TRAFFIC INJURY RESEARCH FOUNDATION



ROAD SAFETY MONITOR 2021 | MICROMOBILITY IN CANADA Traffic Injury Research Foundation, August 2022

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A variety of micromobility devices have emerged on Canadian roads in the past decade. Personal micromobility devices (PMDs) include Segways, e-bikes, and e-skateboards or hoverboards. Perhaps the most recognizable form of micromobility available in many jurisdictions across Canada, however, is the e-scooter, which has become a regular sight on roads and sidewalks in the past few years. Although e-scooters, like bicycles, can be purchased and owned by individuals, the sudden ubiquity of e-scooters in some cities is generally attributed to the commencement of dockless e-scooter rideshare services operated by private companies. These services, which distribute and maintain large fleets of e-scooters in the cities where they are permitted to operate, generally began operating in 2017 (Hawkins, 2017). Since then, the industry has grown rapidly. Prior to the COVID-19 pandemic, one source estimated the global market for e-scooters would be worth approximately 40 to 50 billion dollars by the year 2025 (Schellong et al., 2019).

Many Canadian cities have allowed these services to operate, in accordance with regulations, through pilot programs intended to gather data to inform transportation and infrastructure planning (Tait, 2019; Deschamps, 2021). E-scooters have become quite popular with residents in certain cities. For example, 10% of residents in Calgary were estimated to have rented an e-scooter from a dockless e-scooter sharing service by 2019 (Tait, 2019).

Using PMDs for transportation can have advantages. Examples of potential benefits of e-scooter sharing services include access to a convenient, inexpensive and physically distanced transportation choice, an increase in connectivity between people and public transit, and a fun experience akin to "feeling like a little kid again" (Schellong et al., 2019, quote from p. 1; Bubbers, 2020). The same can likely be said for other PMDs, including e-bikes, hoverboards and Segways. However, micromobility can also produce harm, and injuries and fatalities related to using PMDs are a paramount concern.

Different types of PMDs are associated with distinct injury characteristics.

- > Segways are associated with radius fractures and other orthopedic injuries to the upper and lower extremities, head injuries, and thoracic injuries, among older individuals, resulting from falls (Pourmand et al., 2017).
- Hoverboard injuries include fractures and soft tissue injuries, particularly to the wrist, arm and elbow. These result from falling and frequently involve children (Schapiro et al., 2017; Goldhaber et al., 2020; Ho et al., 2018; Monteilh et al., 2017; McIlvain et al., 2019). Hoverboards are unique and associated with Seymour fractures (i.e., breaks in the bone

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beneath the fingernail), which have occurred when riders wedge their fingers in the wheel well while picking up a powered hoverboard or performing stunts (Ho et al., 2018; Schapiro et al., 2017).

- E-bike injuries often include fractures, head injuries, soft tissue injuries, dental injuries and organ injuries, commonly affecting the head, neck, upper and lower extremities, and abdomen (Gross et al., 2017; Hermon et al., 2020; Papoutsi et al., 2014; Karepov et al., 2019; Zmora et al., 2019). These injuries are typically a result of losing traction, falling, collisions and speed.
- E-scooter injuries resulting in emergency medical attention usually affect the upper and lower extremities, as well as the head and face, and commonly include soft tissue injuries, fractures, and dental injuries (Toofany et al., 2020; DiMaggio et al., 2019; Alwani et al., 2020; Bloom et al., 2021; Moftakhar et al., 2021; Anderson et al., 2021; Faraji et al., 2020; Tischler et al., 2021; Kim et al., 2021). Loss of balance and falls are major contributors to e-scooter injuries (Alwani et al., 2020; Anderson et al., 2021; Bloom et al., 2021; Tischler et al., 2021).

To this end, there are several steps that micromobility riders can take to avoid crashes and injuries. This fact sheet summarizes evidence from previously published studies and incorporates data from the Traffic Injury Research Foundation's (TIRF)'s Road Safety Monitor (RSM) poll. The benefits associated with the use of micromobility options are described along with specific risks related to riding location, time of day, distraction, and helmet use.

The RSM is an annual survey conducted by TIRF, with financial contribution from Beer Canada and Desjardins, and support from Neuron, to assess road safety knowledge, attitudes and behaviours in Canada. Questions in the 2021 poll focused on regulatory violations, technological distractions, and other risky behaviours among riders of PMDs such as electric bikes (e-bikes), electric scooters (e-scooters), Segways, hoverboards and electric skateboards observed by Canadians. This is the first year the RSM included questions related to PMDs and how they are used. Specifically, the survey prompted respondents to consider the following actions:

- > performing stunts on public roads
- > failing to obey traffic signs or yield right of way
- riding wheeled vehicles on sidewalks instead of on the road
- travelling while wearing headphones or earbuds
- > travelling while using a cell phone or texting,
- weaving in and out of traffic while operating their vehicle on the road
- riding at night when they are not easily visible to traffic; for example, without a light or reflectors
- > riding without a helmet



They were asked to indicate how often they observed people operating these devices in their community in the past year using a 6-point scale, where 1 means *never* and 6 means *extremely often*.

A total of 1,500 Canadians responded and are included in these analyses. *Often observed* was scored as 5 and 6 on each scale whereas *not often observed* was scored as 1, 2, 3 and 4 on each scale. See Figure 1, above, for an illustration of the proportion of respondents who reported often observing a variety of e-scooter behaviours.

Road riding

PMDs are often prohibited from sidewalks by local regulations, but this varies by municipality. For example, in 2019, Edmonton did not permit e-scooters on the sidewalk, but Calgary did; and, in Edmonton, e-scooters were permitted on the road, but in Calgary, they were not (Tait, 2019). In some cases, e-scooters are only technically allowed on private property (Tchir, 2021). Predictably, research has shown many people report either not knowing the regulations related to e-scooter use or are found to have incorrect knowledge of those laws (James et al., 2019; Glenn et al., 2020). Additionally, e-scooter riders have been observed violating such rules (e.g., Todd et al., 2019).



A primary concern related to using micromobility on the road is that riders travel near moving motor vehicles, meaning relatively unprotected PMD riders risk significant injuries in the event of a collision. The Collaborative Sciences Center for Road Safety (CSCRS), a US DOT National University Transportation Center, maintains a database that catalogues fatalities involving e-scooters around the world. As of December 2021, 64 of the 90 recorded e-scooter rider fatalities occurred on roads, and of those 64 fatalities, 57 involved motor vehicles (CSCRS, 2022). Perhaps unsurprisingly, e-scooter riders generally appear to prefer riding in locations not shared by motor vehicles, such as sidewalks and bike lanes (Zhang et al., 2021; Glenn et al., 2020). The same is likely true for riders of other PMDs as well.



However, motor vehicle collisions are not the only hazard encountered on roads. Falls are another common source of injury with certain types of PMDs (i.e., Segways, hoverboards and e-scooters). In fact, six of the e-scooter rider fatalities occurring on roads in the CSCRS database were characterized by falling off the e-scooter in the road with no motor vehicle involvement (CSCRS, 2022). PMD riders should therefore consider more than just other vehicles when assessing the risk of riding on the road.

Despite the risks, TIRF's RSM data revealed PMD riders were observed riding on the road in a manner that needlessly increases the risk of conflict with another road user or falling from the mobility device. In particular:

- > 28.1% of respondents reported frequently observing PMD riders failing to obey traffic signs or failing to yield the right of way. These behaviours were less frequently observed by those from Newfoundland and Labrador, and those in population centres with over 100,000 residents.
- > 21.2% of respondents reported often observing PMD riders weaving in and out of traffic while operating their vehicle on the road.

> 10.8% reported often observing PMD riders performing stunts on public roads. Stunting was less frequently observed among those aged 36 to 55, 56 to 75 and 76 and over, as well as those living in a population centre with over 100,000 residents.

Sidewalk riding

The riding of PMDs on sidewalks also poses risks. Falls can still occur, and PMD riders can encounter conflicts with other active transportation users such as pedestrians. Injuries associated with e-scooters commonly occur on sidewalks (Toofany et al., 2020). In the U.S. at least one pedestrian has been fatally injured in a collision with an e-scooter rider on a sidewalk (CSCRS, 2022). Additionally, although e-scooter riders may feel safer riding away from motor vehicles, pedestrians often report feeling unsafe sharing their walking spaces with e-scooter riders. James and colleagues (2019), who sampled respondents from Rosslyn, Virginia, reported that slightly more than half of their respondents reported feeling unsafe or very unsafe walking around dockless e-scooter riders. In that study, feeling unsafe around dockless e-scooter riders was more prevalent among respondents who reported not using this mode of travel. Furthermore, in places with dockless e-scooter sharing services, residents have submitted complaints to local governments concerning e-scooter riders sharing the sidewalk (Nowak, 2019; Tait, 2019). Cases of pedestrians injured by Segway riders and e-board riders have also occurred (e.g., Boniface et al., 2011; Kim et al., 2021).

TIRF's RSM respondents reported seeing PMDs commonly operated on sidewalks. Specifically, about one in five respondents (22.8%) reported frequently seeing this behaviour. It is important to note that the legality of riding on sidewalks varies between municipalities, so not all observations of sidewalk riding represent rule violations. For example, four out of five municipalities where Neuron operates its e-scooter sharing service allow e-scooter riding on sidewalks (Neuron, n.d.). Observations of sidewalk PMD riding were reported less frequently among those aged 36 to 55, among female respondents, and those residing in Quebec and New Brunswick.

Riding at night

Travelling at night has known risks for active transportation users such as pedestrians and cyclists. The TIRF Fatality Database indicates that from 2010 to 2019, 21.3% of cyclist fatalities and 28.3% of pedestrian fatalities occurred between the hours of 9:00 PM and 5:59 AM in Canada. In particular, darkness during nighttime hours presents a risk to active road users. Data from the U.S. Fatal Accident Reporting System (FARS), which captures motor vehicle involved fatal crashes, showed many bicycle (43.5%) and most (72.1%) pedestrian crashes occurred specifically when it was dark between 2010 and 2015 (Coleman & Mizenko, 2018).

Given that conspicuity (i.e., being visible or being able to clearly discern objects or people) is a factor in crashes between motorists and both pedestrians and bicyclists (NHTSA, n.d.), it is likely to a factor in motor vehicle crashes involving personal device riders as well. TIRF's Fatality Database contains only 11 e-bike fatalities between 2010 and 2019, and of these, one occurred between the hours of 9:00 PM and 5:59 AM. The CSCRS database, however, indicated that approximately 40% of fatalities involving e-scooters (including pedestrian and bicyclist deaths) around the world occurred during nighttime hours,¹ and of those fatalities, approximately 74% involved a motor vehicle (CSCRS, 2022). A unique aspect of e-scooter riding is that unlike pedestrians or cyclists, riders stand upright with straight legs in a still position (e.g., Bloom et al., 2021). Segway, hoverboard and electric skateboard riders take similar stances. In low visibility environments, it is more difficult for drivers to see and recognize people when they are standing still than when they are exhibiting what is known as biological motion (i.e., "patterns of human motion" that occur with natural human movements, such as walking; Balk et al., 2008, p. 1276; Kwan & Mapstone, 2004;

A unique aspect of e-scooter riding is that riders stand upright with straight legs in a still position. In low visibility environments, it is more difficult to recognize people when they are standing still.

¹ Recorded between 9:00 pm and 6:00 am, or with the general descriptor "night."

Tyrell et al., 2016; Mian & Caird, 2018). It stands to reason that upright stances, which do not convey biological motion effectively, could make e-scooter, hoverboard, Segway and e-skateboard riders more difficult to detect as compared to pedestrians and cyclists. However, the role of biological motion in the detection of personal mobile device riders, and its effects on personal device rider injury rates and crashes, is unclear.



Unfortunately, pedestrians (Shinar, 1984; Tyrell et al., 2004a) and bicyclists (Wood et al., 2013) commonly believe they are more visible to drivers than they are. PMD riders, who likely overlap to some extent with pedestrians and bicyclists, could reasonably make the same misjudgements. Additionally, conspicuity issues could contribute to crashes between micromobility riders, bicyclists and pedestrians. Fortunately, making people aware of pedestrians' tendencies to overestimate their conspicuity at night has shown promise in correcting those estimations (Tyrell et al., 2004b). PMD riders are encouraged to think about how visible they may appear to other road riders when out riding at night. Additionally, PMD riders should also be aware that alcohol is associated with nighttime road injuries and fatalities. For example, among e-scooter fatalities involving an impaired motor vehicle driver, all occurred at night (CSCRS, 2022).

To this end, TIRF's RSM results showed riding PMDs at night while not easily visible to traffic was often observed by 16.0% of respondents. It was less frequently observed by those aged 36 to 55 and by those aged 56 to 75.

Riding without a helmet

All PMD riders could benefit from using helmets. However, research suggests e-scooter riders have a particularly high risk of head injury. The use of helmets among e-scooter riders is very low, both among those who present to emergency rooms with injuries (e.g., 4.5%; Toofany et al., 2020) and among those observed riding without incident (Todd et al., 2019). The rate of helmet use among e-scooter riders appears to be lower than the rate of helmet use among bicyclists (Todd et al., 2019). Differences in helmet use may contribute to the observation that concussions and fractures are more likely to result from powered scooters than from e-bikes (Dimaggio et al., 2019). Norms related to helmet wearing among e-scooters may be weak. For example, a study of one e-scooter's social media account indicated that images posted on the company's account rarely depicted the use of their scooters with riders wearing safety equipment (Allem & Majmundar, 2019). Nonetheless, e-scooter riders should seriously consider using a helmet while riding given the pattern of injuries associated with e-scooters. Those who have never ridden an e-scooter before, in particular, should consider using a helmet. Both Cicchino and colleagues (2020) and Austin Public Health (2019) each reported that of injured e-scooter riders, approximately one-third were first-time riders (i.e., 33% and 37%, respectively). As previously discussed, the head and face are common injury sites among e-scooter riders.

Across Canada, helmet rules vary by province, municipality and device type. For example, in Edmonton, Alberta, helmets are required based on provincial regulations, meaning they are required by bicycle riders under the age of 18, all e-bike riders regardless of age, but not e-scooter riders (City of Edmonton, n.d.). Less than 20 km away, in St. Albert, Alberta, the same provincial regulations apply for bicycle and e-bike riders, but e-scooter riders are additionally required by local regulations to wear helmets (Narvey, 2021). Though there are inconsistencies in helmet requirements from place to place, the consequences of crashing on a PMD without a helmet are consistent. All PMD riders should consider wearing a helmet regardless of whether one is required by local or provincial regulation. Overall, of RSM

respondents, 27.1% responded having often observed PMD riders riding without a helmet.

Technological distractions

There has been limited research investigating the prevalence of technological distractions in micromobility crashes and injuries. One study from Austin, Texas indicated that among 190 injured e-scooter riders, one had been on a phone call when the injury occurred, and six others were listening to music or a podcast (APH, 2019). Cell phone distraction has a clearly negative effect on driving performance and crash risk (Caird et al., 2014; Simmons et al., 2016; Caird et al., 2018), and it has been shown to interfere with safe walking behaviour as well (Simmons et al., 2020). Similar consequences could reasonably occur with PMD riders who are engaged in these cell phone tasks.

According to TIRF's RSM results, almost one in five respondents (19.5%) reported they often observed PMD riders travelling while using a cell phone, including texting. Observations were less frequent among respondents in population centres with over 100,000 residents. In addition, 31.3% of respondents reported they often observed PMD riders travelling while wearing headphones or earbuds. These observations were less frequently reported by Quebec residents.

Conclusions

This is the first year that TIRF included items related to micromobility and PMDs in its annual Road Safety Monitor survey. Overall:

- about one in four reported often seeing PMD riders failing to obey traffic signs or failing to yield the right of way
- about one in five reported often seeing PMD riders weaving in and out of traffic
- about one in ten reported often seeing PMD riders performing stunts on public roads
- about one in five reported often seeing PMD riders riding wheeled vehicles on sidewalks instead of on the road
- about one in six reported often seeing PMD riders riding at night while not easily visible to traffic

- about one in four reported often seeing PMD riders riding without a helmet
- > about one in five reported often seeing PMD riders travelling while using a cell phone
- about one in three reported often seeing PMD riders travelling while wearing headphones or earbuds

These data represent the current behaviours of PMD riders and create a baseline against which future years of data can be measured with respect to safety. Given the proliferation of PMD technologies and micromobility sharing services in Canadian municipalities, the prevalence of these behaviours is likely to increase with ridership, which could lead to increased burden within the healthcare system. As such, municipalities are encouraged to play an active role in both regulating the use of these devices to promote safety and to support concerted educational initiatives to promote safe riding. At the same time, current and prospective riders should be aware of the risks of using these technologies. Of importance, they should wear protective equipment in case falls or collisions occur and avoid engaging in activities which could increase their risk of falls or collisions.

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Traffic Injury Research Foundation

The vision of the Traffic Injury Research Foundation (TIRF) is to ensure people using roads make it home safely every day by eliminating road deaths, serious injuries and their social costs. TIRF's mission is to be the knowledge source for safe road users and a world leader in research, program and policy development, evaluation, and knowledge transfer. TIRF is a registered charity and depends on grants, awards, and donations to provide services for the public.

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