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Craniofacial injuries related to motorized scooter use: A rising epidemic

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ABSTRACT

Objectives: Over the last decade, there has been increased interest in utilizing motorized scooters for transportation. The limited regulation of this modernized vehicle raises numerous safety concerns. This analysis examines a national database to describe the yearly incidence of craniofacial injuries and patterns of injury related to motorized scooter use.

Methods: The Consumer Product Safety Commission's National Electronic Injury Surveillance system was queried for craniofacial injuries associated with motorized scooter use. Patient demographics, injury type, anatomic location, injury pattern, and helmet status were extracted for analysis.

Results: From 2008 to 2017, there were 990 recorded events for craniofacial injuries secondary to motorized scooters extrapolating to an estimated 32,001 emergency department (ED) visits. The annual incidence was noted to triple over that 10-year period. The majority of patients were male (62.1%) and the common age groups at presentation were young children 6–12 years old (33.3%), adolescents 13–18 years old (16.1%) and young adults 19–40 years old (18.0%). The most common injury pattern was a closed head injury (36.1%) followed by lacerations (20.5%). Facial fractures were only present in 5.2% of cases. In cases in which helmet use was recorded, 66% of the patients were not helmeted.

Conclusion: The incidence of motorized scooter related craniofacial trauma is rising, resulting in thousands of ED visits annually. Many patients are experiencing morbid traumatic injuries and may not be wearing appropriate protective equipment. This study highlights the importance of public awareness and policy to improve safety and primarily prevent craniofacial trauma.

1. Introduction

The search for efficient and environmentally-friendly urban transportation ignited an ongoing debate in the United States regarding the role motorized scooters. Although known to be a popular method of transportation in Europe and Asia, motorized scooters have only recently begun to make inroads in the United States [1]. The gradual rise in popularity has been attributed to their convenience, affordability, and status as a “green” alternative to vehicles with combustion engines [2]. These advantages combined with the fact electric scooters enable users to travel longer distances than conventional scooters present an attractive method of transportation to school, work and for leisure.

Public electric scooter availability has been embraced by certain states and shunned by others [3]. Thousands of rentable “dockless” electric scooters have filled the sidewalks of major cities within the past year [4]. Most often, scooters are supplied by one of many private corporations battling to gain traction in the rapidly expanding scooter industry, and are rented in seconds with the help of a cell phone application [5]. Public concern has arisen regarding scooting safety sparking a national discussion.

In anticipation of further adoption of these motorized scooters into mainstream commuting, it is crucial that the medical community be prepared to evaluate patients presenting to the emergency room with injuries secondary to these vehicles. Our objective was to query a nationwide database to quantify and review trends related to motorized scooters and injuries to the head and neck resulting in emergency room visits and formulate evidence-based recommendations.

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2. Methods

The United States Consumer Product Safety Commission National Electronic Injury Surveillance System (NEISS) database was accessed November 20th, 2018. This database has proven to be an invaluable epidemiologic resource and has previously been harnessed to characterize the dangers of the nationwide trends of consumer products across numerous specialties [6–13].

This unique database collates data from over 100 participating hospitals, which is then extrapolated to provide national estimates on injuries related to consumer products. The data collected includes a general diagnosis, specific consumer product code, patient demographic, and one-to-two-phrase narratives that describes other aspects of the patient visit. For each NEISS designated hospital, a specifically trained physician coordinator compiles the data to ensure a nationally standardized data collection. Additionally, NEISS incorporates sample weights and cluster variables to enable variance calculation and confidence interval estimates for data.

The NEISS database was queried for visits specifically related to "Scooters/skateboards, powered" (code 5042). We selected the past decade (2008–2017) to highlight the most recent trends. The results were then filtered to include entries with injuries specifically involving the craniofacial region. The incidence, patient demographic characteristics (i.e. age and sex), and injury characteristics (injury location, disposition, injury diagnosis) were collected from the entries meeting our search criteria. This study qualifies as nonhuman subject research and is exempted from institutional review board approval because the data is derived from a publicly available database offered by the U.S. Consumer Product Commission.

3. Results

From 2008 through 2017, there were 990 craniofacial injuries related to motorized scooter use diagnosed in a NEISS-participating hospital emergency department (ED) visits extrapolating to an estimated 32,001 (95% confidence interval: 25,308–38,649) patient visits nationwide. At the start of the study period in 2008, the annual incidence of motorized scooter related injury was 2325 (95% confidence interval: 1379–3271). Over the following decade, the annual incidence of motorized scooter related craniofacial injuries tripled to 6947 (95% confidence interval: 4921–8974) (Fig. 1). The median age of presentation was 14 years old (interquartile range: 8–39) (Table 1). The patients were grouped into clinical relevant ages including toddlers (2–5 years old), young children (6–12 years old), adolescent (13–18 years old), young adult (19–40 years old), middle-age adult (41–65 years old), and senior adults (66+ years old). Among the pediatric population (patients < 19-years-old), the most commonly affected age group was young children 6–12 years old (Fig. 2). Among adults, both young and middle-aged adults were commonly affected while adults > 65 comprised only 9.7% of the cohort. The two most common locations for injuries were at home (25.8%) and on public streets (24.5%). Patient's helmet status was not consistently documented; however, at least 10% of total patients presented without helmets. However, helmet use did increase with age from 18.8% in toddlers to 66.7% in senior adults – Fig. 3.

Table 1
Demographic characteristics of patients presenting to the emergency room with injuries related to motorized scooters.

Demographic variable	Patients injured (n, %)
Sex	
Male n	615 (62.1)
Female	375 (37.8)
Age	
0–5	105 (10.6)
6–12	330 (33.3)
13–18	159 (16.1)
19–40	179 (18.0)
41–65	151 (15.2)
66+	96 (9.7)
Median Age (IQR)	14 (8–39)
Incident Locale	
Home	255 (25.8)
Street/Highway	243 (24.5)
Other public property	89 (8.9)
School	4 (0.4)
Place of recreation	28 (2.8)
Not recorded	371 (37.5)
Helmet Status	
Helmet	45 (4.5)
No Helmet	99 (10)
Unknown	846 (85.4)

The most common craniofacial site of injury was the "head" occurring in 61.6% of cases while "facial" injuries were present in 24.1% of cases (Fig. 4). The overall most common injury was a closed head injury (36.1%) followed by laceration (20.5%) (Table 2). The most common facial injuries included lacerations (53.1%) and contusions/abrasions (31%). Facial fractures were only seen in 5.2% of events. Specifically, the most common fractures observed were skull (27%), nose (27%), and cervical spine (14%) fractures (Fig. 5).

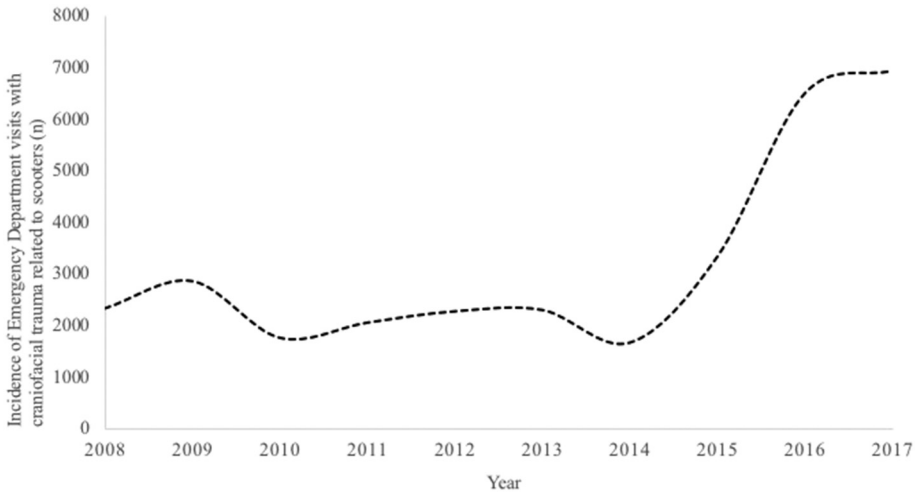

Fig. 1. Estimated incidence of motorized scooter related craniofacial injuries presenting to the ED in the United States between 2008 and 2017.

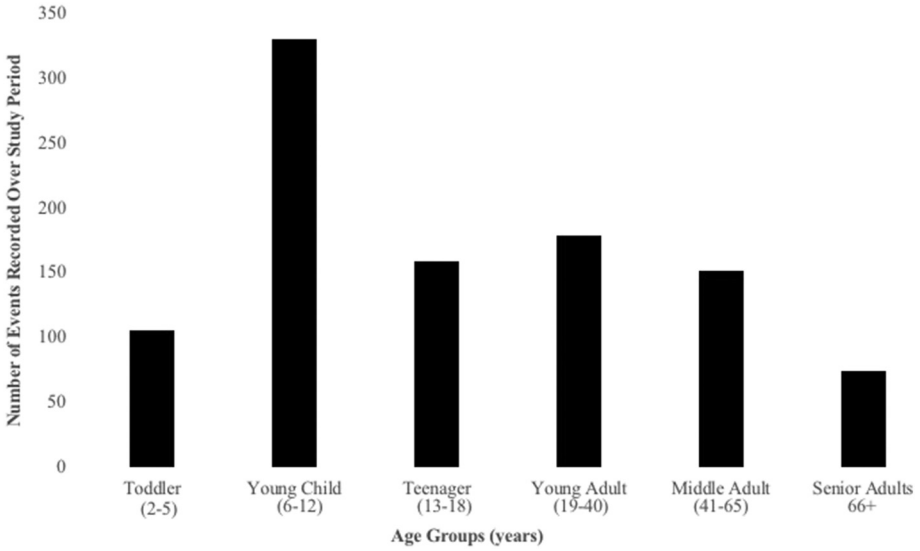

Fig. 2. Age distribution of patients presented to the emergency department with craniofacial injuries related to motorized scooters.

4. Discussion

The interplay between industrial crowding, traffic congestion, and environmental awareness has spurred an interest in alternative and sustainable methods of transportation. This transportation revolution has been accompanied by arising safety and regulatory concerns regarding motorized scooter use. Scooter injuries are on the rise globally, and our analysis of a recent decade indicates this trend is present in the United States as well [1,9,10]. Specifically, there has been nearly a tripling of craniofacial injuries diagnosed in emergency department related to motorized scooter use. This rising tide of motorized scooter related craniofacial injuries and the associated emergency care consumption represents a looming public health concern. In addition to a rise in ED visits, there are substantial secondary costs including hospitalizations, subspecialty consultations, operations, medications, and follow visits. Consequently, there should be active development of preventative strategies.

Regarding preventative medicine, our study directly touches upon the key issue of personal protective equipment. In our analysis, the most common injury was a “head” injury (61.6%) and 14.5% of reports detailed a patient's helmet status upon arrival to the Emergency Department. In this cohort, 66.6% of patients were not wearing a helmet at the time of injury. Helmets have repeatedly demonstrated impact mitigation in other types of similar personal transportation vehicles including bicycles and motorcycles [14,15]. Recognizing this fact, laws for these devices have been adapted to motorized scooters in other countries. For example, in March of 2000, Italy implemented a universal helmet law mandating helmet use for all types of recreational scooter drivers including motorized scooters. This legislative event reduced head trauma among scooter riders from 26.65/10,000 person-years in the pre-legislation period to 8.88/10,000 person-years in the post-legislation period [16]. This remarkable success should encourage U.S. legislators to consider implementing similar safety regulations in order to decrease national motorized scooter injury burden.

Currently, in the U.S., there is significant variation between state laws regarding motorized scooters. In the District of Columbia, motorized scooters are classified as “Personal Mobility Devices” and not subject to inspection or helmet laws [17]. In contrast, in California, a person riding a motorized scooter under the age of 18 must wear a helmet [18]. Without widespread evidence-based guidelines detailing the safety measures necessary to mitigate motorized scooter related injury, this may become an increasingly important public health

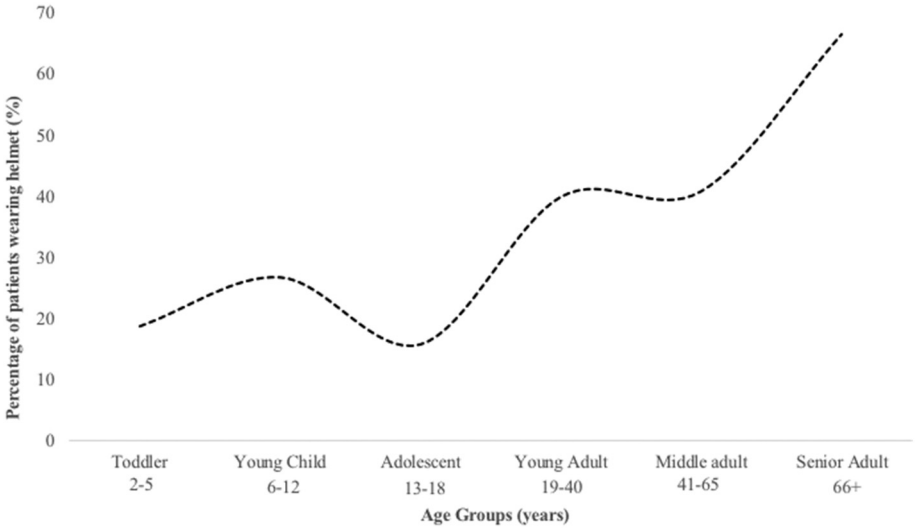

Fig. 3. Frequency of helmet use as a function of age among patients presenting to the ED from 2008 to 2018.

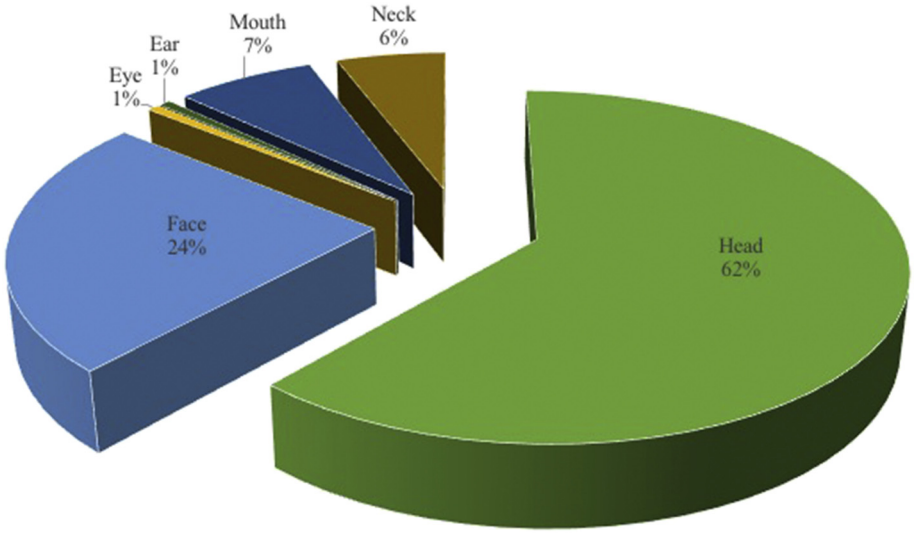

Fig. 4. Distribution of primary injury location among patients presented to the ED in the United States with a motorized scooter related injury.

concern.

In addition to lacking sufficient safety equipment, cultural norms and limited regulation may minimize motorized scooter drivers' perception of the potential dangers. In a study of traffic patterns, Bai et al. found using field collection data that compared to bicycle riders motorized scooters were more likely to stop beyond the stop line and even to ride against the flow of traffic [19]. Related to cultural norms, the most common cohort presenting with motorized scooter related injuries are children. These children are likely using motorized scooters specifically marketed as “toys,” but in reality, certain models can reach speeds of almost 30 miles per hour [20]. In light of this, standardization of motorized scooter laws and license requirements should be considered to decrease motorized scooter risky behaviors.

Closed head injuries (58.5%) and concussions (22.9%) were the primary diagnoses accounting for a majority of emergency department visits. Providers responsible for facial trauma call will often be consulted on these patients to repair facial lacerations and evaluate facial fractures. It is critical for the facial trauma surgeon to assess and understand the sequela of closed head injury in order to help assist in post-traumatic recommendations. Traumatic brain injuries (TBIs) have been linked to an increased risk for other health conditions including depression (1.5 times), alcoholism (1.8 times), Alzheimer's disease (4.5 times), and epilepsy (11 times) [21–23]. Although the optimal treatment of even mild TBIs is a focus of future research, it generally agreed upon that the minimum precaution should include a period (generally 24 h) of physical and cognitive rest prior to a return to work, school, or physical activity [24]. It is imperative to remember closed head injury as a secondary diagnosis while evaluating scooter related facial trauma in order to coordinate appropriate neurologic/psychiatric assessments, and to provide detailed activity restrictions to mitigate further complications.

Limitations of this study are inherent to the database utilized. Although carefully designed to utilize a selected 100 hospitals to provide an estimate for injuries on a national level, they may be located in states with varying regulations regarding motorized scooters, potentially over- or underestimating the true national incidence. Additionally, a portion of patients with less severe injuries may present elsewhere, such as urgent care centers or to their primary care physician. Nonetheless, our study, which demonstrates a tripling increase in craniofacial injuries is a crucial piece of evidence in the discussion regarding motorized scooter use and public health. Additionally, the database does not allow access to actual patient charts to confirm the diagnosis or type of injury and the possibility of coding errors inherent in any database. Importantly, helmet status was not consistently recorded in the NEISS database. Individualized patient data in a prospective large institutional study would allow detailed analysis of injuries and may offer further insight into the effectiveness of helmets for protection from motorized scooter related head injuries. However, it is our hope that this consumer-based data identifying the common patterns of craniofacial injury related to specifically motorized scooters will be useful for patient education and injury prevention in the future.

Table 2
Injury diagnosis stratified by location for patients presenting to the ED with a motorized scooter related injury.

Injury type	Body part affected						Overall
	Head	Face	Eye	Ear	Mouth	Neck	
Laceration, n, (%)	45 (7.4)	127 (53.1)	–	4 (66)	27 (38)	–	203 (20.5)
Contusion/Abrasion, n, (%)	40 (6.5)	74 (31)	1 (16)	–	3 (4.1)	–	118 (11.9)
Foreign Body, n, (%)	–	–	1 (16)	1 (16)	–	–	2 (0.2)
Closed Head Injury, n, (%)	357 (58.5)	–	–	–	–	–	357 (36.1)
Concussion, n (%)	140 (22.9)	–	–	–	–	–	140 (14.1)
Fracture, n, (%)	16 (2.6)	29 (12)	–	–	–	7 (12)	52 (5.2)
Hematoma, n, (%)	11 (1.8)	4 (1.7)	–	–	–		15 (1.5)
Dental Injury, n, (%)	–	–	–	–	40 (56)	–	40 (4.0)
Cervical Sprain/Strain, n, (%)	–	–	–	–	–	37 (65)	37 (3.7)
Other or not stated, n, (%)	1 (0.1)	5 (2.1)	4 (66)	1 (16)	2 (2.8)	13 (22)	26 (2.6)
Total, n (%)	610 (61.6)	239 (24.1)	6 (0.6)	6 (0.6)	72 (7.3)	57 (5.7)	990 (100)

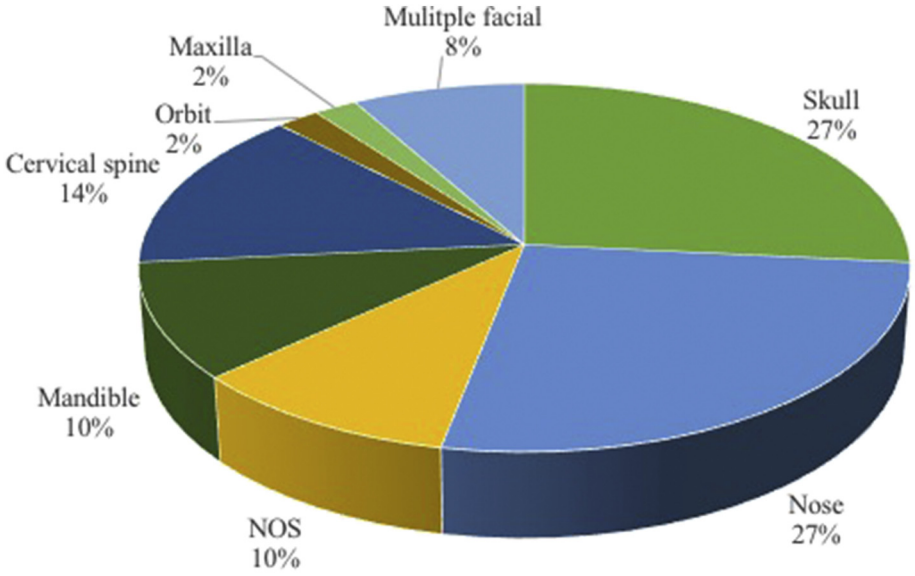

Fig. 5. Distribution of motorized scooter related craniofacial fractures presenting to the ED from 2008 to 2017.
NOS: Not otherwise specified.

5. Conclusion

Motorized scooters are becoming an increasingly popular method of transportation which is coinciding with a dramatic rise in patients present to the emergency room with traumatic injuries from motorize scooter accidents. The majority of the patients may not be wearing helmets. Understanding these trends is an important patient safety issue and requires the development of appropriate public policies.

Financial disclosures

The authors have no financial disclosures.

Declaration of Competing Interest

None.

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