C33-2020

Sayers, Margery

From:	Steve Singer <sws@DedicatedResponse.com>
Sent:	Saturday, February 8, 2020 6:11 PM
To:	CouncilMail
Cc:	Ball, Calvin
Subject:	CB3-2020
Attachments:	Badeau 2019.pdf; Buehler AJPH.2016.pdf; Electric Scooters AJPH.2019.305499.pdf; Trivedi_2019_oi_180307.pdf

[Note: This email originated from outside of the organization. Please only click on links or attachments if you know the sender.]

Attached is a sample of four recent scientific articles (out of 15 found in a survey of PubMed, the National Institutes of Health medical archive on February 2).

These articles link an increase in serious traffic injuries to the introduction of electric scooters.

This is not surprising; while driving in Baltimore over the past eighteen months, I have personally witnessed more than half a dozen unsafe uses --riders nearly always without helmets, two middle-school children riding in tandem on one scooter, an adult driving a scooter with a pre-schooler grinning and hanging on for dear life.

Caution should prompt the Council to amend this bill, asking health experts within the County government to:

a) evaluate the recent literature;

b) consult with colleagues in Baltimore City and other nearby jurisdictions where scooters have been introduced;

c) provide an informed, written report to the Council about how best to mitigate safety risks.

Such a study and report should _precede_ the setup of _any_ permitting process or its approval.

Steve Singer

9430 Diamondback Drive
Columbia, Maryland 21045-1812

Telephone: +1 410 730 8722
Email: sws@DedicatedResponse.com

American Journal of Emergency Medicine 37 (2019) 1531–1533

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Brief Report

Emergency department visits for electric scooter-related injuries after introduction of an urban rental program

Austin Badeau, MD [a], Chad Carman, DO [b], Michael Newman, MS [a], Jacob Steenblik, MPH, MHA, BSN [a], Margaret Carlson, BS [a], Troy Madsen, MD [a,*]

[a] University of Utah School of Medicine, Salt Lake City, UT, United States of America
[b] Salt Lake Regional Medical Center, Salt Lake City, UT, United States of America

ARTICLE INFO

Article history:
Received 1 April 2019
Received in revised form 29 April 2019
Accepted 2 May 2019

ABSTRACT

Background: Providers in Salt Lake City emergency departments (EDs) anecdotally noted a significant number of electronic scooter (e-scooter)-related injuries since the launch of e-scooter rentals in the downtown area in June 2018. The aim of this study was to quantify and characterize these injuries.

Methods: We reviewed the electronic medical records of the University of Utah ED and the Salt Lake Regional Medical Center ED. Using a broad keyword search for "scooter," we examined all notes for ED visits between June 15–November 15, 2017, and June 15–November 15, 2018, and identified e-scooter related injuries. The 2017 data pre-dated the launch of the e-scooter share programs in Salt Lake City and served as a control period.

Results: We noted 8 scooter-related injuries in 2017 and 50 in 2018. Injury types from the 2018 period included: major head injury (8%); major musculoskeletal injury (36%); minor head injury (12%); minor musculoskeletal injury (34%); and superficial soft tissue injury (40%). 24% of patients presented via ambulance and 6% presented as a trauma activation. 16% of patients required hospital admission and 14% had an injury requiring operative repair. 16% reported alcohol intoxication and none of the patients reported wearing a helmet at the time of the injury.

Conclusion: Since the launch of e-scooter share programs in Salt Lake City, we have seen a substantial increase in e-scooter related trauma in our EDs. Of particular note is the number of patients with major head injuries and major musculoskeletal injuries.

1. Introduction

Modes of transportation in the United States continue to evolve with our advancing technology and desire to find more economical and environmentally conscious mediums of traveling in cities. Perhaps none more evident of this are the "dockless e-scooter share" electric scooters (e-scooters) that have appeared on the sidewalks and streets of over 100 cities in 20+ states. [1] While safety regulations between these e-scooter companies and city officials who grant their business licenses appear to have been discussed, there are a growing number of reports from around the country highlighting the numerous injuries that have occurred while riding e-scooters. [2-5]

Physicians in Salt Lake City emergency departments (EDs) noted a significant number of e-scooter-related injuries since the launch of e-scooters in the downtown area in June 2018. We suspect that emergency departments around the country are witnessing a similar pattern of ED visits related to e-scooter accidents. We hypothesized that our investigation would reveal an increase in the number of e-scooter related injuries presenting to urban EDs after the launch of the dockless e-scooter share companies in Salt Lake City. The aim of this study was to quantify and characterize the nature of these injuries.

2. Methods

We conducted a retrospective review of the electronic medical record at the University of Utah Hospital Emergency Department and Salt Lake Regional Medical Center Emergency Department to evaluate patients presenting to the emergency department with e-scooter related injuries between June 15–November 15, 2017, as well as June 15–November 15, 2018. The 2017 time period pre-dated the launch of e-scooter share programs in Salt Lake City and served as a control arm of our study. We recognized that e-scooters existed prior to the launch of area rental programs and used this 2017 period as a baseline for scooter-related injuries prior to the wider availability through rental programs.

The University of Utah Hospital Emergency Department is an urban, academic, Level 1 Trauma Center, located in Salt Lake City with

* Corresponding author.
E-mail address: troy.madsen@hsc.utah.edu (T. Madsen).

https://doi.org/10.1016/j.ajem.2019.05.003
0735-6757/

Table 1
Patient presentation characteristics during the 2018 study period

Characteristic	Average/% of total
Female gender	50%
Age	34 years (range: 18–72)
Arrival via ambulance	24%
Trauma activation	6%
Alcohol intoxication	16%
Helmet use	0%

approximately 50,000 patient visits per year. Salt Lake Regional Medical Center is an urban community emergency department located in downtown Salt Lake City with approximately 10,000 patient visits per year.

We queried ED records of the University of Utah Hospital and Salt Lake Regional Medical Center for patients who presented to the ED during the two study periods of June 15–November 15, 2017, and June 15–November 15, 2018, by searching for occurrences of the word "scooter" within any text note generated during the ED encounter. We did not utilize billing codes (International Classification of Diseases, Tenth Revision, Clinical Modification – ICD-10-CM) typically used to identify patients in retrospective studies due to the lack of e-scooter accident codes within ICD-10-CM.

The lead study investigators (AB, CM, TM), then reviewed individual records generated through the broad search, including ED Triage Notes, ED Provider Notes, History and Physicals, Consult Notes, and Discharge Summaries. We excluded encounters that had been flagged due to the use of the term "scooter" but which involved knee scooters, mobility scooters, Rascal© scooters, mopeds, motorcycles, and non-motorized foot powered scooters (i.e. Razor©).

We calculated the total number of e-scooter related ED visits at each institution for both study time periods. For patient encounters that met the inclusion criteria in the 2018 time period, we collected basic patient demographic data as well as details of the injury. We analyzed the data utilizing descriptive statistics, with data presented utilizing percentages for categorical variables and means for continuous variables (STATA v. 12.0, StataCorp, College Station, TX).

The primary study outcome was the number of ED visits related to e-scooter related trauma during the two study periods. Our secondary outcomes included: type and location of injury or injuries, whether the patient was helmeted, whether the patient reported being intoxicated at the time of the accident, the location of the accident (sidewalk, bike lane, road, etc.), the patient's disposition from the ED (home, admitted to the hospital, taken to the operating room), whether the patient's visit triggered a trauma activation, means of patient arrival (private vehicle versus ambulance), and the type of e-scooter involved in the accident (privately owned, rental, or not reported).

3. Results

During the 2017 study period, eight e-scooter related visits presented to the two EDs. During the 2018 study period, 50 e-scooter related visits presented to the EDs: 13 at Salt Lake Regional Medical Center and 37 at the University of Utah Hospital. Half of patients injured during the 2018 study period were female, with an age range of 18–72 years old and an average age of 34 years. (Table 1)

Injury types included: major head injury (skull fracture and intracranial hemorrhage) 4 patients (8%); major musculoskeletal injury (fractures and dislocations): 18 patients (36%); minor head injury (closed head injury/concussion) 6 patients (12%); minor musculoskeletal injury (sprains and strains): 17 patients (34%); and superficial soft tissue injury (abrasions, hematomas, and lacerations): 20 patients (40%). Fourteen patients (28%) presented with multiple injury types and thus received more than one classification. (Fig. 1).

Twelve patients (24%) arrived to the ED via ambulance. Three patients (6%) were designated as trauma activations and had mobilization of all of the associated personnel and resources. Eight patients (16%) required hospital admission and 7 patients (14%) had an injury requiring operative repair. (Table 1).

Twenty-two (44%) patients reported that the accident occurred on a sidewalk. Eight patients (16%) reported alcohol intoxication at the time of the accident, and none of the patients reported wearing a helmet at the time of the injury. One patient (2%) reported that the e-scooter was privately owned and was not a rental e-scooter. (Table 1).

4. Limitations

Limitations of this study include its retrospective design, single city (though multi-center) patient population, and its limited study period. Due to its retrospective nature, this study relied on the accuracy and completeness of the electronic medical record. As e-scooter related injuries are a relatively new phenomenon in the ED we were not able to reliably use billing codes (International Classification of Diseases, Tenth Revision, Clinical Modification – ICD-10-CM) typically used to identify patients in retrospective studies. Instead we performed a string search for "scooter" for every note associated with an ED encounter during

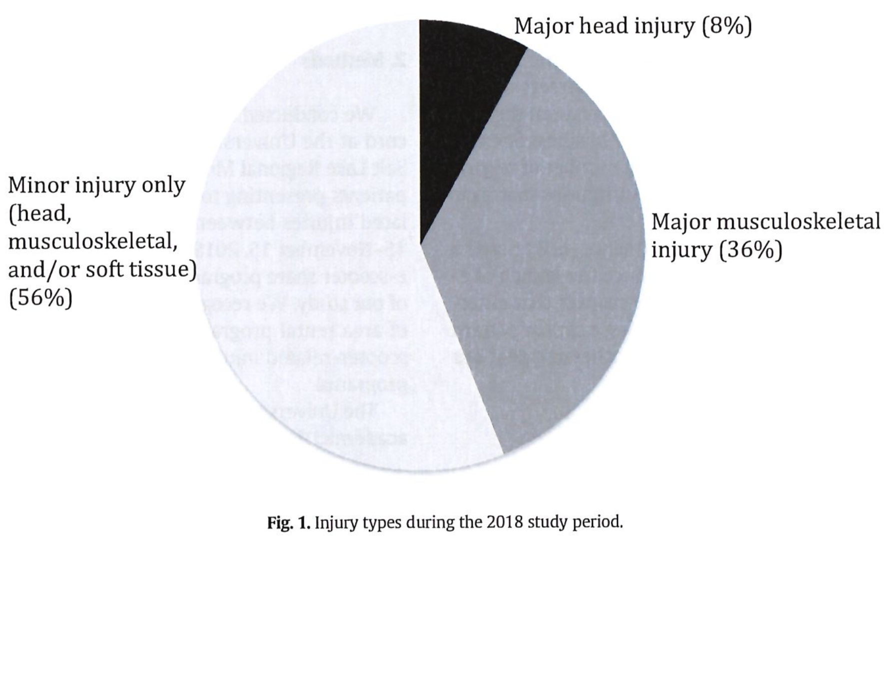


Fig. 1. Injury types during the 2018 study period.

the study periods. Using this method, we feel we were able to accurately measure our primary outcome.

Collecting complete information on some of our secondary outcomes was more limited by the retrospective nature of the study. In particular, we were limited by provider documentation when evaluating whether the patient was wearing a helmet, whether the patient was intoxicated, the location of the accident, and whether the e-scooter was a rental versus a personally owned e-scooter.

Also limiting this study was its single city patient population. Thought the study involved two centers, they both serve the downtown Salt Lake City area. City characteristics are an important consideration when attempting to generalize the results of this study. For example, city population, population density, city layout, topography, availability of sidewalks, availability of bike lines, robust public transportation system, and weather could all affect the incidence of e-scooter related trauma.

Lastly, this study was limited by a five-month study period. The decision to limit our evaluation to give months was multifactorial. Given the ever-increasing presence of e-scooters in our city and around the country we felt a public health/safety responsibility to provide a timely (even if limited) evaluation of e-scooter related trauma seen at our institutions. Additionally, given cold, snowy conditions during the winter months in Salt Lake City we anticipated a significant decrease in e-scooter usage following our study period. We even speculated that the fleet of scooters may be removed during the winter months by their respective companies. This of course means that the incidence we witnessed during our 5-month period cannot be extrapolated to create an expected annual incidence of e-scooter related trauma in Salt Lake City. In more temperate climates (i.e. California, Texas, etc.) we expect that e-scooter use remains more consistent throughout the year.

5. Discussion

Since the launch of e-scooter share programs in Salt Lake City, we have seen a 625% increase in e-scooter related trauma in our EDs. The total number of e-scooter related trauma in our city is probably under-represented in this study as many patients likely present to urgent care clinics or primary care clinics as witnessed on the University of Texas at Austin campus where 110 scooter-related injuries were treated at the on-campus primary care clinic in a 3-month period. [5] We suspect that EDS around the country in cities with similar scooter share programs are witnessing a similar pattern of ED visits related to e-scooter accidents. This hypothesis has been borne out in recent studies and publications which have also observed a significant number of e-scooter related traumas. [2-6]

Of note, we saw a large number of patients with major/minor head injuries and no patients reported helmet use. Our findings do not appear to be unique; a similarly designed study out of UCLA Medical Center also reported 100 head injuries (40.2%) with only 4.4% of the total 249 patients wearing a helmet. Lack of helmet use was again observed in 94.3% of riders during a public observation component of this study. [3]

These findings are particularly troubling given what the medical community has learned about the short- and long-term sequelae of head trauma (even "minor") in the last decade. While e-scooter user agreements and their respective companies publicly encourage helmet use, recently passed legislation in California allows riders over 18 years old to ride without wearing a helmet. [7,8] Also concerning is that 22 (44%) of the accidents in our study reportedly occurred on sidewalks which are prohibited from e-scooter use in Salt Lake City. In the observational component of the UCLA study, 26.4% of riders were riding on sidewalks. [3]

In conclusion, our study demonstrates a significant increase in e-scooter related trauma since the launch of dockless e-scooters in Salt Lake City. These injuries included a substantial percentage of head injuries and major orthopedic injuries. We anticipate a growing number of e-scooter related trauma in our EDs and around the country as e-scooter use continues to increase.

Meetings

Presented at the Annual Meeting of the Society for Academic Emergency Medicine, May 14–17, 2019, Las Vegas, NV.

Grants

None.

Conflicts of interest

None of the authors has any conflicts of interest to report.

Author contributions

AB and TM conceived the study. CC was responsible data collection, data analysis and data organization at Salt Lake Regional Medical Center. MN, JS, and MC were responsible for data collection at the University of Utah. AB and TM were responsible for data analysis and data organization at the University of Utah. AB drafted the manuscript, and all authors contributed substantially to its revision. TM takes responsibility for the paper as a whole.

References

[1] Ellingson, A. Year-old Bird surpasses 10 million rides. L.A. Biz. https://www.bizjournals.com/losangeles/news/2018/09/20/year-old-bird-surpasses-10-million-rides.html. Published September 20, 2018. Accessed March 24, 2019.

[2] Felton, R. E-Scooter Ride-share industry leaves injuries and angered cities in its path. A Consumer Reports investigation finds 1,500 e-scooter injuries across the country, and many hospitals still don't track them. Consum Rep. https://www.consumerreports.org/product-safety/e-scooter-ride-share-industry-leaves-injuries-and-angered-cities-in-its-path Published February 5, 2019. Accessed March 21, 2019.

[3] Trivedi TK, Lui C, Antonio AL, Wheaton N, Kreger V, Yap A, et al. Injuries associated with standing electric scooter use. JAMA Netw Open 2019;2(1).

[4] Woodyard, C. Study: Electric scooters sending lots of riders to emergency rooms with injuries. USA Today. https://www.usatoday.com/story/news/nation/2019/01/25/scooters-injuries-hospitals-emergency-rooms-jama-bikes-study/2665343002. Published January 25, 2019. Accessed March 14, 2019.

[5] Jervis, R. Are scooters safe? Government scientists study health risks as scooters descend on cities. USA Today. https://www.usatoday.com/story/news/2018/12/13/dockless-scooters-austin-cdc-study-health-risk/2298911002. Published December 13, 2018. Accessed March 14, 2019.

[6] Felton, R. Electric scooter injuries on the rise as riders go without helmets. Head injuries and fractures are common, a UCLA study finds. Consum Rep. https://www.consumerreports.org/product-safety/electric-scooter-injuries-rise-as-riders-go-without-helmets. Published January 25, 2019. Accessed March 21, 2019.

[7] Flora H, Chen P, Gloria T, Low E. AB-2989 motorized scooter: use of helmet: maximum speed. California Legislative Information. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2989 Published August 31, 2018. Accessed March 24, 2019.

[8] Gomez L. Riding an e-scooter without a helmet to be legal in California. What could go wrong? San Diego Union-Tribune. https://www.sandiegouniontribune.com/opinion/the-conversation/sd-california-helmets-optional-forelectric-scooters-20180920htmlstory.html Published September 20, 2018. Accessed March 24, 2019.

Trends in Walking and Cycling Safety: Recent Evidence From High-Income Countries, With a Focus on the United States and Germany

Ralph Buehler, PhD, and John Pucher, PhD

Objectives. To examine changes in pedestrian and cyclist fatalities per capita (1990–2014) and per kilometer (2000–2010) in selected high-income countries, and in fatalities and serious injuries per kilometer by age in the United States and Germany (2001–2009).

Methods. We used Organisation for Economic Cooperation and Development data to estimate 5-year annual averages of per-capita fatalities relative to the 1990–1994 average. To control for exposure, we divided fatalities and serious injuries by kilometers of walking or cycling per year for countries with comparable data from national household travel surveys.

Results. Most countries have reduced pedestrian and cyclist fatality rates per capita and per kilometer. The serious injuries data show smaller declines or even increases in rates per kilometer. There are large differences by age group in fatality and serious injury rates per kilometer, with seniors having the highest rates. The United States has much higher fatality and serious injury rates per kilometer than the other countries examined, and has made the least progress in reducing per-capita fatality rates.

Conclusions. The United States must greatly improve walking and cycling conditions. All countries should focus safety programs on seniors and children. (*Am J Public Health.* 2017;107:281–287. doi:10.2105/AJPH.2016.303546)

Improved traffic safety for pedestrians and cyclists is an important goal of public health policies in countries throughout the world.[1–3] The World Health Organization (WHO) has identified traffic injuries and fatalities as among the world's 5 most important causes of unnatural death, with predictions that they will become the leading cause by 2030.[2] As of 2015, they were already the leading cause of unnatural death among persons in the group aged 15 to 29 years. Reducing pedestrian and cyclist deaths and injuries is obviously a benefit in itself. In addition, however, safer walking and cycling conditions have been shown to increase levels of walking and cycling, especially among vulnerable or risk-averse groups such as children, seniors, and women.[4–9] Increasing walking and cycling rates would help raise the low physical activity levels in most developed countries, thus contributing to improved public health.[3,5,10]

The Organisation for Economic Cooperation and Development (OECD) issues annual reports with international comparisons of traffic safety over recent decades.[1] The OECD reports falling rates of total traffic fatalities per capita in most developed countries, including the United States, where traffic fatalities per capita fell by 46% from 1990 to 2014.[1] There are large differences among countries, however, and the United States has suffered for many years from a much higher traffic fatality rate per capita than most other OECD countries. In 2014, for example, the per-capita fatality rate in the United States was 2 to 3 times higher than that in most Western European countries.[1] The OECD's published reports do not include separate fatality rates for walking and cycling over time. Nor do they control for exposure rates such as the number of trips, distance, or hours walked and cycled, which are crucial in measuring the safety of these 2 nonmotorized modes.[1] Yet another gap in the OECD reports is the variation in walking and cycling safety by age group. Several studies suggest that children and seniors are especially vulnerable to walking and cycling injuries and fatalities.[4,11]

We first show trends in pedestrian and cyclist fatalities per capita from 1990 to 2014 for 11 major OECD countries on 4 continents to provide a broader context for the narrower analysis of the United States and Germany that follows. Most of the article is devoted to a detailed analysis of changes between 2001–2002 and 2008–2009 in pedestrian and cyclist fatalities and serious injuries per kilometer in the United States and Germany, disaggregated by the same 4 age groups used in both countries' national travel surveys: 5 to 14, 15 to 24, 25 to 64, and 65 years and older. We focused on the United States and Germany because their 2 most recent national travel surveys are almost identical in methodology and timing, and because their data on fatalities and serious injuries are comparably defined.[12] The 2 countries are similar in other respects as well: high per-capita incomes, high rates of car ownership, nearly identical rates of driver licensing, extensive high-quality road networks, and similarly advanced systems of emergency medical care, both at the crash site

ABOUT THE AUTHORS

Ralph Buehler is with the School of Public and International Affairs, Virginia Tech, Alexandria. John Pucher is with the Bloustein School of Planning and Public Policy, Rutgers University, New Brunswick, NJ.

Correspondence should be sent to Ralph Buehler, PhD, Associate Professor in Urban Affairs and Planning, School of Public and International Affairs, Virginia Tech, Alexandria Center, 1021 Prince St, Suite 200, Alexandria, VA 22314 (e-mail: ralphbu@vt.edu). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints" link.

This article was accepted October 22, 2016.

doi: 10.2105/AJPH.2016.303546

and in hospitals.[12–14] As noted in the Discussion section, however, there are large differences in government policies toward walking and cycling, thus highlighting the importance of public policies in improving pedestrian and cyclist safety.

METHODS

For annual data on pedestrian and cyclist fatalities, we used the official national traffic fatality data reported by each member country to OECD, which expresses them as annual totals as well as per-capita rates to enable comparison among countries of different sizes.[1] For almost all countries, the fatalities include deaths occurring within 30 days of the injury. The OECD's fatality statistics are based on police reports, which underestimate pedestrian and cyclist fatalities, as noted in our discussion of data limitations later in this article.[1,15] Because only a few countries have alternative sources of fatality data, we used the OECD data to ensure the same definition of traffic fatalities and the same reporting method for all countries. Upon special request by the authors, OECD provided fatality data disaggregated by mode of travel (e.g., pedestrian vs cyclist) and by age group (5 to 14, 15 to 24, 25 to 64, and ≥65 y).[16] For per-capita comparisons, we used the OECD's estimates of fatalities per 100 000 population, based on fatality and population data provided by countries to the OECD.

Especially in countries with low cycling levels, cyclist fatalities can fluctuate widely from year to year because of small numbers. To smooth out fluctuations and provide more reliable estimates, we calculated 5-year annual averages of fatalities per 100 000 population for both cyclists and pedestrians: 1990–1994, 1995–1999, 2000–2004, 2005–2009, 2010–2014. We only used the OECD data since 1990 to include Germany, which was reunified in 1990.

To focus on trends since 1990, we showed all per-capita fatality rates relative to the base period of 1990–1994. This also controlled indirectly (albeit imperfectly) for the very different levels of walking and cycling in the various countries. Expressing per capita rates relative to 1990 avoids the unfair comparison of countries with different walking and cycling levels and focuses instead on the degree of improvement in each country since 1990. It is only possible to calculate per-kilometer fatality rates for a few countries with reliable exposure data from comparable travel surveys, which explains the widespread use of per-capita rates by international organizations (such as OECD) to compare traffic safety among many countries.

Whereas the per-capita data are based on population-level numbers, the per-kilometer rates require sample estimates from national travel surveys to calculate exposure levels. The samples from such surveys are scaled up to the population level by using representative weights. In our analysis, we calculated total kilometers walked and cycled—by age group and in total—over roughly the decade of 2000 to 2010 (slightly different survey years) for the United States, Germany, the United Kingdom, the Netherlands, and Denmark.[17–21] We divided those exposure levels into the 5- or 6-year annual average pedestrian or cyclist fatalities for the period bracketing each country's survey years: the 2 years before, during, and after the US and German surveys (which were both conducted over a 2-year period), and the 2 years before, during, and after the UK, Dutch, and Danish surveys (1-year survey period).

It was only possible to calculate confidence intervals for the United States and Germany. The authors had access to the micro data sets for both of their travel surveys, thus enabling calculation of confidence intervals and a t test of the statistical significance of differences between the countries and over time. As shown in Table A in Appendix A (available as a supplement to the online version of this article at http://www.ajph.org), the US and German travel surveys are highly comparable, using the same methodology and timing (2001–2002 and 2008–2009). Access to the micro data sets for the United Kingdom, the Netherlands, and Denmark was denied to the authors, and the agencies that conducted the surveys were not willing to calculate the standard deviations of estimates necessary for our analysis.

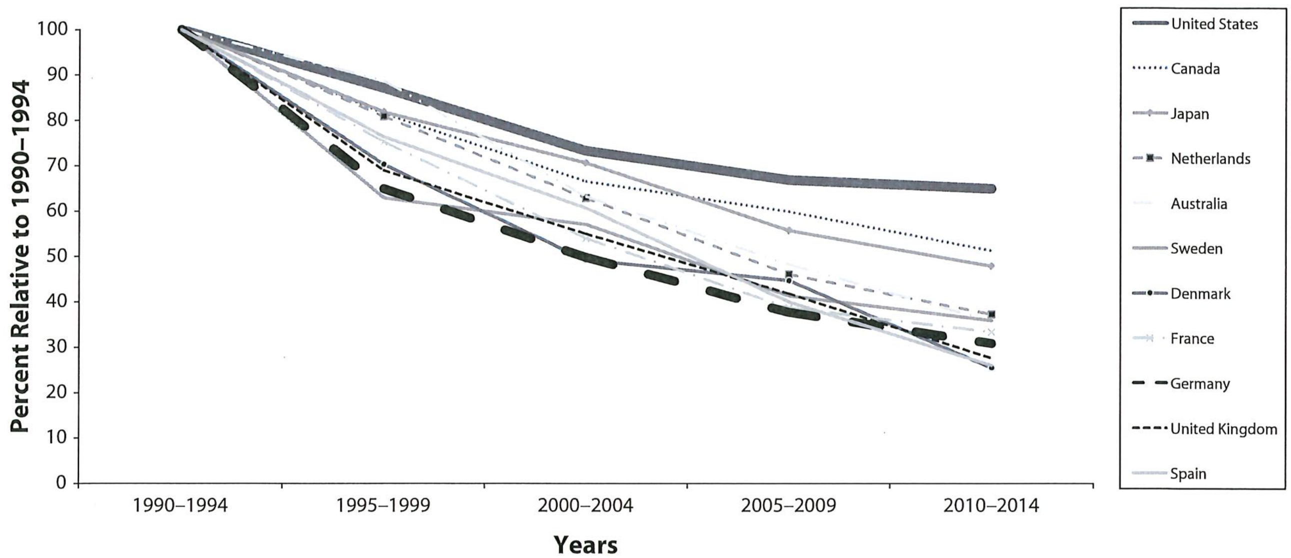
Moreover, the British, Dutch, and Danish surveys used slightly different age categories and survey years than those of the US and German surveys. Thus, the remainder of this article focuses on the United States and Germany. Nevertheless, we include Figures A and B in Appendix B, available as a supplement to the online version of this article at http://www.ajph.org, for readers who are interested in the 5-country comparison of fatality rates per kilometer, even though data for the United Kingdom, the Netherlands, and Denmark do not permit calculation of confidence intervals, and thus do not enable firm conclusions about statistical significance.

This article's comparison of severe pedestrian and cyclist injury rates per kilometer is limited to the United States and Germany for the same reason. In addition, the United Kingdom, the Netherlands, and Denmark had definitions of severe injuries that were not exactly comparable to those used in the United States and Germany (overnight hospitalization), but instead included lists of specific kinds of injuries categorized as serious, often in combination with the hospitalization criterion.[1] For both the United States and Germany, we calculated 2-year annual averages of serious injuries because both of their travel surveys were over the same 2-year periods.

There is one difference in the severe injury data in the United States and Germany. The German data are population-level numbers, based on comprehensive, nationwide collection of police reports combined with hospital reports on the status of patients.[22] The US data are sample estimates from the Centers for Disease Control and Prevention's (CDC's) WISQARS injury database derived from hospital reports and not police reports.[23] The CDC uses representative weights to scale up the sample results to population levels. Thus, the US ratios of serious injuries to kilometers walked or cycled are sample estimates of injuries divided by sample estimates of kilometers traveled. The German ratio is the population-level number of injuries divided by a sample estimate of kilometers traveled. Appendix C (available as a supplement to the online version of this article at http://www.ajph.org) provides details of the methodology used to calculate fatality and injury rates, confidence intervals, and a t test of statistical significance.

RESULTS

Figures 1 and 2 show trends in pedestrian and cyclist fatality rates per 100 000

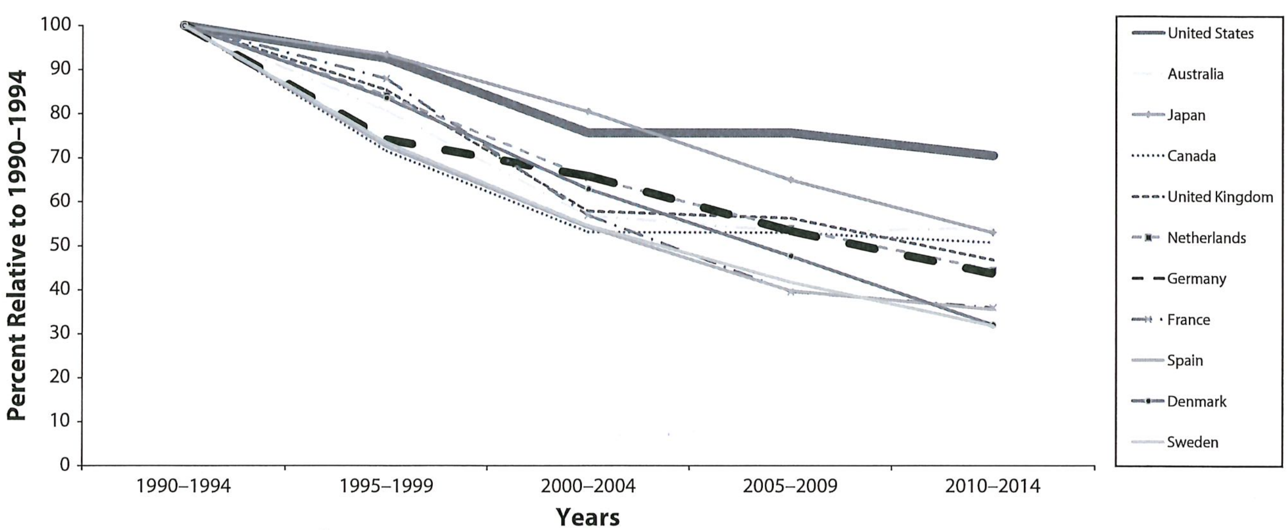


Note. For comparison, the 1990–1994 average was set at 100%.
Source. Calculated by the authors on the basis of data from the Organisation for Economic Cooperation and Development.[16]

FIGURE 1—Trend in Pedestrian Fatality Rate per 100 000 Population 1990–2014, 5-Year Annual Averages Relative to 1990–1994 Average

population in the United States, Canada, Australia, Japan, the United Kingdom, the Netherlands, Sweden, Denmark, Germany, France, and Spain. Both the fatality and population data on which the rates are based are population-level numbers and not sample estimates. Rates are shown as 5-year annual averages for 5 periods, with those average rates expressed relative to the average for the base period of 1990–1994.

Without exception, all 11 countries succeeded in reducing pedestrian and cyclist fatality rates per capita between the periods of 1990–1994 and 2010–2014. By far, the least progress has been made in the United States. Its pedestrian fatality rate per capita fell by 35% compared with 49% in Canada, 52% in Japan, and 63% to 75% in Australia and the 7 Western European countries. Similarly, the cyclist fatality rate in the United States fell by 30% compared with 46% in Australia, 47% in Japan, 49% in Canada, and by 53% to 68% in Western Europe. These per-capita rates do not adjust for changes in walking and cycling



Note. For comparison, the 1990–1994 average was set at 100%.
Source. Calculated by the authors on the basis of data from the Organisation for Economic Cooperation and Development.[16]

FIGURE 2—Trend in Cyclist Fatality Rate per 100 000 Population 1990–2014, 5-Year Annual Averages Relative to 1990–1994 Average

levels over time, but the large percentage reductions suggest improvement in walking and cycling safety.

Table 1 shows pedestrian and cyclist fatality rates per 100 million kilometers walked and biked in the United States and Germany for 2001–2002 and 2008–2009, disaggregated by the same 4 age groups in each country: 5 to 14, 15 to 24, 25 to 64, and 65 years and older. In both survey periods, fatality rates in the United States were significantly higher than in Germany for all age groups ($P < .05$). In 2008–2009, for the population as a whole, pedestrian fatality rates in the United States were about 5 times higher than in Germany (9.7 vs 1.9) and more than 3 times higher for cyclists (4.7 vs 1.3).

There is, however, much variation among age groups. The fatality rate for senior pedestrians is roughly twice as high as for the population as a whole in both the United States (21.5 vs 9.7) and Germany (3.8 vs 1.9). Similarly, the fatality rate for senior cyclists is much higher than average in both the United States (7.6 vs 4.7) and Germany (4.2 vs 1.3). By comparison, children have much lower fatality rates per kilometer walked than the population as a whole in both countries: 2.9 versus 9.7 (United States) and 0.9 versus 1.9 (Germany). Children have slightly lower fatality rates per 100 million kilometers cycled: 4.1 versus 4.7 (United States) and 0.9 versus 1.3 (Germany). In both the United States and Germany, fatality rates per 100 million kilometers declined for both pedestrians and cyclists and among all age groups from 2001–2002 to 2008–2009. The declines were statistically significant except for German pedestrians aged 15 to 24 years and 25 to 64 years—for which rates fell only slightly—and for US pedestrians and cyclists aged 15 to 24 years and 65 years and older, 2 age groups with small sample sizes in the National Household Travel Survey.[18]

As already noted, we could not calculate confidence intervals for fatality rates per 100 million kilometers estimated for the Netherlands, Denmark, and the United Kingdom. For their populations as a whole, however, the fatality rates for the Netherlands and Denmark are so low, and their levels of walking and cycling are so high (yielding large sample sizes),[24] that the estimated rates are almost certainly statistically significantly lower than those for the United States. For example, for all age groups combined, the estimated pedestrian fatality rate per 100 million kilometers in 2010 was 1.2 in the Netherlands and 2.5 in Denmark, compared with 9.7 in the United States (Figure A in Appendix B). Similarly, the estimated cyclist fatality rate in 2010 was 1.0 in the Netherlands and 1.1 in Denmark, compared with 4.7 in the United States (Figure B in Appendix B). The corresponding rates for the United Kingdom in 2010 were 2.7 for walking and 2.5 for cycling, also much lower than in the United States. These estimates suggest that the United States has, by far, the most dangerous walking and cycling among the 5 countries. We can only report with 95% statistical confidence, however, that walking and cycling fatality rates per kilometer are much higher in the United States than in Germany.

Confirming the importance of injuries, the number of severe pedestrian and cyclist injuries (requiring overnight hospitalization) far exceeds the number of fatalities. In 2008–2009, the ratio of severe injuries to fatalities for pedestrians was 8 to 1 in the United States and 13 to 1 in Germany. The ratio is many times higher for cycling: 44 to 1 in the United States and 34 to 1 in Germany.

As shown in Table 2, the rate of serious pedestrian injuries per 100 million kilometers in the United States rose significantly from 70.4 in 2001–2002 to 72.9 in 2008–2009 ($P < .05$). In Germany, the rate fell from 29.4 to 24.4 ($P < .05$). The rate of serious cyclist injuries fell from 230.5 to 207.1 in the United States ($P < .05$), and from 47.2 to 44.2 in Germany (but not significantly at $P < .05$). For their populations as a whole, the rate of severe pedestrian injuries in 2008–2009 was 3.0 times higher in the United States than in Germany, and the rate of severe cyclist injuries was 4.7 times higher in the United States. As with fatalities, however, there is variation among the 4 age groups. Most striking for the United States is the high severe injury rate for senior pedestrians, almost twice the national average (131.4 vs 72.9). Moreover, that rate rose significantly from 2001–2002 to 2008–2009 ($P < .05$). Similarly, the

TABLE 1—Pedestrian and Cyclist Fatality Rates per 100 Million Kilometers Walked or Cycled: United States and Germany, 2000–2001 and 2008–2009

	Pedestrian Fatality Rates per 100 Million km Walked (95% CI)		Cyclist Fatality Rates per 100 Million km Cycled (95% CI)	
Age Group	2001–2002	2008–2009	2001–2002	2008–2009
5–14 y				
United States	4.4[a] (4.1, 4.7)	2.9[a] (2.6, 3.2)	5.9[a] (5.3, 6.7)	4.1[a] (3.6, 4.8)
Germany	1.2[a] (1.1, 1.4)	0.9[a] (0.8, 1.0)	1.3[a] (1.1, 1.6)	0.9[a] (0.7, 1.0)
15–24 y				
United States	11.9 (8.8, 18.3)	9.6 (8.6, 10.8)	10.0 (4.2, 15.8)	4.2 (3.1, 6.6)
Germany	2.1 (1.8, 2.5)	2.0 (1.8, 2.2)	1.0[a] (0.9, 1.3)	0.6[a] (0.5, 0.7)
25–64 y				
United States	13.2[a] (13.1, 13.3)	9.6[a] (9.5, 9.7)	6.9[a] (6.7, 7.1)	4.7[a] (4.4, 5.0)
Germany	1.2 (1.1, 1.3)	1.1 (1.0, 1.2)	1.4[a] (1.2, 1.6)	0.9[a] (0.8, 0.9)
≥ 65 y				
United States	23.9 (23.2, 24.7)	21.5 (13.6, 51.2)	11.2 (10.1, 12.5)	7.6 (2.8, 12.4)
Germany	6.4[a] (5.8, 7.1)	3.8[a] (3.6, 4.0)	7.3[a] (6.1, 9.1)	4.2[a] (4.0, 4.4)
All				
United States	11.6[a] (11.5, 11.7)	9.7[a] (9.6, 9.8)	6.8[a] (6.8, 6.9)	4.7[a] (4.7, 4.7)
Germany	2.6[a] (2.4, 2.7)	1.9[a] (1.7, 2.0)	2.0[a] (1.8, 2.2)	1.3[a] (1.2, 1.5)

Note. CI = confidence interval. Differences in fatality rates between the United States and Germany were statistically significant ($P < .05$) for all age groups and both survey periods.

Source. Calculated by the authors on the basis of data from the Organisation for Economic Co-operation and Development, the US Department of Transportation, and the German Federal Ministry of Transport.[16–18]

[a]These estimates indicate a statistically significant ($P < .05$) change between 2001–2002 and 2008–2009.

TABLE 2—Pedestrian and Cyclist Serious Injury Rates per 100 Million Kilometers Walked or Cycled: United States and Germany, 2000–2001 and 2008–2009

	Pedestrian Injury Rates per 100 Million km Walked (95% CI)		Cyclist Injury Rates per 100 Million km Cycled (95% CI)	
Age Group	2001–2002	2008–2009	2001–2002	2008–2009
5–14 y				
United States	84.5[a] (82.3, 86.7)	66.5[a] (64.0, 69.0)	392.9[a] (387.2, 398.6)	415.7[a] (408.6, 422.8)
Germany	73.2 (64.9, 83.9)	74.8 (67.6, 83.7)	63.0 (53.6, 76.5)	55.9 (47.8, 67.3)
15–24 y				
United States	76.2 (72.3, 80.1)	79.1 (75.7, 82.4)	305.2[a] (285.9, 326.7)	176.0[a] (170.5, 181.6)
Germany	33.5 (28.7, 40.2)	32.5 (29.7, 35.7)	46.7[a] (39.7, 56.7)	36.4[a] (32.4, 41.7)
25–64 y				
United States	62.2 (59.6, 64.7)	61.8 (60.1, 63.5)	141.5[a] (137.0, 145.9)	156.5[a] (152.7, 160.2)
Germany	16.8[a] (15.2, 18.7)	14.3[a] (13.3, 15.6)	38.8 (33.6, 46.1)	38.2 (35.0, 42.1)
≥65 y				
United States	98.6[a] (91.9, 105.2)	131.4[a] (126.6, 136.2)	351.3[a] (312.3, 390.3)	337.3[a] (308.2, 368.4)
Germany	43.7[a] (39.8, 48.5)	30.4[a] (28.7, 32.1)	77.1 (64.5, 95.9)	68.5 (65.6, 71.7)
All				
United States	70.4[a] (69.0, 71.7)	72.9[a] (71.7, 74.1)	230.5[a] (228.1, 232.8)	207.1[a] (204.5, 209.6)
Germany	29.4[a] (27.8, 31.3)	24.4[a] (22.7, 26.4)	47.2 (43.0, 52.3)	44.2 (40.4, 48.8)

Note. CI = confidence interval. Differences in serious injury rates between the United States and Germany were statistically significant ($P<.05$) for all age groups and both survey periods, except for child pedestrians.

Source. Calculated by the authors on the basis of data from the Centers for Disease Control and Prevention, the German Federal Office of Statistics, the US Department of Transportation, and the German Federal Ministry of Transport.[17,18,22,23]

[a]These estimates indicate a statistically significant ($P<.05$) change between 2001–2002 and 2008–2009.

severe injury rate for cyclists in 2008–2009 in the United States was much higher for children (415.7) and seniors (337.3) than the national average (207.1). The rate for children rose significantly over the decade, from 392.9 to 415.7 ($P<.05$). The rate for seniors fell slightly (from 351.3 to 337.3), but not statistically significantly.

In Germany, child pedestrians in 2008–2009 had a walking injury rate 3 times as high as the national average (74.8 vs 24.4), even higher than the rate for children in the United States (66.5), the only instance in Table 2 in which the serious injury rate in Germany is higher than that in the United States. By comparison, the serious injury rate for senior pedestrians in Germany in 2008–2009 was only slightly higher than the national average (30.4 vs 24.4), and less than a fourth the rate for seniors in the United States (131.4). There is less variation among age groups in cycling injury rates in Germany than in the United States, but children (55.9) and senior (68.5) cyclists have higher rates than the national average (44.2). It is noteworthy that the injury rate for child cyclists in the United States in 2008–2009 was more than 7 times higher than in Germany (415.7 vs 55.9) and that the rate for senior cyclists was 5 times higher in the United States than in Germany (337.3 vs 68.5).

DISCUSSION

In all 11 countries shown in Figures 1 and 2, pedestrian and cyclist fatality rates per capita fell between 1990 and 2014, but the smallest reductions were in the United States. Moreover, fatality rates per kilometer in 2010 were much higher in the United States than in Germany, the Netherlands, Denmark, and the United Kingdom. Serious injury rates per kilometer were also much higher in the United States than in Germany, the 2 countries with comparable injury data.

One possible explanation for greater pedestrian and cycling safety in northern European countries is the far more extensive and better quality walking and cycling infrastructure in Europe.[12,25–30] In contrast with the United States, many northern European cities have extensive auto-free zones in much of their centers; most neighborhood streets traffic-calmed with speed limits of 30 kilometers per hour (20 miles per hour) or less; sidewalks on both sides of almost every street; pedestrian refuge islands for crossing wide streets; clearly marked crosswalks, often raised and with special lighting; and pedestrian signals at intersections and midblock crosswalks with ample crossing times. Facilitating safe and convenient cycling, many northern European cities have extensive systems of separate bikeways, both on-road and off-road, often including priority traffic signals and advance stop lines for cyclists at intersections.[25,31] US cities only began building separate bike facilities in the 1990s, and, even currently, they lag far behind northern European cities in the extent, quality, and integration of their bikeways.[8,13,14,24,31,32]

In addition to better infrastructure, some European countries provide mandatory traffic education in schools—to teach safe walking and cycling skills—and require far stricter motorist training and licensing than in the United States.[25] Further promoting traffic safety, police enforcement of traffic regulations is much stricter in northern Europe, both for motorists and nonmotorists.[25]

Although pedestrian and cyclist safety is much higher in Germany than in the United States, fatality rates per kilometer fell significantly in both countries for their populations as a whole between 2001–2002 and 2008–2009, the 2 periods of their most recent national travel surveys. By comparison, severe injury rates per kilometer fell significantly only for German pedestrians, while the severe injury rate for US pedestrians rose. Injury rates for both German and US cyclists fell slightly, but only statistically significantly in the United States. In short, there has been more improvement in reducing walking and bicycling fatalities than serious injuries, which greatly exceed the number of fatalities.

Moreover, there is important and statistically significant variation in both fatality and injury rates among the 4 age groups examined in the United States and Germany. Senior pedestrians and cyclists have 2 to 3 times as high a fatality rate per kilometer than the population as a whole. Seniors in the

United States also have much higher walking and cycling injury rates than the population as whole, but US children have an even higher cycling injury rate than seniors. In Germany, children have, by far, the highest walking injury rate—3 times the national average—and children and seniors both have cycling injury rates higher than the national average. Our analysis confirms the special vulnerability of seniors and children when walking and cycling.

The falling per-capita fatality rates in the United States and Germany from 1990 to 2014 and falling per-kilometer fatality rates from 2001–2002 to 2008–2009 do not necessarily mean that walking and cycling conditions have been getting safer. The likelihood of fatal injury has fallen, but serious injury rates have fallen less (or increased). The difference in fatality and serious injury trends might be attributable to improved emergency medical technology, both at the site of the incident and at the hospital, thus reducing the percentage of serious injuries resulting in death. Our findings are consistent with those of the annual OECD reports on overall traffic safety trends, which find that traffic fatalities per capita have declined more than serious injuries from 2000 to 2014 in member countries for which both fatality and serious injury data are available.[1]

The unknown degree of reliability and comparability of the fatality and injury data fundamentally limit the conclusions that can be drawn from the analysis. Police reports understate total pedestrian and cyclist fatalities because they only include traffic crashes on public roadways.[1,15] For example, the CDC's hospital-based statistics on pedestrian and cyclist fatalities in the United States from 1999 to 2014 averaged 16% higher for cyclists and 21% higher for pedestrians than police-reported fatalities.[1,23,33] Similarly, in the Netherlands, hospital fatality data from 1996 to 2014 were 11% higher than police data for pedestrians and 18% higher for cyclists.[1] In short, it is likely that the calculated fatality rates are underestimates for all countries. In addition, the serious injury data for the United States and Germany are only partly comparable. They both rely on the same criterion of an overnight hospital stay, but the US injury data (from CDC) are derived from a representative sample of hospital reports, whereas the German data are collected through a comprehensive national canvassing of coordinated police and hospital reports.[22,23]

There is yet another reason to interpret the fatality and injury statistics with caution. They do not control for differences in where and how walking and cycling take place. Because the vast majority of pedestrian and cyclist fatalities are attributable to collisions with motor vehicles, roadways are the most lethal environment for walking and cycling.[1,2,7,26] Walking and cycling are safer on completely separate off-road facilities, such as mixed-use recreational paths, or in car-free zones, traffic-calmed residential streets (with slower speeds and less traffic), and physically separated on-street facilities (such as cycle tracks).[11,28,30,32,34,35] Thus, the provision of more and better separate facilities is a key to improving overall walking and cycling safety. Such facilities are especially important for children and seniors, who are most likely to be killed or seriously injured if hit by a motor vehicle.[1,2,4,7,26] AJPH

CONTRIBUTORS

J. Pucher initiated the research and led the writing of the article. R. Buehler had primary responsibility for the data analysis and created the tables and figures. Both authors conceptualized the analysis and guided the study design and data analysis. Both authors participated in interpreting the findings and reviewing successive drafts of the article.

ACKNOWLEDGMENTS

The authors thank Veronique Feypell of the Organisation for Economic Cooperation and Development (OECD; International Transport Forum, Paris office) for having provided us with annual fatality data from 1990 to 2014 for each of OECD's member countries, disaggregated by age group and means of transportation. We also thank the team of statisticians at the Virginia Tech Department of Statistics and their Laboratory of Interdisciplinary Statistical Analysis for their assistance with our statistical analysis at several stages, especially with the calculation of standard errors, confidence intervals, and levels of statistical significance for estimates of fatality and serious injury rates that are ratios of sample estimates, and thus require a special methodology to calculate statistical measures of reliability.

HUMAN PARTICIPANT PROTECTION

The analysis was based on statistical data sets and did not require human participants.

REFERENCES

1. *Road Safety Annual Report 2016.* Organisation for Economic Cooperation and Development, International Transport Forum, International Traffic Safety, Datam and Analysis Division. 2016. Available at: http://dx.doi.org/10.1787/irtad-2016-en. Accessed November 9, 2016.

2. *Global Status Report on Road Safety 2015.* Geneva, Switzerland: World Health Organization; 2015.

3. *Physical Activity and Health: A Report of the Surgeon General.* Atlanta, GA: US Department of Health and Human Services; 1996.

4. McDonald N. Children and cycling. In: Pucher J, Buehler R, eds. *City Cycling.* Cambridge, MA: MIT Press; 2012: 235–255.

5. Buehler R, Götschi T, Winters M. Moving toward active transportation: how policies can encourage walking and bicycling. *Active Living Research: Research Brief and Synthesis.* 2016. Available at: http://activelivingresearch.org/sites/default/files/ALR_Review_ActiveTransport_January2016.pdf. Accessed September 12, 2016.

6. Pucher J, Dill J, Handy S. Infrastructure, programs, and policies to increase bicycling: an international review. *Prev Med.* 2010;50(suppl 1):S106–S125.

7. *Pedestrian Safety: A Road Safety Manual for Decision-Makers and Practitioners.* World Health Organization. 2013. Available at: http://www.who.int/roadsafety/projects/manuals/pedestrian/en. Accessed November 9, 2016.

8. *Bicycling and Walking in the United States: 2016 Benchmarking Report.* Alliance for Biking and Walking. 2016. Available at: http://www.bikewalkalliance.org/resources/benchmarking. Accessed November 9, 2016.

9. Jacobsen PL, Ragland DR, Komanoff C. Safety in numbers for walkers and bicyclists: exploring the mechanisms. *Inj Prev.* 2015;21(4):217–220.

10. Bassett DR Jr, Pucher J, Buehler R, Thompson DL, Crouter SE. Walking, cycling, and obesity rates in Europe, North America and Australia. *J Phys Act Health.* 2008;5(6):795–814.

11. Sanford T, McCulloch CE, Callcut RA, Carroll PR, Breyer BN. Bicycle trauma injuries and hospital admissions in the United States, 1998–2013. *JAMA.* 2015; 314(9):947–949.

12. Buehler R, Pucher J, Merom D, Bauman A. Active travel in Germany and the US: contributions of daily walking and cycling to physical activity. *Am J Prev Med.* 2011;41(3):241–250.

13. Pucher J, Dijkstra L. Making walking and cycling safer: lessons from Europe. *Transp Q.* 2000;54(3):25–50.

14. Pucher J, Dijkstra L. Promoting safe walking and cycling to improve public health: lessons from The Netherlands and Germany. *Am J Public Health.* 2003; 93(9):1509–1516.

15. Lusk AC, Asgarzadeh M, Farvid MS. Database improvements for motor vehicle/bicycle crash analysis. *Inj Prev.* 2015;21(4):221–230.

16. International comparison of cyclist and pedestrian traffic fatalities and fatality rates per 100,000 population by age group. In: *IRTAD Road Safety Database.* Paris, France: Organisation for Economic Cooperation and Development, International Transport Forum, International Traffic Safety Data and Analysis Division; 2016.

17. *German National Household Travel Survey (MID), 2001–2002 & 2008–2009.* German Federal Ministry of Transport. 2010. Available at: http://www.mobilitaet-in-deutschland.de. Accessed November 9, 2016.

18. *National Household Travel Survey (NHTS), 2001–2002 & 2008–2009.* US Department of Transportation. 2010. Available at: http://nhts.ornl.gov/index.shtml. Accessed November 9, 2016.

19. *Dutch National Travel Survey.* Institute for Road Safety Research. 2016. Available at: https://www.swov.nl/UK/Research/cijfers/Toelichting-gegevensbronnen/Personenmobiliteit-UK.html. Accessed November 9, 2016.

20. Average distance travelled and average number of trips by age, and mode: 2002, 2003, 2010, and 2014. In: *National Travel Survey*. Department for Transport. 2016. Table NTS0605. Available at: https://www.gov.uk/government/collections/national-travel-survey-statistics. Accessed November 9, 2016.

21. Hansen AS, Jensen C. Traffic safety 2007–2010. In: *DTU Transport Report*. 4. Technical University of Denmark. 2012;4. Available at: http://www.dtu.dk/nyheder/2012/04/webnyhed_ny-rapport-om-risiko-i-trafikken?id=5f4912c7-dd9a-4aba-a23d-cfe540746bbc. Accessed November 9, 2016.

22. Severe traffic injuries in Germany 1991–2014. In: *Traffic Safety in Germany*. German Federal Statistical Office. 2015. Table 5.6.3. Available at: https://www.destatis.de/DE/Publikationen/Thematisch/TransportVerkehr/Verkehrsunfaelle/VerkehrsunfaelleZeitreihen.html. Accessed November 9, 2016.

23. Web-based Injury Statistics Query and Reporting System (WISQARS). Centers for Disease Control and Prevention, Injury Data and Statistics Division. 2016. Available at: https://www.cdc.gov/injury/wisqars. Accessed November 9, 2016.

24. Buehler R, Pucher J, Gerike R, Goetschi T. Reducing car dependence in the heart of Europe: lessons from Germany, Austria, and Switzerland. *Transp Rev*. 2017;37(1):4–28.

25. Pucher J, Buehler R. Making cycling irresistible: lessons from the Netherlands, Denmark, and Germany. *Transp Rev*. 2008;28(1):495–528.

26. *Achieving Traffic Safety Goals in the United States: Lessons From Other Nations*. Transportation Research Board. 2011. TRB Special Report 300. Available at: http://onlinepubs.trb.org/onlinepubs/sr/sr300.pdf. Accessed November 9, 2016.

27. Making urban mobility greener and safer. In: *State of European Cities in 2016*. UN Habitat and European Union. 2016: 112–137. Available at: http://ec.europa.eu/regional_policy/en/information/publications/reports/2016/state-of-european-cities-report-2016. Accessed November 9, 2016.

28. Hass-Klau C. *The Pedestrian and the City*. New York, NY: Routledge; 2015.

29. Newman P, Kenworthy J. *The End of Automobile Dependence: How Cities Are Moving Beyond Car-Based Planning*. Washington, DC: Island Press; 2015.

30. Teschke K, Harris MA, Reynolds CC, et al. Route infrastructure and the risk of injuries to bicyclists: a case-crossover study. *Am J Public Health*. 2012;102(12):2336–2343.

31. Lanzendorf M, Busch-Geertsema A. The cycling boom in large German cities—empirical evidence for successful cycling campaigns. *Transp Policy*. 2014;36(C):26–33.

32. Furth PG. Bicycling infrastructure for mass cycling: a trans-Atlantic comparison. In: Pucher J, Buehler R, eds. *City Cycling*. Cambridge, MA: MIT Press; 2012: 105–140.

33. *Traffic Safety Facts 2013: A Compilation of Motor Vehicle Crash Data From the Fatality Analysis Reporting System and the General Estimates System*. US Department of Transportation, National Highway Traffic Safety Administration. 2013. Available at: https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812139. Accessed November 9, 2016.

34. Lusk AC, Furth PG, Morency P, Miranda-Moreno LF, Willett WC, Dennerlein JT. Risk of injury for bicycling on cycle tracks versus in the street. *Inj Prev*. 2011;17(2):131–135.

35. Lusk AC, Morency P, Miranda-Moreno LF, Willett WC, Dennerlein JT. Bicycle guidelines and crash rates on cycle tracks in the United States. *Am J Public Health*. 2013;103(7):1240–1248.

these findings to the lack of disease-prevention services, such as opioid agonist therapies and SSPs in Puerto Rico.[2] These low HIV prevalence numbers among PWID in Puerto Rico may stem from PWID's everyday practices helping prevent HIV infection despite sustained injection paraphernalia sharing. In a context of increasing poverty, identifying these practices and understanding how they are maintained despite all the contextual disincentives to remain HIV safe may help save lives through their systematic dissemination.

A recent editorial in *AJPH* addressed the negative impact that the US law Puerto Rico Oversight, Management, and Economic Stability Act (2016) has over the economy and health of Puerto Ricans.[7] It is also true that the Puerto Rican government could still significantly improve its efforts to prevent disease, death, and the structurally forced US-bound migration of PWID searching for services they lack in Puerto Rico.[2] Science has conclusively shown that SSPs and opioid agonist therapies save lives (and governmental resources) by preventing infections. To save lives, the Puerto Rican government must start supporting evidence-based interventions: opioid agonist therapies, SSPs and the distribution of naloxone through SSPs, methadone clinics and prisons. Finally, the scientific community concurs that it is no longer medically sound to deny HCV treatment to PWID. We do not need more research on the efficacy of these interventions. They work. The data are conclusive. The political inertia costs lives. AJPH

Camila Gelpí-Acosta, PhD
Carlos E. Rodríguez-Díaz, PhD
Yesenia Aponte-Meléndez, MA
Roberto Abadie, PhD

CONTRIBUTORS
The authors contributed equally to this article.

CONFLICTS OF INTEREST
The authors have no conflicts of interest to declare.

REFERENCES

1. Degenhardt L, Peacock A, Colledge S, et al. Global prevalence of injecting drug use and sociodemographic characteristics and prevalence of HIV, HBV, and HCV in people who inject drugs: a multistage systematic review. *Lancet Glob Health*. 2017;5(12):e1192–e1207.

2. Gelpí-Acosta C, Guarino H, Benoit E, Deren S, Pouget ER, Rodríguez A. Injection risk norms and practices among migrant Puerto Rican people who inject drugs in New York City: the limits of acculturation theory. *Int J Drug Policy*. 2019;69:60–69.

3. Puerto Rico Department of Health. Puerto Rico HIV/AIDS surveillance summary: cumulative HIV/AIDS cases diagnosed as of February 28, 2019. 2019. Available at: http://www.salud.gov.pr/Estadisticas-Registros-y-Publicaciones/Estadisticas%20VIH/Estad%C3%ADsticas%20Generales/2019/Febrero%202019/Puerto%20Rico%20HIVAIDS%20Surveillance%20Summary.pdf. Accessed November 23, 2019.

4. Thrash C, Welch-Lazoritz M, Gauthier G, et al. Rural and urban injection drug use in Puerto Rico: network implications for human immunodeficiency virus and hepatitis C virus infection. *J Ethn Subst Abuse*. 2018;17(2):199–222.

5. Abadie R, Welch-Lazoritz M, Gelpí-Acosta C, Reyes JC, Dombrowski K. Understanding differences in HIV and HCV prevalence according to differentiated risk behaviors in a sample of PWID in rural Puerto Rico. *Harm Reduct J*. 2016;13:10.

6. Martínez-Guzmán DA. Perfil de la Población Confinada, año 2015 [Profile of the Incarcerated Population, 2015]. 2015. Available at: http://ac.gobierno.pr/correccion/wp-content/uploads/2015/12/perfil_poblacion_confinado2015.pdf. Accessed November 23, 2019.

7. Rodríguez-Díaz CE. Maria in Puerto Rico: natural disaster in a colonial archipelago. *Am J Public Health*. 2018;108(1):30–32.

Electric Scooters: Case Reports Indicate a Growing Public Health Concern

With the introduction of rideshare electric "dockless" scooters in 2017 by Bird Rides, Inc, a new type of affordable transportation became available to the public. Often seen along the sidewalks and street corners of downtown metropolitan areas, these devices are strategically designed for the heavily congested, urban population centers. Patrons download an application on their smartphone, enter billing information, and then link the account to any available electric scooter. Although commercially available models exist with a top speed of 50 miles per hour and a range of 75 miles, electric scooters from Bird and Lime travel at a top speed of 15 miles per hour and have a range between 15 and 20 miles. On completion, the rider leaves the scooter along the sidewalk, where it waits for the next interested patron. Some of the appealing aspects of these devices include low cost, ease of accessibility, and the ability to bypass the often standstill traffic conditions by using the bike lanes, surface street, and sidewalk.

Over the past two years, market demand has grown, with multiple companies (e.g., Bird, Lime, Spin, Uber, and Lyft) entering the industry. Electric scooters and their derivative will become a $42 billion industry by 2030.[1] However, in parallel with their growing popularity has been an awareness of their safety hazards. Reports across the United States cite various types of injuries, from skin abrasions and ankle sprains to major injuries including open fractures, traumatic brain injuries, and even death.[2–4]

RECENT CATASTROPHIC INJURIES

Cedars-Sinai serves a large trauma catchment area in west Los Angeles, California, which represents ground zero for the introduction of electric scooters partly because of the high pedestrian traffic, tourist activity,

ABOUT THE AUTHORS
Peyton L. Nisson and Ray Chu are with the Department of Neurosurgery, Cedars-Sinai, Los Angeles, CA. Eric Ley is with the Department of Surgery, Cedars-Sinai.
Correspondence should be sent to Ray Chu, MD, Associate Professor, Department of Neurosurgery, Cedars-Sinai, 127 S San Vicente Blvd, Advanced Health Sciences Pavilion, A6600, Los Angeles, CA 90048 (e-mail: ray.chu@cshs.org). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints" link.
This editorial was accepted November 16, 2019.
doi: 10.2105/AJPH.2019.305499

and surrounding universities.[5] Almost overnight, we experienced a significant rise in trauma activations and hospital admissions attributed to electric scooters. In 2018, the total number of trauma activations related to electric scooters at Cedars-Sinai was 30; in 2019, we will receive approximately 100. By comparison, Los Angeles County General Hospital, the largest trauma center in Los Angeles County, had zero electric scooter–related trauma activations in 2018, whereas the 2019 estimate is 300.

Recently, two patients were admitted to our institution after catastrophic electric scooter–related collisions. One patient was an otherwise healthy 23-year-old man who was riding a scooter when he was struck by a motor vehicle, which sent him flying approximately 20 feet. On arrival to Cedars-Sinai, the patient went into a pulseless rhythm, and we initiated chest compressions. Despite our best efforts, he was declared dead soon after arrival. This patient marks the ninth known death linked with electric scooter use that has been cited across the United States.[4]

Less than a few weeks after this death, another patient experienced a severe traumatic brain injury after being struck by an electric scooter while in a crosswalk. This 75-year-old gentleman had numerous skull fractures with multiple intracranial hemorrhages and large-territory infarcts. After one month in the neurology intensive care unit, he showed little recovery and was eventually transferred to a long-term-care facility, flaccid in all extremities.

Our experience serves as a warning regarding the public health safety ramifications associated with the use of these devices. In particular, our second case shows that not only riders are at risk for severe injury, which constitute most of the emergency department admissions (92%–98%), but also pedestrians.[2,3] The combination of mass and force from an electric scooter rider can be lethal. Pedestrian injuries after collisions with electric scooters will likely increase as the industry continues to expand and the space on sidewalks becomes increasingly congested with scooters.

POLICY AND ACTION

Multiple cities have enacted laws to try to curb the associated dangers. In Atlanta, Georgia, scooters were banned at night; Nashville, Tennessee, weighed banning their use; and Santa Monica, California, filed a lawsuit against one of the companies. In a comprehensive effort, Los Angeles and other cities released a Vision Zero strategic plan to reduce all traffic-related deaths by 2025. The Vision Zero plan includes traffic safety protocols on how to reduce injuries related to emerging mobility devices such as electric scooters. Although no easy solution exists to reduce all hazards associated with electric scooters, safety standards are necessary and feasible to achieve zero deaths related to their use.

A fruitful discussion on this topic must place the use of these devices within the greater context of other transportation devices. In a theoretical sense, no transportation device is without risk. Motor vehicles, which represent the most commonly used means of transit, still constitute the vast majority of emergency department traumas, with an estimated 89 related deaths per day in the United States.[6] Bicyclists and joggers are the source of numerous hospital admissions and deaths reported each year.[7] However, these types of travel are far more ingrained in our society and less likely to fall under scrutiny than the recently introduced electric scooters. We must recognize that without an objective comparison of rider miles or ride hours to the number of severe injuries incurred from other types of transportation in urban areas, the attributable relative risk of scooters cannot be fully described. As such, it is important to be cautionary of any major, knee-jerk responses.

With that said, however, our anecdotal experience and the growing concern for the safety of these devices require lawmakers and stakeholders to take policy steps to prevent injuries from occurring. Outright banning electric scooters would represent the most extreme form of action and would be premature until clear evidence exists that these devices represent a greater danger than other types of transportation. A ban would not only deter innovation and ingenuity but also fail to allow new innovations to address these, and future, safety hazards.

FUTURE DIRECTIONS

Our experience suggests that several thoughtful, targeted interventions may be necessary. Because helmet use is limited while riding electric scooters, newer, more portable helmet designs may lead to increased use. Many riders describe injuries during their first electric scooter ride related to their unexpected speed, which suggests that initial rides should have a limit to the acceleration and top speed. Other riders stated that their injuries occurred while holding a bag or phone, which indicates the need for a cage to hold these items. Potholes or other road hazards that led to a crash suggest that improvements in the electric scooter shocks may reduce injuries.

One important characteristic worth stressing is how silent electric scooters are. Additionally, they are typically dark in color and do not have the high-powered lights or reflectors required by cars and motorcycles. This combination makes scooters particularly prone to collisions with pedestrians. Simple interventions such as a noise alerting sound and additional lights or reflectors could lead to a reduction in scooter versus pedestrian injuries. Dedicated paths that separate electric scooters from both pedestrians and automobiles also would provide significant protection to both riders and pedestrians.

Given the projected growth of the electric scooter industry, we predict that the injury burden from these devices will exceed other pedestrian- or bicycle-related trauma and be second only to automobile collisions in related mortality. Targeting zero deaths is an achievable goal, and further discussion on how best to address this growing public health concern is necessary. AJPH

Peyton L. Nisson, MD
Eric Ley, MD
Ray Chu, MD

CONTRIBUTORS

All of the authors contributed equally to this editorial.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to disclose.

REFERENCES

1. Grand View Research, Inc. Electric scooters market size worth $41.98 billion by 2030 | CAGR 8.5%: Grand View Research, Inc. June 17, 2019. Available

at: https://www.prnewswire.com/news-releases/electric-scooters-market-size-worth-41-98-billion-by-2030--cagr-8-5-grand-view-research-inc-300869248.html. Accessed October 24, 2019.

2. Trivedi TK, Liu C, Antonio ALM, et al. Injuries associated with standing electric scooter use. *JAMA Netw Open*. 2019;2(1):e187381.

3. Badeau A, Carman C, Newman M, Steenblik J, Carlson M, Madsen T. Emergency department visits for electric scooter-related injuries after introduction of an urban rental program. *Am J Emerg Med*. 2019;37(8):1531–1533.

4. Felton R. 8 Deaths now tied to e-scooters. June 3, 2019. Available at: https://www.consumerreports.org/product-safety/deaths-tied-to-e-scooters. Accessed January 25, 2019.

5. Hall M. Bird scooters flying around town. September 26, 2017. Available at: https://www.smdp.com/bird-scooters-flying-around-town/162647. Accessed September 25, 2019.

6. Evans L. Traffic fatality reductions: United States compared with 25 other countries. *Am J Public Health*. 2014;104(8):1501–1507.

7. Buehler R, Pucher J. Trends in walking and cycling safety: recent evidence from high-income countries, with a focus on the United States and Germany. *Am J Public Health*. 2017;107(2):281–287.

JAMA Network Open.

Original Investigation | Emergency Medicine

Injuries Associated With Standing Electric Scooter Use

Tarak K. Trivedi, MD, MS; Charles Liu, MD; Anna Liza M. Antonio, DrPH; Natasha Wheaton, MD; Vanessa Kreger, MD, MPH; Anna Yap, MD; David Schriger, MD, MPH; Joann G. Elmore, MD, MPH

Abstract

IMPORTANCE Since September 2017, standing electric scooters have proliferated rapidly as an inexpensive, easy mode of transportation. Although there are regulations for safe riding established by both electric scooter companies and local governments, public common use practices and the incidence and types of injuries associated with these standing electric scooters are unknown.

OBJECTIVE To characterize injuries associated with standing electric scooter use, the clinical outcomes of injured patients, and common use practices in the first US metropolitan area to experience adoption of this technology.

DESIGN, SETTING, AND PARTICIPANTS This study of a case series used retrospective cohort medical record review of all patients presenting with injuries associated with standing electric scooter use between September 1, 2017, and August 31, 2018, at 2 urban emergency departments associated with an academic medical center in Southern California. All electric scooter riders at selected public intersections in the community surrounding the 2 hospitals were also observed during a 7-hour observation period in September 2018.

MAIN OUTCOMES AND MEASURES Incidence and characteristics of injuries and observation of riders' common use practices.

RESULTS Two hundred forty-nine patients (145 [58.2%] male; mean [SD] age, 33.7 [15.3] years) presented to the emergency department with injuries associated with standing electric scooter use during the study period. Two hundred twenty-eight (91.6%) were injured as riders and 21 (8.4%) as nonriders. Twenty-seven patients were younger than 18 years (10.8%). Ten riders (4.4%) were documented as having worn a helmet, and 12 patients (4.8%) had either a blood alcohol level greater than 0.05% or were perceived to be intoxicated by a physician. Frequent injuries included fractures (79 [31.7%]), head injury (100 [40.2%]), and contusions, sprains, and lacerations without fracture or head injury (69 [27.7%]). The majority of patients (234 [94.0%]) were discharged home from the emergency department; of the 15 admitted patients, 2 had severe injuries and were admitted to the intensive care unit. Among 193 observed electric scooter riders in the local community in September 2018, 182 (94.3%) were not wearing a helmet.

CONCLUSIONS AND RELEVANCE Injuries associated with standing electric scooter use are a new phenomenon and vary in severity. In this study, helmet use was low and a significant subset of injuries occurred in patients younger than 18 years, the minimum age permitted by private scooter company regulations. These findings may inform public policy regarding standing electric scooter use.

JAMA Network Open. 2019;2(1):e187381. doi:10.1001/jamanetworkopen.2018.7381

Key Points

Question What are the types of injuries associated with standing electric scooter use and the characteristics and behaviors of injured patients?

Findings In this study of a case series, 249 patients presented to the emergency department with injuries associated with electric scooter use during a 1-year period, with 10.8% of patients younger than 18 years and only 4.4% of riders documented to be wearing a helmet. The most common injuries were fractures (31.7%), head injuries (40.2%), and soft-tissue injuries (27.7%).

Meaning In this study, injuries associated with electric scooter use were common, ranged in severity, and suggest low rates of adherence to existing regulations around rider age and low rates of helmet use.

+ Invited Commentary

+ Supplemental content

Author affiliations and article information are listed at the end of this article.

Introduction

Standing electric scooters first appeared in Santa Monica, California, in September 2017, when the micromobility company Bird Rides, Inc, placed thousands of their scooters all around the city.[1] These scooters were immediately popular with riders, presumably due to their ease of use, convenience, and low cost. The scooters are located and unlocked using a downloaded smartphone application, rides are paid for by the minute, and the ride can be ended anywhere the rider decides. With a maximum speed of 15 mph,[2] these short-range electric vehicles consist of a narrow platform on which the rider stands with 1 foot in front of the other and a waist-high rod with handlebars for steering; after kicking off initially with 1 foot, riders accelerate and brake the scooter using triggers activated with their thumbs.

Companies offering standing electric scooters are rapidly expanding in the United States. For example, Lime-S scooters are available in more than 60 US cities and 6 cities internationally,[3] and in April 2018, Bird Rides, Inc, announced more than 1 million completed rides.[4] Today, several major companies, including Bird and Lime, offer dockless electric scooter services, and several other companies, including the ride-sharing companies Uber and Lyft, have recently entered the market.[5] Availability is projected to grow rapidly, with market analysis showing that Lime was valued at $1.1 billion and its rival Bird was valued at more than $2 billion.[6]

The early personal transporters by Segway, introduced in 2001, were few in number, expensive to use, restricted to tourist locations, and associated with a specific set of injuries.[7] In comparison, many thousands of riders are now using standing electric scooters daily on US streets shared with millions of pedestrians and drivers. Therefore, understanding the impact of rising scooter use on public health is more important than ever. Local laws regarding electric scooters are variable, with most locales prohibiting riding on the sidewalk and requiring the use of helmets,[8] but no uniform set of policies exists, and differences in enforcement further amplify this variation. The scooter rental smartphone applications require riders to state that they will comply with state and local laws, show proof of a driver's license, be older than 18 years, and use a helmet as part of their initial user agreements, but it is unclear to what extent these requirements are followed. Debates over the role of greater regulation of electric scooters continue in cities like San Francisco[9] and Santa Monica, California.[10] Of note, a bill supported by Bird to remove the helmet requirement for riders aged 18 years and older was recently signed into law in California,[11,12] illustrating the timeliness of this issue as well as the importance of garnering evidence to guide policy.

Given our institution's proximity to where these electric scooters were first available in the United States, we have the unique ability to describe injuries associated with electric scooters that were severe enough to trigger an emergency department (ED) visit over the course of 1 year. We report on the patient demographic and clinical characteristics of injuries associated with electric scooter use evaluated in our institution's 2 EDs. Additionally, we conducted public observations to describe common scooter riding practices in the community near the 2 EDs.

Methods

Study Design

We retrospectively analyzed deidentified data from all patient encounters for standing electric scooter injuries presenting to either of 2 EDs affiliated with the University of California, Los Angeles (UCLA), Ronald Reagan UCLA Medical Center and UCLA Medical Center–Santa Monica. We report summary statistics on the continuous and categorical variables of interest. Additionally, we observed a convenience sample of scooter riders to describe common use practices of standing electric scooters in the community surrounding our hospitals (eAppendix in the Supplement). The UCLA institutional review board approved all aspects of this study with waiver of informed patient consent. The study was conducted using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.[13]

Data Collection

We identified all ED encounters for injuries associated with standing electric scooter use in patients of any age by querying our unified electronic medical record for ED encounters between September 1, 2017, and August 31, 2018, that contained a clinician note with any of the non–case-sensitive terms "scooter," "bird," or "lime." Two of us (T.K.T. and C.L.) reviewed the medical records to verify eligibility and excluded ED encounters that were not due to trauma associated with standing electric scooter use. The eAppendix in the Supplement describes our process of determining inclusion and data abstraction, and eTable 1 in the Supplement details how categories of injuries were assigned using *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) diagnosis codes.

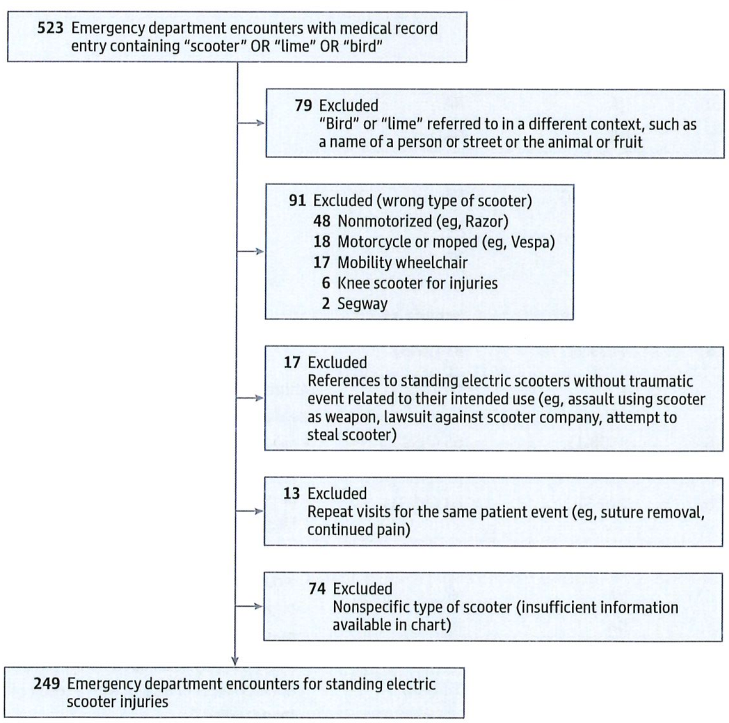
Statistical Analysis

In this descriptive study of a case series, we report proportions, calculate means and standard deviations for normally distributed data, and calculate medians and interquartile ranges for data that were not normally distributed.

Results

Two hundred forty-nine patients (145 [58.2%] male; mean [SD] age, 33.7 [15.3] years) presented to the emergency department with injuries associated with standing electric scooter use during the study period (**Figure**; eFigure in the Supplement). The demographic and incident characteristics of these patients are shown in **Table 1**. A majority of patients (152 [61.0%]) were between the ages of 18 and 40, although ages ranged from 8 to 89, and 27 patients (10.8%) were younger than 18 years. Of the 249 patients, 228 (91.6%) were riders and 21 (8.4%) were nonrider pedestrians (11 hit by a scooter, 5 tripped over a parked scooter, and 5 were attempting to lift or carry a scooter not in use).

Figure. Identifying Visits for Injuries Associated With Standing Electric Scooter Use



A majority of ED visits (141 [56.6%]) occurred during the late afternoon and evening hours, between 3 PM and 11 PM.

Among scooter riders, the most common mechanisms of injury were fall (183 riders [80.2%]), collision with an object (25 riders [11.0%]), and being hit by a moving vehicle or object (20 riders [8.8%]). Only 10 riders were documented as wearing a helmet, constituting 4.4% of all riders or 11.9% of riders whose helmet use status was documented. Twelve patients (4.8%) had physician-documented intoxication or a blood alcohol level greater than 0.05%.

Table 2 describes the ED evaluation and injury characteristics of patients presenting with injuries associated with standing electric scooter use. The majority of patients (200 [80.3%]) received imaging in the ED, with the most common imaging studies being radiographs or computed tomography of the distal upper extremity (36.5%), computed tomography of the head (29.7%), and radiographs or computed tomography of the distal lower extremity (20.1%). A total of 8.4% of patients underwent a trauma-protocol computed tomography scan (head, cervical spine, chest, abdomen, and pelvis), indicating high concern for serious injury. Two hundred thirty-four patients (94.0%) were discharged home from the ED.

Table 1. Patient and Accident Characteristics for ED Visits Associated With Standing Electric Scooters During a 1-Year Period

Characteristic	No. (%)		
	Riders (n = 228)	Nonriders (n = 21)	Total (N = 249)
Demographic Characteristics			
Age, y			
<18	26 (11.4)	1 (4.8)	27 (10.8)
18-25	61 (26.8)	1 (4.8)	62 (24.9)
26-40	85 (37.3)	5 (23.8)	90 (36.1)
41-64	51 (22.4)	10 (47.6)	61 (24.5)
≥65	5 (2.2)	4 (19.1)	9 (3.6)
Male	134 (58.9)	11 (52.4)	145 (58.2)
Accident Characteristics			
Mechanism of injury			
Rider			
Fall, no specific details	183 (80.2)	NA	NA
Collision with an object	25 (11.0)	NA	NA
Hit by a vehicle or moving object	20 (8.8)	NA	NA
Nonrider			
Hit by scooter	NA	11 (52.4)	NA
Tripped over scooter in road	NA	5 (23.8)	NA
Other[a]	NA	5 (23.8)	NA
Mechanism of ED transport			
Self-presented	151 (66.2)	17 (81.0)	168 (67.5)
Emergency medical services	77 (33.8)	4 (19.1)	81 (32.5)
Emergency medical services trauma activation	20 (8.8)	0	20 (8.0)
Time of day			
7 AM-3 PM	57 (25.0)	8 (38.1)	65 (26.1)
3 PM-11 PM	130 (57.0)	11 (52.4)	141 (56.6)
11 PM-7 AM	41 (18.0)	2 (9.5)	43 (17.3)
Helmet use[b]			
Unknown	144 (63.2)	NA	NA
No helmet	74 (32.5)	NA	NA
Wearing a helmet	10 (4.4)	NA	NA
Drug or alcohol intoxication[c]			
Blood alcohol level >0.05% or subjectively indicated by physician	12 (5.2)	0	12 (4.8)

Abbreviations: ED, emergency department; NA, not applicable.

[a] Other mechanisms involved 4 people injuring foot while attempting to lift or manipulate scooter and 1 person who injured their hand while trying to lift scooter.

[b] Numbers for nonriders are not calculated, as they would not be wearing helmets. One nonrider was a bicyclist wearing a helmet who was hit by a scooter.

[c] Patients were considered not intoxicated unless there was physician documentation of intoxication or blood alcohol testing with a result of greater than 0.05%.

Table 2. Emergency Department Resource Use and Injury Characteristics

Characteristic	No. (%) Riders (n = 228)[a]	Nonriders (n = 21)[a]	Total (N = 249)[a]
Triage acuity			
1: Most concerning	2 (0.9)	0	2 (0.8)
2	26 (11.4)	0	26 (10.4)
3	52 (22.8)	7 (33.3)	59 (23.7)
4	139 (61.0)	14 (66.7)	153 (61.4)
5: Least concerning	6 (2.6)	0	6 (2.4)
Missing[b]	3 (1.3)	0	3 (1.2)
Imaging			
Received any radiograph or CT	183 (80.3)	17 (81.0)	200 (80.3)
Received extremity radiograph or CT			
Upper extremity			
Distal	87 (38.2)	4 (19.0)	91 (36.5)
Proximal	39 (17.1)	3 (14.3)	42 (16.9)
Lower extremity			
Distal	47 (20.6)	3 (14.3)	50 (20.1)
Proximal	21 (9.2)	2 (9.5)	23 (9.2)
Received other radiography or CT[c]			
Chest radiograph	40 (17.5)	3 (14.3)	43 (17.3)
CT			
Head	66 (28.9)	8 (38.1)	74 (29.7)
Head and cervical spine	44 (19.3)	1 (4.8)	45 (18.1)
Head, cervical spine, chest, abdomen, and pelvis	21 (9.2)	0	21 (8.4)
Face	23 (10.1)	2 (9.5)	25 (10.0)
Cervical spine	45 (19.7)	1 (4.8)	46 (18.5)
Abdomen	22 (9.6)	0	22 (8.8)
Chest	21 (9.2)	0	21 (8.4)
ED length of stay for discharged patients[c]			
Patients discharged, No.	214	20	234
<4 h	156 (72.9)	19 (95.0)	175 (70.3)
>4 h	58 (27.1)	1 (5.0)	59 (23.7)
ED disposition			
Home	214 (93.9)	20 (95.2)	234 (94.0)
Admit to floor or observation	12 (5.3)	1 (4.8)	13 (5.2)
Intensive care unit	2 (0.9)	0	2 (0.8)
Injury characteristics[d]			
Any fracture	71 (31.1)	8 (38.1)	79 (31.7)
Upper extremity			
Distal	30 (13.2)	1 (4.8)	31 (12.5)
Proximal	15 (6.6)	2 (9.5)	17 (6.8)
Lower extremity			
Distal	9 (4.0)	2 (9.5)	11 (4.4)
Proximal	3 (1.3)	0	3 (1.2)
Facial	12 (5.3)	2 (9.5)	14 (5.6)
Vertebral column	2 (0.9)	0	2 (0.8)
Thoracic	3 (1.3)	1 (4.8)	4 (1.6)
Head injury	92 (40.4)	8 (38.0)	100 (40.2)
Minor head injury[e]	87 (38.2)	8 (38.0)	95 (38.2)
Intracranial hemorrhage	5 (2.2)	0	5 (2.0)
Contusions, sprains, and lacerations with no fracture or head injury	63 (27.5)	6 (28.6)	69 (27.7)

(continued)

Table 2. Emergency Department Resource Use and Injury Characteristics (continued)

Characteristic	No. (%) Riders (n = 228)[a]	Nonriders (n = 21)[a]	Total (N = 249)[a]
Dislocations			
Major[f]	9 (3.9)	0	9 (3.6)
Minor[g]	2 (0.9)	0	2 (0.8)
Procedural sedation for fracture reduction or joint dislocation	8 (3.5)	0	8 (3.2)
Lacerations	65 (28.5)	6 (28.6)	71 (28.1)
Major intra-abdominal or intrathoracic injuries[h]	3 (1.3)	0	3 (1.2)

Abbreviations: CT, computed tomography; ED, emergency department.

[a] Unless otherwise noted.

[b] 3 Cases were missing an acuity; on review, all 3 were trauma activations.

[c] Proportions calculated based only on discharged patients.

[d] Categories are not mutually exclusive.

[e] Minor head injuries include all closed head injuries without skull fracture or intracranial hemorrhage.

[f] Major dislocations include dislocations of the jaw, hips, shoulders, elbows, knees, and ankles.

[g] Minor dislocations included dislocations of the fingers or foot.

[h] Major intra-abdominal or intrathoracic injuries were defined as any internal injury of the thorax, abdomen, and pelvis represented by *International Classification of Diseases, Ninth Revision*, codes 860 to 869. The 3 cases included a splenic laceration and 2 lung contusions.

Among the 15 patients (6.0%) who were admitted or transferred, 13 patients were admitted to a floor or observation bed and 2 patients to the intensive care unit (one with traumatic subarachnoid hemorrhage, the other with a subdural hematoma). The reasons for hospitalization for the 15 patients admitted were orthopedic injuries (n = 5), intracranial hemorrhage (n = 5), major intra-abdominal or intrathoracic injuries (n = 3), cervical spine fracture (n = 1), and concussion (n = 1).

The most common injuries were fracture (79 patients [31.7%]), head injury (100 [40.2%]), and contusions, sprains, and lacerations without fracture or head injury (69 [27.7%]). Common fracture locations included the distal upper extremity (31 [12.5%]), proximal upper extremity (17 [6.8%]), distal lower extremity (11 [4.4%]), and face (14 [5.6%]). There was 1 open fracture. Eight patients (3.2%) received procedural sedation in the ED for reduction of a fracture or dislocation. Ninety-five patients (38.2%) sustained a minor head injury (head injury without intracranial hemorrhage or skull fracture), and 5 patients (2.0%) had an intracranial hemorrhage. Five of 95 patients (5.3%) with a minor head injury were documented as wearing a helmet during the incident, while none of the 5 patients with an intracranial hemorrhage had such documentation. Three patients had injuries to the intrathoracic or intra-abdominal organs, specifically pulmonary contusion, pneumothorax or hemothorax, and splenic injury.

A total of 193 scooter riders were observed during 3 public observation sessions, and the following unsafe riding practices were observed: no helmet use (182 riders [94.3%]), tandem riding (15 riders [7.8%]), and failure to comply with traffic laws (18 riders [9.3%]), as shown in eTable 2 in the Supplement. Additionally, many riders were observed to be riding on the sidewalk (51 riders [26.4%]), where scooter use is prohibited.

Discussion

To our knowledge, this is the first study examining the injury patterns and clinical outcomes of patients presenting to the ED after incidents involving standing electric scooters. This rapidly expanding technology is a disruptive force in short-distance transportation, and policy makers seeking to understand associated risks and appropriate regulatory responses should seriously consider its effects on public health. Riders share roads with fast-moving vehicular traffic but appear to underestimate hazards; we found that 94.3% of observed riders in our community were not wearing a helmet. Unsurprisingly, injuries associated with standing electric scooter use are prevalent, with 249 patients presenting to the ED over the course of 1 year in our study of 2 EDs. Comparatively, in a post hoc analysis prompted by the review process, we identified 195 visits for bicyclist injuries (*ICD-10* V10-V19) and 181 visits for pedestrian injuries (*ICD-10* V00-V09) during the same time period at the 2 EDs. Scooter injuries documented in this study were mostly minor, but could also be severe and costly, with 6.0% of patients admitted to the hospital, and 0.8% admitted to the intensive care unit.

Like standing electric scooters, personal transporters launched by Segway offered a novel and convenient means of short-distance transportation, but came with a serious risk for orthopedic and neurologic trauma.[14-16] Segway-related injuries commonly included upper and lower extremity fractures, but some were severe, including reported cases of intracranial hemorrhage requiring admission to the intensive care unit.[16] We noted similar patterns of injury with standing electric scooters. However, unlike Segway transporters, standing electric scooters could have substantial impact on public health given their low cost, popularity, and accessibility.

While riders of electric scooters in California are required to be at least 16 years old by state law and 18 years old by company rental agreements,[17,18] we found that 10.8% of electric scooter injuries were in patients younger than 18 years. This suggests that current self-enforced regulations imposed by private electric scooter companies may be inadequate. Although California law required helmet use while operating electric scooters during the entire study period, only 4.4% of injured scooter riders were documented to be wearing a helmet. A newly passed California law will make helmet use optional for electric scooter riders older than 18 years on January 1, 2019[11,12]; it is unclear how this change in policy will affect rider practices and injury patterns.

Limitations

While this is the first study, to our knowledge, of trauma associated with electric scooter use to provide data on a full year of ED visits, our study is retrospective and therefore necessarily limited to available clinical variables. Future work would benefit from efforts to improve ED clinician documentation of relevant incident characteristics, such as helmet use. We likely underestimated the number of electric scooter–associated injuries for several reasons. We excluded 74 ED encounters where it was suspected, but not clear, that an electric scooter was involved, and we did not include outpatient visits to urgent care or primary care clinics for minor injuries. Additionally, scooter use and availability rapidly increased toward the end of our study period, evidenced by the fact that most associated injuries occurred during the later months of the study (eFigure in the Supplement). We were also unable to evaluate the geographic and urban planning factors influencing the incidence and severity of these injuries. Future work should include prospective data collection and examine the effects of bikeway availability and speed limits, which may modify the occurrence of injuries associated with electric scooter use. It would also be meaningful to characterize the costs incurred by patients and the health care system from trauma associated with electric scooter use. This descriptive study was unable to identify any risk factors for injury; future work could use data from private scooter companies to calculate the rates of injury based on number of trips, distance traveled, and demographic characteristics of scooter users.

Conclusions

Standing electric scooters are a novel, innovative, and rapidly expanding form of transportation with the potential to alleviate traffic congestion, provide affordable transportation to residents of all incomes, and reshape how commuters travel the "last mile" to home or work. Our findings provide insight into the public health and safety risks associated with this rapidly growing form of transportation and provide a foundation for modernizing public policy to keep pace with this trend.

ARTICLE INFORMATION
Accepted for Publication: November 29, 2018.

Published: January 25, 2019. doi:10.1001/jamanetworkopen.2018.7381

Corresponding Author: Tarak K. Trivedi, MD, MS, National Clinician Scholar Program, University of California, Los Angeles, 1100 Glendon Ave, Ste 900, Los Angeles, CA 90024 (tktrivedi@mednet.ucla.edu).

Author Affiliations: Veterans Administration, Greater Los Angeles Healthcare System, Los Angeles, California (Trivedi, Liu); National Clinician Scholars Program, University of California, Los Angeles, Los Angeles, California (Trivedi, Liu, Elmore); Department of Emergency Medicine, University of California, Los Angeles (Trivedi, Wheaton, Kreger, Yap, Schriger); Department of Surgery, Stanford University, Stanford, California (Liu); Department of Surgery, University of California, Los Angeles (Liu); Office of Health Informatics and Analytics, UCLA Health, University of California, Los Angeles (Antonio); Division of General Internal Medicine and Health Services Research, University of California, Los Angeles (Elmore).

Author Contributions: Drs Trivedi and Liu had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Concept and design: Trivedi, Antonio, Wheaton, Kreger, Yap, Schriger, Elmore.

Acquisition, analysis, or interpretation of data: Trivedi, Liu, Antonio, Wheaton, Kreger, Yap, Schriger.

Drafting of the manuscript: Trivedi, Liu, Antonio, Wheaton, Kreger, Yap, Schriger.

Critical revision of the manuscript for important intellectual content: Trivedi, Liu, Wheaton, Kreger, Yap, Schriger, Elmore.

Statistical analysis: Trivedi, Antonio, Wheaton, Schriger.

Obtained funding: Elmore.

Administrative, technical, or material support: Trivedi, Schriger.

Supervision: Schriger, Elmore.

Conflict of Interest Disclosures: None reported.

Funding/Support: Drs Trivedi and Liu were supported by the UCLA National Clinician Scholars Program at the David Geffen School of Medicine at UCLA. Drs Trivedi and Liu are supported by the VA Office of Academic Affiliations through the VA/National Clinician Scholars Program. Dr Schriger's time was supported in part by a grant from the Korein Foundation.

Role of the Funder/Sponsor: The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Disclaimer: The contents do not represent the views of the US Department of Veterans Affairs or the US government.

REFERENCES

1. Hall M. Bird scooters flying around town. *Santa Monica Daily Press*. http://www.smdp.com/bird-scooters-flying-around-town/162647. Published September 26, 2017. Accessed September 13, 2018.

2. Hollister S, Holland P, Serrels M, Little M. The electric scooter war continues. here's how they work (FAQ). *CNET*. https://www.cnet.com/news/electric-scooters-bikes-dockless-ride-share-bird-lime-jump-spin-scoot/. Published May 30, 2018. Accessed November 12, 2018.

3. Lime. Locations. https://www.li.me/locations. Accessed September 13, 2018.

4. Bird. Bird riders fly one million rides. https://www.bird.co/press/bird-riders-fly-one-million-rides/. Published April 22, 2018. Accessed September 13, 2018.

5. McFarland M. Lyft launches a scooter service. Uber is close behind. *CNN*. https://money.cnn.com/2018/09/06/technology/lyft-scooters-denver-uber/index.html. Published September 6, 2018. Accessed September 13, 2018.

6. O'Brien C. Lime VP on company's meteoric rise to $1 billion valuation. *VentureBeat*. https://venturebeat.com/2018/07/02/lime-vp-on-companys-meteoric-rise-to-1-billion-valuation/. Published July 2, 2018. Accessed September 13, 2018.

7. Boniface K, McKay MP, Lucas R, Shaffer A, Sikka N. Serious injuries related to the Segway personal transporter: a case series. *Ann Emerg Med*. 2011;57(4):370-374. doi:10.1016/j.annemergmed.2010.06.551

8. City of Santa Monica Planning and Urban Development. Scooter and bike share services. https://www.smgov.net/Departments/PCD/Transportation/Shared-Mobility-Services/. Accessed September 18, 2018.

9. Said C, Sernoffsky E. Bye-bye, SF Scooters as Bird, Lime, and Spin go on hiatus. *San Francisco Chronicle*. https://www.sfchronicle.com/business/article/Bye-bye-SF-scooters-as-Bird-Lime-and-Spin-go-on-12966874.php. Published June 5, 2018. Updated June 5, 2018. Accessed September 13, 2018.

10. Newberry L. Bird and Lime deactivate scooter services in Santa Monica for a day in protest. *Los Angeles Times*. http://www.latimes.com/local/lanow/la-me-ln-santa-monica-scooter-suspension-20180814-story.html. Published August 14, 2018. Accessed September 13, 2018.

11. Flora H, Chen P, Gloria T, Low E. AB-2989 Motorized scooter: use of helmet: maximum speed. California Legislative Information. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2989. Published August 31, 2018. Accessed September 13, 2018.

12. Gomez L. Riding an e-scooter without a helmet to be legal in California. what could go wrong? *San Diego Union-Tribune*. https://www.sandiegouniontribune.com/opinion/the-conversation/sd-california-helmets-optional-for-electric-scooters-20180920-htmlstory.html. Published September 20, 2018. Accessed November 12, 2018.

13. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet*. 2007;370(9596):1453-1457. doi:10.1016/S0140-6736(07)61602-X

14. Pourmand A, Liao J, Pines JM, Mazer-Amirshahi M. Segway personal transporter-related injuries: a systematic literature review and implications for acute and emergency care. *J Emerg Med*. 2018;54(5):630-635. doi:10.1016/j.jemermed.2017.12.019

15. Ashurst J, Wagner B. Injuries following Segway personal transporter accidents: case report and review of the literature. *West J Emerg Med*. 2015;16(5):693-695. doi:10.5811/westjem.2015.7.26549

16. Roider D, Busch C, Spitaler R, Hertz H. Segway® related injuries in Vienna: report from the Lorenz Böhler Trauma Centre. *Eur J Trauma Emerg Surg*. 2016;42(2):203-205. doi:10.1007/s00068-015-0532-x

17. State of California Department of Motor Vehicles. Motorized scooter registration. https://www.dmv.ca.gov/portal/dmv/detail/vr/scooters. Updated 2018. Accessed August 9, 2018.

18. Thomson Reuters Westlaw. FindLaw. California Code, Vehicle Code—VEH § 21235. https://codes.findlaw.com/ca/vehicle-code/veh-sect-21235.html. Published March 9, 2009. Accessed August 9, 2018.

SUPPLEMENT.

eAppendix. Supplemental Methods

eTable 1. *ICD-9* Codes and Other Criteria Used to Generate Injury Categories

eTable 2. Observation of Rider Behaviors and Pediatric Riders

eFigure. Case Frequency by Date, Definite Cases (Included) vs Unclear Cases (Excluded)

Sayers, Margery

From: Joel Broida <jbroida1@gmail.com>
Sent: Saturday, February 8, 2020 1:59 PM
To: Ball, Calvin; CouncilMail; HCCA; Foehrkolb Lynn; Fitzgerald Kevin; Hillen Robin; Dworkin Dean; Baker Jeryl; Loeber Pat; Colavita Lisa; Lin.eagan@ca-board.org; Milton.Matthews@columbiaassociation.org; Columbia Association Board
Cc: Broida Joel; HCCA; sws@dedicatedresponse.com; bhawkins@jhmi.edu; Berla Nancy
Subject: More background information related to CB-3 2020
Attachments: Badeau 2019.pdf; trivedi_2019_oi_180307.pdf; Electric Scooters AJPH.2019.305499.pdf; Buehler AJPH.2016.pdf

In light of the pending proposal the introduction I though the attached items might be of interest to you all. Being a now retired two wheel Segway owner/user, incidentally these devices are classified by the State of Maryland as PERSONAL MOBILITY DEVICE(S), not vehicles, I say now retired because both my wife and I have difficulty in getting on and off of the Segways, are at risk for falling when getting on and off them, and that's not good for anyone, and so we sold them back to our dealer in Annapolis who uses them for tourist tours. By the way, there is a new Segway equipped with a seat made for aged and/or disabled people.

Back to CB-3....I urge you to require e-scooter venders include 3 and/or 4 wheel scooters and require docking stations for all of their rental scooters. Other jurisdictions have already allowed rental scooters to be left almost anywhere by the riders which is problematic. In some cases these jurisdictions have been able to terminate the rental sttcontracts for this or other reasons. Worst case, the contracts were poorly written and just had to live with.

Regardless of the kinds of e-scooter services you agree to.....please include "user training" and wearing of "approved safety helmets". Also, there is already an ongoing "bike rental service" with docking stations operating in and around Downtown Columbia and possibly at locations throughout Howard County. What has been learned from this experience that might well be applicable to an e-scooter rental service. No reason to reinvent the wheel, doing otherwise might well prevent bad things from happening to good people like....falls, injuries, or even fatal events like those cited in the attachments.

What's the rush to vote on CB-3 2020 anyway? Scooters will not alleviate the need for or the use of motor vehicles, parking space for motor vehicles, street and roadway repairs, public transit services, use of fire and rescue services in Downtown Columbia or for that matter the whole of Howard County.

That's my 2 cents more.

Respectfully submitted,

Joel Broida, Resident of Columbia and Howard County since 1972
5400 Vantage Point Road, Apt.413
Columbia, MD 21044
jbroida1@gmail.com
420.993.1033
443.996.0095 cell

Sent from my iPad