



Analysis of road traffic accidents involving standing electric scooters reported in newspapers in Italy

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Objective As the use of electric scooters increased in Italy in the last years, we aimed to estimate the burden of accidents caused by this micro-mobility vehicle and identify characteristics, severity, and type of injuries.

Methods We conducted a case series analysis of news reports about electric scooter crashes occurring in Italy from January 1, 2019 to September 30, 2020. Events were included when a road traffic accident involved an electric scooter and caused damages or injuries to the driver or others.

Results We identified 96 road accidents involving electric scooters in Italy. The mean age of patients was 30 ± 16 years, and 79% ($n = 71/90$) were male. Of the 96 patients, only two (2%) were driving an electric scooter with a helmet, and three (3%) were driving while intoxicated. In 68% ($n = 62/94$) of cases, the incident was caused by a collision with another vehicle or a pedestrian, and 30% ($n = 18/96$) were transported with life-threatening injuries to the emergency department. In 15% ($n = 14/96$), the emergency medical service physician was dispatched to the scene. Head trauma was the most common injury (60%, $n = 32/53$). Patients who had life-threatening conditions were more likely to have head trauma than those who did not (82% [$n = 9/11$] vs. 55% [$n = 23/42$], $P = 0.10$). Polytrauma was significantly more common in patients with life-threatening conditions than in patients with no life-threatening conditions (36% [$n = 4/11$] vs. 5% [$n = 2/42$], $P < 0.01$). Fifteen percent of patients ($n = 12/81$) were admitted to the intensive care unit; only one death was reported.

Conclusion Road traffic accidents involving electric scooters often result in serious injuries, including head trauma and polytrauma, necessitating the involvement of an emergency medical service physician and intensive care unit admission in a non-negligible percentage of instances.

Keywords Traffic accidents; Multiple trauma; Hospital emergency service; Emergency medical services; Electric scooters

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Capsule Summary

What is already known

There is partial information on the overall impact of injuries caused by electric scooters (e-scooters), but recent studies from different areas of the world have highlighted an increase in injuries, emergency department visits and hospital admissions associated with e-scooters. Current studies describe injuries associated with e-scooter trauma ranging from mild contusions to severe injuries, including those requiring intensive care unit admission and death.

What is new in the current study

Road traffic accidents involving e-scooters often result in serious injuries, including head trauma and polytrauma, necessitating the involvement of an emergency medical service physician and intensive care unit admission in a non-negligible percentage of instances. Considering the sporadic use of helmets and that head trauma was the most frequent injury, injury prevention campaigns by governmental authorities are urgently needed to reduce e-scooter-related morbidity.

INTRODUCTION

Electric scooters (e-scooters) are among the protagonists of micro-mobility in recent years. The first worldwide introduction of e-scooter rentals occurred in 2017 in the United States. Over the following years, a rapid expansion of e-scooter availability and use was also observed in Italy. In 2020, the micro-mobility sector received a further indirect boost due to the coronavirus disease 2019 (COVID-19) pandemic, causing people to limit the use of public transport and to look for alternatives that can guarantee increased safety. In fact, the Italian government approved a bonus of up to 500 euros for the purchase of e-scooters and other micro-mobility vehicles in May 2020.

There is partial information on the overall impact of injuries caused by e-scooters, but recent studies from different areas of the world have highlighted an increase in injuries, emergency department (ED) visits and hospital admissions associated with e-scooter.¹⁻⁷ In a 3-month study, 20 people were injured for every 100,000 rides in the United States.⁸ Pedestrians were also involved in collisions with e-scooters, and several accidents involved cars and obstacles on the ground. Current studies describe injuries associated with e-scooter trauma ranging from mild contusions to severe injuries, including those requiring intensive care unit admission and death. In the United States, 11 fatalities occurred between the start of 2018 to mid-2019.⁹ The use of helmets could reduce the number of head injuries, but only a small proportion of drivers wore one. This study aims to investigate injuries related to e-scooters in Italy and identify characteristics, severity, and type of injuries, to inform public authorities, decision-makers, and clinicians.

METHODS

Search strategy

We conducted a case series analysis of news reports about standing e-scooter crashes occurring in Italy from January 1, 2019 to September 30, 2020, which were reported in national and regional newspapers indexed on Google, Yahoo, or Bing. Two investigators independently queried the news aggregators Google News (<https://news.google.it/>), Yahoo News (<https://it.notizie.yahoo.com/>), and Bing News (<https://www.bing.com/news>) using the keywords "electric scooter," "micro-mobility," "crash," and "accident" and each region or region capital in Italy. An e-scooter was defined as a two-wheeled, stand-up, light electrical micro-mobility vehicle. Events were considered eligible for inclusion when a road traffic accident involved an e-scooter and caused damages or injuries to the driver or other people. When more than one news article referred to the same event, we merged the articles using date, city, age, and sex of the patient to avoid duplicates. Patients were considered to have life-threatening conditions when they were reported as severe or transported as a red code (immediate life threat code in Italian emergency medical service [EMS]).

Variables and data collection

For each news report, two investigators independently extracted in a standardized form details of the event, with disagreements being resolved by discussion and involving a third reviewer. Extracted data included publication date; date, time, and city of the event; age and sex of the person involved; mechanism of trauma; vehicles involved; type of trauma; helmet use; injury to other people; severity code of transport; EMS physician presence; conditions of the patient; admission to intensive care unit; and hospi-

tal treatments. Ethical committee approval was not required as data used in this work was publicly available and previously de-identified.

Statistical analysis

Results are presented as numbers and percentages, and the continuous variables are presented as mean and standard deviation or as median and interquartile range, as appropriate. Continuous variables were compared using the Student t-test or the Mann-Whitney U-test, and categorical variables using the chi-square test or Fisher exact test. Two-sided P-values less than 0.05 were considered significant. Statistical analysis was performed with Stata ver. 13.0 (StataCorp., College Station, TX, USA).

RESULTS

We identified 96 road traffic accidents involving an e-scooter, which occurred in Italy between January 1, 2019 and September 30, 2020. The majority of events (88%, $n = 84/96$) occurred between January and September 2020, particularly after the lockdown measures for the COVID-19 pandemic on May 18, 2020 (83%, $n = 80/96$), in Italy.

Characteristics of patients

The mean age of patients was 30 ± 16 years, and 79% ($n = 71/90$) were male. Fifteen percent ($n = 12/79$) were aged less than 18 years old, and 8% ($n = 6/79$) were less than 14 years old, which is the minimum age limit to drive an e-scooter in Italy. Of these 96 patients, only two (2%) were driving an e-scooter with a helmet, and three (3%) were driving while intoxicated. The most common mechanisms of injury were collision with another vehicle (59%, $n = 57/94$) or a pedestrian (4%, $n = 4/94$). In half of the cases (49%, $n = 46/94$), the vehicle involved was a car (Table 1). Eighteen percent ($n = 15/83$) of the cases occurred between 7 a.m. and 1 p.m., 35% ($n = 29/83$) between 1 p.m. and 6 p.m., and 47% ($n = 39/83$) after 6 p.m. Forty-six percent ($n = 44/96$) of cases occurred between Friday and Sunday.

Severity of conditions and injuries

Of all cases, 30% ($n = 18/96$) were transported with life-threatening injuries to the ED. In 15% ($n = 14/96$), the EMS physician was dispatched to the scene. Head trauma was the most common injury (60%, $n = 32/53$), and 15% ($n = 12/81$) were admitted to the intensive care unit. Only one case of death was recorded: a 60-year-old man who collided with a car and was admitted to the hospital in critical conditions. Patients who had life-threatening conditions were more likely to have head trauma than those

who did not (82% [$n = 9/11$] vs. 55% [$n = 23/42$], $P = 0.10$). Poly-trauma was significantly more common in patients with life-threatening conditions than in patients with no life-threatening conditions (36% [$n = 4/11$] vs. 5% [$n = 2/42$], $P < 0.01$) (Table 2). No cases of penetrating trauma following an e-scooter crash were reported.

DISCUSSION

Between January 1, 2019 and September 31, 2020, 96 road traffic accidents involving an e-scooter were reported in Italian online newspapers. In this case series, standing e-scooter-related injuries were mostly minor, but a considerable proportion (15%) of the patients was admitted to the intensive care unit, with higher costs for the healthcare system and potentially severe health consequences. In one out of three cases, the driver lost control of the e-scooter, and in the remaining cases, the accident was caused by a collision with a vehicle, mostly cars, or a pedestrian. The driver involved in e-scooter accidents shared the characteristics described in other studies: mostly males and aged 30 years old on average.^{5,9} Although drivers of e-scooters in Italy are required to be at least 14 years old by national law, we found that 7.6% of e-scooter injuries occurred in patients younger than 14 years.¹⁰ This can be due to the frequent use of push scooters during childhood, causing them to have a widespread perception of safety.

Patients transported to the ED with life-threatening conditions were more likely to have head trauma or major trauma. In our series, 60% of patients suffered a head injury, higher than that reported among bicyclists, whose incidence ranges from 10% to 16%.¹¹ In other studies, head injuries accounted for 21% to 38% of all injuries.^{3,4,6,7} Head trauma may increase patient morbidity and require resource-intensive evaluations (e.g., repeated head computed tomography scan, assessment of cervical spine with X-rays or computed tomography scan) and observation in the ED and eventually admission to the intensive care unit, worsening an already demanding period where Italian hospitals and emergency services were disrupted by the COVID-19 pandemic.¹²⁻¹⁶ Despite the use of a helmet being associated with a lower risk of head injury, in our report, we observed that it was rarely used (2.1% of all cases).¹⁷ This finding is in line with a report from Paris and two from the United States reporting a rate of helmet use of 12%, 4.8%, and 2%, respectively.^{7,9,18}

The increase in accidents and injuries, hospital admissions, and even deaths observed in 2020 and that reported in our study can be attributed to the increased overall utilization of standing e-scooters in Italy after the introduction of a series of measures and

Table 1. Characteristics of patients and accidents involving electric scooters

	Total (n=96)	Life-threatening conditions (n=18)	No life-threatening conditions (n=78)	P-value
Age (yr)	30±16	29±15	34±19	0.27
< 18	12/79 (15)	1 (6)	13 (17)	0.28
< 14	6/79 (8)	1 (6)	5 (6)	0.90
Male sex	71/90 (79)	15 (83)	56/72 (78)	0.60
Loss of control/falling off	32/94 (34)	7 (39)	25/76 (34)	0.63
Collision	62/94 (68)	11 (61)	53/76 (70)	0.58
Car	46/94 (49)	9 (50)	37/76 (49)	0.96
Heavy vehicle	5/94 (5)	2 (1)	3/76 (4)	0.23
Pedestrian	4/94 (4)	0 (0)	4/76 (5)	0.32
Motorcycle	4/94 (4)	0 (0)	4/76 (5)	0.32
Electric scooter	2/94 (2)	0 (0)	2/76 (3)	0.48
Bicycle	1/94 (1)	0 (0)	1/76 (1)	0.73
Time of day				
7 a.m.–1 p.m.	15/83 (18)	4/17 (24)	11/66 (17)	0.51
1 p.m.–6 p.m.	29/83 (35)	3/17 (18)	26/66 (39)	0.09
6 p.m.–10 p.m.	17/83 (20)	5/17 (29)	12/66 (18)	0.31
10 p.m.–7 a.m.	22/83 (27)	5/17 (29)	17/66 (26)	0.76
Weekday				
Monday	15 (16)	1 (6)	14 (18)	0.19
Tuesday	13 (14)	5 (28)	8 (10)	0.05
Wednesday	14 (15)	4 (22)	10 (13)	0.19
Thursday	10 (10)	2 (11)	8 (10)	0.92
Friday	18 (19)	3 (17)	15 (19)	0.80
Saturday	16 (17)	2 (11)	14 (18)	0.48
Sunday	10 (10)	1 (6)	9 (12)	0.45

Values are presented as mean ± standard deviation or number (%). Percentages may not total 100 because of rounding.

economic incentives for the COVID-19 crisis by the Italian government. We believe that the widespread introduction of novel micro-mobility vehicles should be accompanied by information campaigns to raise awareness of best driving practices and risk of e-scooter riding to prevent accidents and hospital admissions. In Italy, e-scooters are classified according to the same regulations of standard bicycles. Therefore, the use of a helmet is a legal obligation only for underage drivers, and no other protective gear is required by the law. Considering the important rate of head injuries, helmet use should be mandatory or strongly recommended; however, it is currently encouraged but not required for adult drivers. The perception of safety that e-scooters drivers have often leads to a sporadic use of helmets and other protective gear.

Limitations

This is the first study examining incidents involving standing e-scooters occurring in Italy and could be useful to provide prelimi-

Table 2. Conditions and injuries of patients involved in electric scooters accidents

	Total (n=96)	Life-threatening conditions (n=18)	No life-threatening conditions (n=78)	P-value
EMS physician attended	14 (15)	4 (22)	10 (13)	0.26
Severity of conditions				
Not transported to ED	5/60 (8)	0 (0)	5/42 (12)	0.13
Green, least concerning	14/60 (23)	0 (0)	14/42 (33)	<0.01
Urgent	23/60 (38)	0 (0)	23/42 (55)	<0.01
Red, most concerning	18/60 (30)	18 (100)	0/42 (0)	<0.01
Injuries				
Head trauma	32/53 (60)	9/11 (82)	23/42 (55)	0.10
Maxillofacial trauma	10/53 (19)	2/11 (18)	8/42 (19)	0.95
Polytrauma	6/53 (11)	4/11 (36)	2/42 (5)	<0.01
Short bone fractures	8/53 (15)	1/11 (9)	7/42 (17)	0.53
Other minor injuries	12/53 (23)	3/11 (27)	9/43 (21)	0.68
No injuries	3/53 (6)	0/11 (0)	3/42 (7)	0.40
ICU admission	12/81 (15)	11/14 (92)	1/67 (1)	<0.01
Death	1/59 (2)	1 (6)	0 (0)	0.04

Values are presented as number (%). Percentages may not total 100 because of rounding.

EMS, emergency medical service; ED, emergency department; ICU, intensive care unit.

nary characteristics of patients with trauma following an e-scooter crash to prehospital, ED, and intensive care unit clinicians. Although newspapers as a source of information were previously used,¹⁹⁻²¹ our results might be biased by selective reporting of news media. The main limitation of this study is the source of data (journal articles) and the lack of detailed clinical reports, calling for caution when using and interpreting our data. Unfortunately, medical records were not available to check for consistency with our findings, as there was an unexpected increase in accident rates, and emergency systems were not prepared to keep track of this kind of trauma. Therefore, in the absence of other sources of information at a national level, we performed this analysis using news reports. Of note, despite this methodological issue, our findings are in line with other reports from other countries.^{3,4,6,7,9,18}

The actual incidence of e-scooter trauma may be underestimated because some cases, especially those with minor injuries, may not be reported in the press and riders likely avoided calling EMS or visiting the ED. Future research would benefit from clinical documentation of relevant incident characteristics, such as helmet use and types of injuries. To achieve this result, it is of paramount importance to start tracking e-scooter traumas along with core information (e.g., type of collision, mechanism of trauma, helmet use) in the EMS dispatch and ED software.

Conclusions

In the last year, the number of road traffic accidents involving e-scooters significantly increased in the streets of Italy and were accompanied by severe injuries, in particular head trauma and polytrauma, requiring the intervention of EMS physicians and intensive care unit admission in a non-negligible proportion of case. Considering the sporadic use of helmets and that head trauma was the most frequent injury, injury prevention campaigns by governmental authorities are urgently required to reduce e-scooter-related morbidity.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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