

CITATION

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Key Findings

- Electric bikes (e-bikes) and electronic scooters (e-scooters) are low-cost and easily accessible modes of transportation.
- As relatively new transportation modes, e-bikes and e-scooters still have limited design, production, and use regulations. For e-scooters, limited regulation is exacerbated by the fact that the majority of these micro-vehicles are shared rides with easy access and low rent.
- Currently, e-bikes are generally classified as non-motorized vehicles; therefore, they have the same rights and regulations as bicycles and do not require specific driver's licenses, helmets, or insurance to operate.
- Research on the effectiveness of helmet use for e-bike and e-scooter riders is limited.
- Several studies have shown that head injuries account for the majority of the serious injuries suffered by e-bike and e-scooter riders. For example, 75% of the deaths among e-bike users in China result from head injuries. The protective role of helmets for bicyclists and motorcyclists has been well documented and widely demonstrated in both lab tests and empirical data from real-world observations.



Recommendations

A multi-pronged, systems-level approach is needed to regulate the use of e-bikes and e-scooters and promote helmet use, including:

- Campaigns
 - Safety campaigns to increase awareness of the risks associated with e-bike and e-scooter use and promote safe use are urgently needed.
 - Engaging ride-share companies as key stakeholders as they can play an influential role in enhancing helmet use among their riders. For example, the City of Portland's Bureau of Transportation (PBOT) organized an e-scooter safety event where e-scooter operators distributed free helmets to participants and also provided rider training on road safety. Similarly, the University of Maryland Department of Transportation Services (DOTS), the town of University Park, and the city of College Park are collaborating to pilot a one-year ride-share service that requires riders to use helmets.

- Evidence Generation
 - Applying and adapting lessons learned from the development and implementation of helmet use laws for bicyclists and motorcyclists to e-bike and e-scooter regulations in various contexts across the globe.
 - Collecting helmet-use data specific to e-bike and e-scooter users to provide evidence on the type of crashes and injuries experienced by these riders. This will also help to monitor the implementation of helmet use regulations for e-bike and e-scooter users, and the data generated will enable policymakers to make informed decisions regarding how to enhance helmet regulations.
- Helmet Standards and Helmet Use Legislation
 - Introducing standards for e-bike helmets; empirical work is required to understand the type of helmet needed for e-bike and e-scooter users.
 - Introducing mandatory helmet use legislation for e-bikes and e-scooters as in the case in many countries including Australia, New Zealand, and Canada.
 - E-bikes and e-scooters should be categorized as motorized vehicles.



The Problem

Over the past decade, electronic micro-mobility vehicles—e-bikes and e-scooters—have emerged as some of the fastest-growing vehicle types from all transportation modes. While China leads the world in e-bike production, sales, and use, other countries like Vietnam, Thailand, the U.S., and many European countries (Germany, Switzerland, the Netherlands, and Israel) have also documented dramatic increases.^{1,2}

There has been an increase in fatal and non-fatal crashes involving e-bikes and e-scooters. Powered two- and three-wheeler users make up 30% of all road fatalities.³ Considering the current upward trend of e-bike and e-scooter use globally, issues related to shared road space, lack of helmet use, and lack of regulations to safeguard micro-mobility vehicle users will be important to address as the number of crashes involving e-bikes and e-scooters continues to increase. Given the prevalence of head injuries among e-bike users, various studies support the benefit of mandatory helmet use for these riders^{4,5,6} based on their effectiveness in reducing head injuries and fatalities among bicyclists and motorcyclists. Introducing and enforcing helmet laws can significantly reduce non-fatal injury rates by 20%³ and can reduce head injury rates by 58-60%.⁷ E-bikes travel at fast speeds, and the lack of regulations governing their manufacture and use imposes an elevated risk for crashes, injuries, and fatalities to not only e-bike and e-scooter riders, but also to other vulnerable road users, such as bicyclists and pedestrians.



What we already know

Our extensive literature review identified limited studies that examined the effectiveness of helmet use for e-bike and e-scooter riders. The protective roles of helmets for bicyclists and motorcyclists have been widely documented in both lab tests and empirical findings from real-world observations. Based on injury and fatality data reported among e-bike and e-scooter users (summarized below), helmet use could potentially offer similar effectiveness for e-bike and e-scooter riders. Further explorations, including large-scale observations, implementation research, and rigorously designed evaluation studies are warranted to support the development of policies and programs.



Aim of the Review

This review summarizes injury epidemiology and consequences among e-bike and e-scooter users, helmet use prevalence and policies, and recommendations to improve helmet use among e-bike and e-scooter riders.



Summary of Evidence

Epidemiology of Injuries and Other Consequences among E-bike and E-Scooter Users	
Types of Injuries	Several studies have shown that head injuries account for a majority of the serious injuries among e-bike and e-scooter riders. ^{4,6,8,9,10,11} In addition, neck and spinal injuries are reported. ¹²
Injury Severity	When compared to bicycle and motor vehicle injuries, e-bike injuries are characterized by increased severity, length of hospital stay, and the use of Computed Tomography (CT) imaging. Injuries caused by e-bikes are more severe than those caused by motorized bikes and those experienced by automobile passengers and are similar to those among pedestrians. ⁵
Health Care Costs	Elevated health care costs were also documented in the literature. For example, median costs associated with e-bike-related injury care in China are about USD \$14,269 with longer lengths of hospital and Intensive Care Unit (ICU) stays (median length of 16 days). ^{13,14}
Country-specific Data on Injury Epidemiology and Helmet Use among E-Bike and E-Scooter Users	
China	<ul style="list-style-type: none"> Fatal and non-fatal injury rates for e-bike riders increased by four and six times, respectively, in China between 2004 and 2010.¹⁵ Gender and age differences in engaging in risky behaviors are documented in China. Male e-bike riders were 1.56 times more likely to engage in risky behaviors on e-bikes and e-scooters than female riders. Young riders (under 25 years old) take the most risks (Odds Ratio [OR] = 4.002), followed by middle-aged riders (OR = 2.179).¹⁶
Germany	<ul style="list-style-type: none"> Of patients arriving at the emergency department after an e-scooter crash, more than 50% had head injuries, and none of the riders used a helmet despite recommendations by e-scooter companies.^{4,6} A study showed that helmet use was common when e-bike riders took a longer trip. This was attributed to riders traveling at increased speeds during long trips. However, helmet use was minimal for shorter trips.^{4,6}
Israel	<ul style="list-style-type: none"> The number of patients injured by e-bike crashes increased by six times between 2013 and 2015. These injuries accounted for 0.3% of all hospitalized patients after road traffic crashes in 2013 and increased to slightly more than 5% in 2015. Of the injured patients, most were e-bike or e-scooter riders.^{8,12} Studies based on patients in an urban tertiary care hospital in Tel-Aviv and the national trauma registry revealed a high proportion of e-bike and e-scooter injuries. Collisions between e-bikes and a motorized vehicle were responsible for injury in 35% of cases.⁸

U.S.	<ul style="list-style-type: none"> • A study on e-scooters showed that riders suffered from head and spine injuries, and none of the riders were using helmets at the time of injury.¹⁰ • According to a study from trauma centers in Indianapolis, none of the admitted e-scooter riders reported using a helmet during the event that led to the injury.¹⁷ • About 40% of the reported injuries occurred to the head and neck region, which, according to the authors, may have been prevented or mitigated if patients were using helmets.¹⁷ • Another emergency department-based study from Los Angeles reported that only 5% of patients were using a helmet at the time of the road crash.¹⁸ • Another study also found a low helmet-use rate of 13% among injured e-bike riders.¹⁹
Current E-Bike and E-Scooter User Policies on Helmet Use	
The policies related to e-bike and e-scooter use tend to vary across contexts.	
China	<ul style="list-style-type: none"> • E-bikes are officially defined as a non-motorized transport mode in China. • A new policy was introduced by China's Ministry of Public Security (CMPS) in April 2019 and implemented in July 2020.²⁰ This includes: <ul style="list-style-type: none"> • Mandatory helmet use and seat-belt use. • Fines to be assessed to e-bike riders who do not use a helmet and car drivers who fail to fasten their seat-belts.²¹ • Delivery and express companies to take responsibility for their employees' safety when using e-bikes (e.g., issuing helmets and providing insurance).²⁰ • After the implementation of the policy, the proportion of people who never use helmets decreased to 4% from 12%, and the proportion of people who often use helmets increased to 51% from 19%.²¹ • Additional technical requirements for e-bike chargers were implemented in July 2023, and safety requirements for the entire e-bike system went into effect in January 2024.²² • The current traffic law includes restrictions for e-bike passengers as well (e.g., in Hainan, e-bike riders must be over the age of 16 and can only carry a single passenger seated directly behind the rider, provided the rider is over the age of 18). Passengers aged 6 and below must be seated in a child-safety seat.²³
Germany	<ul style="list-style-type: none"> • Germany passed regulations in 2019 allowing the use of e-scooters. According to the regulations, e-scooters are subject to a maximum speed limit of 20 km/h. Helmets are not mandatory but are recommended. Individuals 14 years and older can ride e-scooters and can use bike lanes. If there are no bike lanes, these riders must travel on the road.²⁴
Israel	<ul style="list-style-type: none"> • In Israel, it is recommended that everyone using e-bikes and e-scooters use a helmet, but the law is only mandatory for those under 18 years of age. Despite the presence of regulations related to e-bikes and e-scooters, enforcement of general road safety rules has been an issue. In light of increasing road crashes, bills are being proposed to make helmet use mandatory for all users, increase the minimum age of riders to 16 years, building additional cycling paths, and ensuring that sidewalks are not used by e-bike and e-scooter users.^{8,9,12}
Switzerland	<ul style="list-style-type: none"> • E-bike and e-scooter regulation requires riders to use helmets, but it is only mandatory for those riding fast e-bikes (with pedal assistance up to 45 km/h). Due to the increased cost-efficiency of e-bikes, the acceptance and usage of e-bikes in public is increasing, but the implementation of helmet laws for all e-bike riders is limited.²⁵

U.S.	<ul style="list-style-type: none">• Connecticut (U.S.) has the strictest e-bike helmet law requiring riders and passengers for all classes of e-bikes to use a helmet. There are 25 other states in the U.S. that have a state law for e-bike-related helmet use, but the laws vary based on the type of e-bike, user type, and age group.²⁶• Although e-scooter services (Lime) encourage helmet use as part of their terms of service, no uniform legislation requires helmet use or dictates how fast scooters can go or even where they should be operated. While the major companies operating e-scooters seemingly promote safety and helmet use in marketing, their actions in the legislative arena are often in favor of less regulation regarding safety.¹⁰• “Wheels,” an e-bike company in the United States (U.S.) and Sweden, has designed its e-bikes to include helmets that can be unlocked using its proprietary mobile application. The company designed its e-bike helmets in line with legislation passed for bicycle helmets.
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