consistent with previous reports.^{10,16,17} Studies suggest that the risk for falls is higher for children because of their lower body weight, higher centre of gravity and underdeveloped body coordination.^{14,17,18}

The literature suggests that the majority of hospital admissions occurred following head injuries, severe injury complexes and infection caused as a result of a fall.¹⁷ Our study found that head injuries represented the largest proportion of all injuries (25.2%) and that less than half of those

who gave information on their use of protective equipment used some (44.9%), and in most cases, it was a helmet. This is also consistent with existing literature^{8-10,12-14} and supports the need for safety promotion and legislation requiring protective equipment use when riding motorized scooters. The use of wrist guards and elbow pads may prevent injuries of the wrist and forearm and subsequently lower the occurrence of fractures and dislocations as well as sprains.^{12,14-17}

Injuries occurred in traffic in 28.5% of incidents, and 14.3% of all incidents resulted in a hospital admission. Recent studies have shown that collisions involving motorized scooter riders and motor vehicles can result in serious injuries and death.^{8,19-21} This, together with our study findings, underlines the need to control the use of motorized scooters in high traffic areas. No fatalities were identified in the eCHIRPP database because emergency department data do not capture information about people who died before they could be taken to hospital or after being admitted.¹¹

Limitations

eCHIRPP's sentinel surveillance system collects data from participating hospitals across Canada, and thus data may not be representative of injury patterns across the entire country. Some populations may be overrepresented in the eCHIRPP database, that is, pediatric populations in urban centres. Conversely, the data used in this study may provide an underestimation of injuries, since they were not included in our analysis in the following cases: injured riders who did not seek treatment at a participating emergency department; older teenagers and adults who were seen at non-participating general hospitals; injured people who sought care at walk-in clinics; or the injured riders who were Inuit, First Nations or other people living in rural and remote areas. Lastly, we carried out free-text keyword searches to identify injury incidents in the database. This strategy can introduce bias through the lack of knowledge of potential keyword search terms, use of overly specific terms or misclassification.

Conclusion

This study provides a descriptive overview of 523 motorized scooter-related injury incidents reported to eCHIRPP

TABLE 2
Characteristics of outdoor motorized scooter injury, eCHIRPP, 2012–2019

Characteristic	n (%)		
	Male (n = 328)	Female (n = 195)	Total (n = 523)
Body part (all that apply)			
Head, face, mouth	86 (26.2)	46 (23.6)	132 (25.2)
Neck, spine, back	31 (9.5)	9 (4.6)	40 (7.6)
Thorax, abdomen, pelvis	35 (10.7)	10 (5.1)	45 (8.6)
Shoulder, clavicle, upper arm	31 (9.5)	16 (8.2)	47 (9.0)
Elbow	32 (9.8)	17 (8.7)	49 (9.4)
Forearm, including radius, ulna	47 (14.3)	34 (17.4)	81 (15.5)
Wrist, including carpal bones	53 (16.2)	42 (21.5)	95 (18.2)
Hand, finger or thumb	24 (7.3)	16 (8.2)	40 (7.6)
Hip and thigh	17 (5.2)	8 (4.1)	25 (4.8)
Knee	27 (8.2)	22 (11.3)	49 (9.4)
Lower leg	20 (6.1)	16 (8.2)	36 (6.9)
Ankle	23 (7.0)	18 (9.2)	41 (7.8)
Foot and toe	27 (8.2)	4 (2.1)	31 (5.9)
Multiple injuries of >1 body part	116 (35.4)	67 (34.4)	183 (35.0)
Body part not required ^a	7 (2.1)	1 (0.5)	8 (1.5)
Unspecified body part / blank on questionnaire	2 (0.6)	3 (1.5)	5 (1.0)
Nature of injury			
Superficial	99 (20.7)	34 (13.0)	133 (18.0)
Open wound	45 (9.4)	18 (6.9)	63 (8.5)
Fracture and dislocation	166 (34.7)	107 (41.0)	273 (36.9)
Sprain or strain	22 (4.6)	29 (11.1)	51 (6.9)
Soft tissue injury	62 (12.9)	36 (13.8)	98 (13.2)
Minor closed head injury or concussion	34 (7.1)	19 (7.3)	53 (7.2)
Major head injury (intracranial)	9 (1.9)	1 (0.4)	10 (1.4)
Injury to nerve, muscle or tendon	10 (2.1)	6 (2.3)	16 (2.2)
Internal organ	12 (2.5)	2 (0.8)	14 (1.9)
Other	5 (1.0)	4 (1.5)	9 (1.2)
Not specified and blanks	15 (3.1)	5 (1.9)	20 (2.7)
Treatment/disposition			
Advice only, diagnostic testing, referred to GP (no treatment in ED)	66 (20.1)	47 (24.1)	113 (21.6)
Treated or observed in ED, follow-up as needed	104 (31.7)	56 (28.7)	160 (30.6)
Treated or observed in ED, follow-up required	104 (31.7)	69 (35.4)	173 (33.1)
Admitted to this or another hospital primarily for injury treatment	53 (16.2)	22 (11.3)	75 (14.3)
Missing	1 (0.3)	1 (0.5)	2 (0.4)

Abbreviations: eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program; ED, emergency department; GP, general practitioner.

^a Body part not required includes poisoning or toxic effect; drowning or immersion; asphyxia or other threat to breathing; systemic overexertion; heat/cold stress; mental health; and when no injury is detected.

between 2012 and 2019. We identified a large proportion of head, forearm and wrist injuries related to motorized scooter use.

These findings underscore the need for continued preventive efforts and improved educational messages on safe riding practices and the use of protective equipment to prevent injuries. Future work involving continued surveillance and research of motorized scooter-related injuries is needed to better inform injury prevention in light of the growing popularity of motorized scooters and their use as a means of transportation.

Conflicts of interest

The authors have no conflicts to declare.

Authors' contributions and statement

SD, MTD, SZ, II, LG, ZW, SRM, JC, AC and GB were involved in the project design and conceptualization.

SD conducted the literature review search and data analyses and drafted the manuscript.

SRM, AC and JC extracted the eCHIRPP data.

All authors contributed to revising the article.

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