

## ELECTRIC SCOOTERS (E-SCOOTERS): ASSESSING THE THREAT TO PUBLIC HEALTH AND SAFETY

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### Abstract

**Objective:** To determine self-reported incidences of health and safety hazards among persons who ride rentable electric scooters (e-scooters), knowledge of e-scooter laws, and attitudes and perceptions of the health and safety of e-scooter usage.

**Methods:** A cross-sectional survey of n= 561 e-scooter riders and non-riders was conducted during June of 2019.

**Results:** Almost half of respondents (44%) report that e-scooters pose a threat to the health and safety of riders. Riders and non-riders disagree regarding the hazards that e-scooters pose to pedestrians. Among riders, 15% report crashing or falling off an e-scooter. Only 2.5% of e-scooter riders self-report that they always wear a helmet while riding.

**Conclusions:** E-scooter riders report substantial rates of harmful behavior and injuries. Knowledge of e-scooter laws is limited, and e-scooters introduce threats to the health and safety of riders, pedestrians on sidewalks, and automobile drivers. Enhanced public health interventions are needed to educate about potential health risks and laws associated with e-scooter use and to ensure health in all policies. Additionally, greater consideration should be given to public health, safety, and injury prevention when passing relevant state and local e-scooter laws.

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## Background

Seemingly overnight, rentable electric motorized scooters (e-scooters) appeared in cities around the country. In addition to creating a new form of transportation, they introduce new public health and safety concerns and the need for new laws and regulations (Choron & Sakran, 2019). Currently, more than 50 cities in the United States allow the use of e-scooters (Bird, n.d.a; Lime, n.d.). Although some cities considered banning e-scooters, those that have approved their use since September of 2017, have passed regulations banning e-scooters from sidewalks, setting parameters for the times that e-scooters may be used, and extending “operating while intoxicated” laws to include e-scooters (Hawkins, 2019b; Hawkins, 2019c; May & Hill, 2018; May, 2019; Renki, 2019; Sikka et al., 2019). The goals of e-scooter regulations are to protect the health and safety of e-scooter riders as well as non-riders, such as pedestrians and drivers. However, questions arise as to whether these initial regulatory attempts substantively respond to the novel morbidity and mortality risks associated with e-scooter proliferation and use.

In Portland, Oregon, a pilot of rentable e-scooters resulted in 176 e-scooter accidents resulting in emergency department (ED) visits during the six-month trial period (Portland Bureau of Transportation, 2019). Additionally, in Portland, the bureau of transportation reported a high number of complaints related to e-scooter riding on sidewalks with 3% of all injuries during the pilot program deriving from collisions with pedestrians (Portland Bureau of Transportation, 2019). A study in Los Angeles, California reported 249 ED visits related to e-scooter use during a one-year period, and Salt Lake City, Utah reported 50 e-scooter-related injuries over a 5-month period in 2018 (Badeau et al., 2019; Trivedi et al., 2019). Individuals renting e-scooters from at least one prominent

e-scooter vendor (Bird) may self-report accidents through their proprietary mobile application. A safety report issued by Bird found that their users’ self-reported accidents via their app at a rate of one injury per 27,000 miles ridden on their e-scooters (Bird, 2019). The most comprehensive examination of e-scooter injuries undertaken to date was conducted by the Centers for Disease Control and Prevention (CDC) in collaboration with the Austin, Texas Public Health Department (Austin Public Health, 2019). Examining both Emergency Services (EMS) and ED visits over a three-month period in 2018, this study reported a total of 192 injuries resulting in a clinical visit. Of those injured, two people were non-riders injured by an e-scooter, and nearly half of those injured sustained a head injury (Hawkins, 2019a). Similar to the CDC study, a recent study published in the Journal of American Medical Association (JAMA) found that head injuries were sustained by 40% of those injured in an e-scooter accident (Trivedi et al., 2019). In addition to reports of injuries, a survey conducted in San Antonio, Texas found that respondents had concerns about e-scooter safety (City of San Antonio, 2019).

Although there have been several studies reporting injuries related to e-scooter use, and one white paper produced by the city of San Antonio exploring attitudes of citizens toward scooters, there have been no studies published assessing the public’s knowledge, attitudes and perceptions of the health and safety of e-scooter use. In order to ensure health in all policies and pass meaningful policies and regulations which support public health and safety, it is important to identify the public’s perception of e-scooter health and safety risks, as well as their knowledge of existing e-scooter laws. This study is the first to report e-scooter rider self-reported incidents of health and safety hazards associated with e-scooter use, knowledge of e-scooter laws, and the public’s attitudes

and perceptions of health and safety issues associated with e-scooter usage. The results of this study will help inform health in all policies.

## Methods

A cross-sectional survey of both e-scooter riders and non-riders was conducted in Indianapolis, Indiana during June 2019 to determine attitudes and perceptions of the health and safety of scooter usage among both e-scooter riders and non-riders.

### Survey Design

The survey was designed from a review of the available literature and was reviewed for both content and face validity. Feedback was obtained from community members regarding question clarity, word choice, missing items, and overall length. The survey was pretested for content validity with possible survey participants. The survey was designed to measure: 1) self-reported incidences of health and safety hazards associated with e-scooter usage; 2) knowledge of local e-scooter laws; and 3) the attitudes and perceptions of the health and safety issues related to e-scooter usage. The survey prompted participants to self-report information using the responses of yes, no, or unsure. The Indiana University-Purdue University Indianapolis (IUPUI) Institutional Review Board Approved this survey.

### Survey Sample

Participants located in the downtown area of Indianapolis, Indiana, who were 18 years of age or older and able to read and write English were included in this study. Participants under 18 years of age were excluded because they are prohibited from renting e-scooters due to minimum age requirements.

### Survey Administration

Individuals located in downtown Indianapolis, Indiana during the week of June 10 – 17th

2019, were asked to participate in this survey. The downtown area with heavy foot traffic was selected for survey distribution because e-scooters are primarily available in this location of the city. Potential participants were a convenience sample who were approached by research assistants and asked if they would like to participate in the survey. Study participants were not offered an incentive for participation. Completed surveys were entered and stored in REDCap electronic data capture (Harris et al., 2009).

### Statistical Analysis

Descriptive statistical analysis was performed to determine participant self-reported use of scooters, scooter safety, knowledge of laws pertaining to e-scooter use in the city, and attitudes and perceptions of the health and safety of scooter use. Chi-squares were performed to determine differences between persons who identified that they have ever ridden an e-scooter (riders) and persons who identified that they have never ridden an e-scooter (non-riders). All analyses were performed using R statistical software and the RStudio development environment (R Core Team, 2014; RStudio, 2015).

## Results

In total, 561 individuals were asked to participate in the survey, 329 of those approached agreed to participate, and 232 declined participation (59% response rate). Survey participants represented roughly equal numbers of males (n=163, 49%) and females (n=161, 50%) (Table 1). The mean age of survey respondents was 32 years of age (C.I. 13.6). The majority of survey takers were white (n=228, 70%), and 21% (n=68) of survey respondents were current college students. The proportion of scooter riders versus non-riders was equal, with 50% of participants (n=162) self-reporting that they have ridden a scooter (scooter riders). Among

scooter riders, 34% (n= 54) reported only using an e-scooter once, 15% (n=23) reported using an e-scooter once per year, 30% (n=49) reported using an e-scooter once per month, 17% (n=27) reported using an e-scooter once

per week, 3% (n=5) reported using an e-scooter once per day, and 2% (n=3) reported using an e-scooter more than once per day. E-scooter riders are younger on average ( $p<0.001$ ) and more likely to be college students ( $p=0.008$ )

**Table 1. Demographics**

	All Survey Takers n=329 n (%)	Scooter Riders n=163 n (%)	Non-Scooter Riders n=164 n (%)	p-value
Age, years (mean, sd)	32.1 (13.6)	27.9 (10.5)	36.1 (15.1)	<b>&lt; 0.001</b>
Gender				
Male	163 (48.9)	91 (55.8)	72 (43.9)	
Female	161 (49.5)	68 (41.7)	91 (55.5)	
Prefer not to answer	5 (1.5)	4 (2.5)	1 (0.6)	
Race				0.313
White	228 (69.5)	99 (63.9)	122 (74.8)	
Black	42 (12.8)	22 (14.2)	20 (12.3)	
Other	48 (14.6)	30 (18.4)	18 (11.0)	
Prefer not to answer	10 (3.0)	7 (4.3)	3 (1.8)	
College Student	68 (20.9)	44 (27.3)	24 (14.7)	<b>0.008</b>
Undergraduate*	31 (45.6)	21 (47.7)	10 (41.7)	0.745
Graduate*	37 (54.4)	23 (52.3)	14 (58.3)	
College Faculty or Staff	32 (9.9)	14 (8.8)	18 (11.1)	0.602
Ever used a motorized scooter	163 (49.8)	---	---	
Frequency of scooter use				
Has only used once	---	54 (33.5)	---	
Once per year	---	23 (14.8)	---	
Once per month	---	49 (30.4)	---	
Once per week	---	27 (16.8)	---	
Once per day	---	5 (3.1)	---	
More than once per day	---	3 (1.9)	---	

\*Percentages are of IUPUI student respondents

than non-riders.

Among e-scooter riders, 15% (n=24) self-report that they have fallen off or crashed a scooter (Table 2). Of those participants who had fallen off or crashed a scooter, 46% (n=11) report having sustained an injury from the crash, and 36% (n=4) of those who sustained an injury report having sought medical treatment for the injury. Only 2.5% (n=4) of scooter riders self-report that they sometimes or always wear a helmet while riding a scooter, although 38% (n=62) report that they would wear a helmet if it was provided at no cost, and only 19% (n=31) reporting that they knew helmets could be acquired for free through scooter companies.

Additionally, while rentable e-scooters are intended for use by individual riders, 30% (n=47) of scooter riders report that they have ridden with another person on the same scooter, and 65% (n=211) of all survey respondents (both scooter riders and non-riders) report having seen multiple people riding on the same scooter. On issues related to public safety, 28% (n=90) of all respondents report seeing an unattended scooter parked on a handicap ramp and 72% (n=235) report seeing a scooter parked in a way that obstructs pedestrians or traffic. Almost half of all respondents (43%, n=140) reported having seen someone appearing to be intoxicated riding an e-scooter.

**Table 2. Self-reported Scooter Safety**

	n (%)
Fallen off or crashed motorized scooter*	24 (14.8)
Sustained injury from motorized scooter crash**	11 (45.8)
Sought medical treatment for injury (of those injured)**	4 (36.4)
Always or sometimes wears helmet while riding motorized scooter*	4 (2.5)
Would wear helmet if provided at no cost*	62 (38.3)
Knows that helmets are provided for free*	31 (19.3)
Ridden scooter with someone else*	47 (29.7)
Seen multiple people riding one scooter+	211 (64.7)
Seen scooter parked on handicap ramp+	90 (27.5)
Seen scooter parked in a way that obstructs pedestrians or traffic+	235 (72.1)
Seen someone riding scooter while intoxicated+	140 (43.1)

\*Of self-reported scooter users

\*\*Of self-reported scooter users who also reported a crash or fall

+Of all respondents

Among all survey respondents, 38% (n=121) did not know or were unsure if it was illegal to ride an e-scooter while intoxicated (35% of riders, n=56 and 40% of non-riders, n=65) (Table 3).

between scooter riders and non-scooter riders (p=.052). More than half (60%, n=194) of all participants report that e-scooters pose a threat to the health and safety of people walking on the sidewalk, with non-scooter riders being

**Table 3. Motorized Scooters and the Law**

	All Survey Takers n (%)	Scooter Riders n (%)	Non-Scooter Riders n (%)	p-value
Illegal to ride scooter while intoxicated				<b>0.404</b>
Yes	205 (62.9)	106 (65.4)	97 (59.9)	
Unsure	97 (29.8)	43 (26.5)	54 (33.3)	
No	24 (7.4)	13 (8.0)	11 (6.8)	
Illegal to ride scooter on the sidewalk				< 0.001
Yes	153 (47.4)	93 (57.8)	60 (37.5)	
Unsure	108 (33.4)	36 (22.4)	70 (43.8)	
No	62 (19.2)	32 (19.9)	30 (18.8)	
Illegal to ride scooter in the street				0.003
Yes	34 (10.5)	15 (9.3)	19 (11.9)	
Unsure	100 (31.0)	37 (22.8)	61 (38.4)	
No	189 (58.5)	110 (67.9)	79 (49.7)	

Less than half of respondents knew that it was illegal under local law to ride an e-scooter on the sidewalk (42% of riders and 63% of non-riders). Additionally, 42% of all respondents did not know or were unsure whether it was legal to ride an e-scooter in the street (32% of riders and 51% of non-riders).

More than half of respondents either agreed (44%, n=142) or were unsure (14%, n=46) whether motorized scooters pose a threat to the health and safety of the people who ride them (Table 4). There was no statistical difference

statistically more likely to report e-scooters as a threat on sidewalks (p<0.001). Forty-six percent (n=150) of all participants report that e-scooters pose a threat to the health and safety of people who are driving in their cars. Forty-eight percent (n=158) of participants believe that more people should use scooters to get around the nearby college campus or the city of Indianapolis, with scooter riders being statistically more likely to agree with the statement that more people should use scooters (p<0.001). The majority of participants (68%, n=220) do not think that e-scooter use should be banned from the city or

**Table 4. Attitudes and Perceptions of the health and safety of motorized scooters**

	All Survey Takers n (%)	Scooter Riders n (%)	Non-Scooter Riders n (%)	p-value
Motorized scooters pose a threat to the health and safety of the people who ride them				
Yes	142 (43.7)	61 (38.1)	81 (49.7)	
No	137 (42.2)	78 (48.8)	58 (35.6)	
Unsure	46 (14.2)	21 (13.1)	24 (14.7)	
Motorized scooters pose a threat to the health and safety of people walking on the sidewalk				< 0.001
Yes	194 (59.7)	75 (46.6)	118 (72.4)	
No	99 (30.5)	64 (39.8)	35 (21.5)	
Unsure	32 (9.8)	22 (13.7)	10 (6.1)	
Motorized scooters pose a threat to the health and safety of people who are driving in their cars				0.011
Yes	150 (46.2)	62 (38.5)	87 (53.4)	
No	150 (46.2)	88 (54.7)	62 (38.0)	
Unsure	25 (7.7)	11 (6.8)	14 (8.6)	
Motorized scooters make you look hip or cool				0.076
Yes	65 (20.0)	40 (24.8)	25 (15.4)	
No	202 (62.2)	91 (56.5)	109 (67.3)	
Unsure	58 (17.8)	30 (18.6)	28 (17.3)	
More people should use motorized scooters to get around IUPUI campus or the City of Indianapolis				< 0.001
Yes	158 (48.3)	102 (63.0)	55 (33.7)	
No	90 (27.5)	23 (14.2)	67 (41.1)	
Unsure	79 (24.2)	37 (22.8)	41 (25.2)	
Motorized scooters should be banned from the IUPUI Campus or from the City of Indianapolis				< 0.001
Yes	54 (16.6)	17 (10.5)	37 (22.8)	
No	220 (67.5)	130 (80.2)	88 (54.3)	
Unsure	52 (16.0)	15 (9.3)	37 (22.8)	

the college campus.

## Discussion

Our findings illustrate that e-scooters may pose a threat to the health and safety of not only those who ride them, but also to persons who are walking on the sidewalk or driving cars. One reason that e-scooters may pose a danger to those who ride them is that riders are not wearing helmets. Only 2.5% of people who ride e-scooters report always or sometimes wearing a helmet. Prior studies have found that head injuries are one of the most prevalent injuries for e-scooter riders (Trivedi et al., 2019). Given the danger of head injury associated with not wearing a helmet and the lack of self-reported helmet use among e-scooter riders, public health interventions are needed to increase helmet usage on e-scooters. One possible public health intervention which is being offered by scooter companies is to provide free helmets to scooter riders (Bird, n.d.a). Although scooter companies offer free helmets to riders, this intervention may merely work to mitigate risk, as only 38% of e-scooter users report that they would not wear a helmet, even though it is recommended by the scooter company and even if it were provided at no cost. Additionally, only 19% of participants knew that free helmets were being offered by the e-scooter manufacturer. Due to the risk of injury associated with not wearing a helmet, public health interventions need to be pursued to increase the use of helmets among e-scooter riders.

The lack of knowledge of the laws pertaining to e-scooter use is another reason why e-scooters may pose a threat to public health and safety. Among e-scooter riders and non-riders alike, almost half of all people do not know that it is illegal to ride an e-scooter while intoxicated, or that it is illegal locally to ride an e-scooter on the sidewalk. Evidence shows that riding e-scooters on the sidewalk can result in pedestrian injury

(Sikka et al., 2019). This is concerning, in part because only 47% of e-scooter riders believe that riding an e-scooter on the sidewalk poses a threat to the health and safety of people walking on the sidewalk, whereas the vast majority of non-riders (72%) believe riding e-scooters on the sidewalk poses a threat to pedestrian health and safety. This gap suggests that e-scooter riders do not appreciate the threat to health and safety that their actions pose to those around them. A lack of knowledge or insight into the dangers of riding e-scooters on the sidewalk may lead to more reckless and improper e-scooter use, in part because they do not believe that their behavior threatens pedestrian health and safety. The results of this study suggest that e-scooter riders may be more inclined to ride on the sidewalk because they believe riding e-scooters in the street is dangerous. One way to combat this issue may be to encourage e-scooter riders and align related e-scooter policies, toward using scooters in bike lanes, rather than ride on the sidewalk or in the street. The e-scooter company Bird had recently pledged to pay cities to build bike lanes in order to keep e-scooter riders off of sidewalks (Schmitt, 2018). Both e-scooter rider and pedestrian safety need to be considered when developing laws, ordinances, and infrastructure within cities that allow e-scooter use.

Another issue with fidelity of the law which may pose a threat to the health and safety of e-scooter riders is the lack of knowledge that it is illegal to ride a scooter while intoxicated. Operating While Intoxicated (OWI) laws apply to e-scooters, and riding an e-scooter while intoxicated may result in the same penalties as operating other motor vehicles while intoxicated. Lack of knowledge of the law may result in people riding e-scooters while intoxicated based on a belief that riding an e-scooter offers a “safer” alternative to

driving while intoxicated. Such unawareness is concerning because intoxication while riding e-scooters has been linked to severe injuries in other studies (Trivedi et al., 2019). The lack of knowledge of both the legality and danger of operating an e-scooter while intoxicated suggest that public health education interventions should be developed to inform the public of these risks. Additionally, steps should be taken to enforce the current e-scooter laws in order to protect the safety and health of the public.

This study has several limitations. First, this study was conducted in one city and may not be representative of the attitudes, perceptions and experiences of those in other cities related to e-scooter use. Second, participants represented a convenience sample and were asked to self-report information, such as the number of times they have ridden an e-scooter, which may introduce bias in the responses. Third, this study sought to measure the attitudes and perceptions of participants at one point in time. It is possible that the responses given by participants may change over time as Indianapolis' approach to e-scooter regulation evolves. Lastly, it is possible that the questions about personal safety and e-scooter use could have influenced answers to the subsequent section on e-scooter laws. Although further studies are needed to gain a more in-depth understanding of the health and safety hazards associated with e-scooter use, this study is the first to explore rider and non-rider perceptions of the risks posed by e-scooters.

## Conclusion

This study finds e-scooters may pose a threat

to the health and safety of the people who ride them, to people on the sidewalk, and people in their cars. When considering health in setting policies, the results of this study indicate three things: 1) That riders are engaging in unsafe behaviors and are being harmed on e-scooters; 2) That despite the risks posed by e-scooters, riders are willing to accept them; and 3) That knowledge of e-scooter laws and safe scooter practices is lacking and needs attention. These findings are concerning from a public health perspective as a significant share of riders engage in risky behaviors when riding e-scooters, such as riding without wearing a helmet, riding with multiple people on one scooter, and riding e-scooters while intoxicated. These risky behaviors have been found to result in severe injury, such as head injuries in other studies. In our study, 15% of scooter riders report falling off or crashing their scooter, with 36% of injury-causing crashes requiring medical attention. These findings are of additional concern because Indianapolis has recently approved two more e-scooter vendors, Lyft and Jump, to bring more rentable e-scooters into the city, although the timelines for e-scooter deployment has not yet been decided. To reduce the risk to public health and safety, we recommend increasing public health interventions to educate e-scooter riders about safe and defensive e-scooter use, potential health and safety risks (to riders and non-riders) associated with e-scooter use, as well as the specifics of local laws and policies. Additionally, stakeholders such as city and state law makers need to consider the threat to public health as well as the safety of e-scooter riders, non-riders using local sidewalks, and drivers when passing relevant laws.

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