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Impact of alcohol and drug use on bicycle and electric scooter injuries and hospital admissions in the United States

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Abstract

Introduction: Bicycles and electric scooters (e-scooters) are convenient and accessible means of transportation. Participant safety is contingent on available infrastructure and safe riding practices including not riding while intoxicated. Understanding national prevalence and injury characteristics of bicycle and e-scooter riders who ride while intoxicated may promote awareness campaigns for safe riding practices and decrease morbidity.

Methods: The National Electronic Injury Surveillance System (NEISS) provides national estimates of injuries that present to emergency departments across the United States. We obtained case information on admitting status, body part injured, diagnosis of injury, age, sex, alcohol usage, and drug usage. We then queried NEISS for injuries related to bicycles and e-scooters in 2019.

Results: A weighted total of 270,571 (95% confidence interval (CI): 204,517–336,625) bicycle injuries occurred in the United States during 2019; alcohol and drug use were associated with 7% (95% CI: 6–9) and 2% (95% CI: 2–3) of all injuries, respectively. Twenty-four percent (CI: 18–31) of alcohol- and 29% (95% CI: 20–41) of drug-related bicycle injuries resulted in hospital admissions, compared to 15% (95% CI: 12–17) of non-alcohol- and 15% (95% CI: 13–18) of non-drug-related injuries ($p < .001$ and $p = .002$, respectively). A total of 28,702 (95% CI: 13,975–43,428) e-scooter injuries occurred in 2019; alcohol and drug use were associated with 8% (95% CI: 5–12) and 1% (95% CI: 1–2) of injuries, respectively. Sixty percent (95% CI: 47–72) of alcohol-related e-scooter injuries resulted in head trauma, compared to 28% (95% CI: 24–32) of non-alcohol-related injuries ($p < .001$).

Conclusions: Intoxication is associated with increasingly severe injuries, hospital admissions, and head trauma in bicycle and e-scooter riders. The findings support awareness campaigns to educate riders about risky practices, improve non-auto infrastructure, and promote helmet usage.

Keywords

Bicycle, electric scooter, e-scooter, alcohol, drugs, intoxication

Introduction

Bicycles are healthy and inexpensive means of transportation that improve urban traffic. Recently, electric scooters (e-scooters) have emerged to offer accessible short distance travel, particularly in busy commercial areas.^{1–3}

The safety of bicycle and e-scooter riders, in addition to pedestrians, depends in part on safe riding practices including not riding while intoxicated.

Despite legislation prohibiting alcohol and drug use while bicycling or e-scootering, Crocker et al.⁴ found that alcohol use occurred in one out of five bicycle trauma patients and tripled the odds of head injury. A 10-year study from a Level 1 trauma center, however, found that alcohol

use did not increase injury burden to the body or head of bicyclists.⁵ Furthermore, drug usage separate from alcohol is understudied in bicyclists, though there are direct associations between cannabis use and crash risk.⁶ Similarly,

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alcohol consumption in e-scooter riders has yet to be extensively quantified, as studies describe prevalence of alcohol consumption in e-scooter injuries to range between 5 and 46%^{2,3,7–10} with few reports on drug usage.

Although riding while intoxicated is prevalent and associated with increased medical costs,¹¹ the literature is limited by small sample sizes representing mostly single institution experience or geographic areas.^{4,11–13} Additionally, these studies lack granular characterization of diagnoses and types of injuries associated with riding while intoxicated. Herein, we aim to build upon the literature by using a national sample of bicycle and e-scooter riders in the United States to evaluate injury profile and hospital admissions associated with alcohol and drug use. Understanding national prevalence and injury characteristics of bicycle and e-scooter riders who ride while intoxicated can be used for awareness and education campaigns to promote safe riding. We hypothesize that alcohol and drug usage is associated with higher rates of hospital admissions, head injuries, and younger age in both bicycle and e-scooter riders.

Methods

The National Electronic Injury Surveillance System (NEISS) provides national estimates of injuries that present to emergency departments (EDs) across the United States.¹⁴ Selection of ED occurred using stratified sampling with four general hospital strata and one stratum for children's hospitals. The NEISS provided statistical weights for each sample to estimate national case numbers with corresponding confidence intervals (CIs). The data source was public, de-identified, and institutional review board exempt.

The NEISS analysts reviewed medical records of sampled hospitals and coded each injury with a product key. We then queried NEISS for injuries related to bicycles (product keys 5033 and 5040) in 2019 ($n = 11,484$) and excluded subjects aged under 18 years ($n = 4934$). We also queried NEISS for injuries related to standing-powered scooters (product key 5042) in 2019 with keyword "scooter" in the case narrative ($n = 800$). We read each e-scooter narrative and excluded non-e-scooter injuries ($n = 20$) such as those involving assisted mobility scooters and non-two-wheeled scooters.

We obtained admitting status, body location of injury, diagnosis of injury, age, sex, alcohol usage, and drug usage from subjects who sustained bicycle and e-scooter injuries. Body location of injury was based on diagnosis of injury determined from each subject's case narrative; for example, diagnosis of right facial laceration denotes a diagnosis of laceration and a body location of head. NEISS confirmed alcohol usage if the ED record indicated alcohol consumption prior to or during the incident, or if the record indicated suspected alcohol use. NEISS defined drug usage as use of any recreational/illegal drug, excluding alcohol, or

medication directly contributing to the injury or injury severity.

We utilized NEISS complex sampling design to obtain US population projections of injuries and hospital admissions. Population estimates from the 2010 US Census Bureau (<https://www.census.gov/programs-surveys/popest/data/data-sets.html>) were utilized for the direct method of age adjustment.¹⁵ We applied Fisher's exact tests using Stata V15 (StataCorp, College Station, TX) to determine differences in injury characteristics among subjects using and not using alcohol or drugs. P-values less than .05 determined statistical significance.

Results

Bicycles

A weighted total of 270,571 (95% CI: 204,517–336,625) bicycle injuries occurred in the US during 2019 (6550 NEISS cases); alcohol and drug use were associated with 7% and 2% of all injuries, respectively (Table 1). Of 41,217 hospital admissions recorded, 11% and 4% were associated with alcohol and drugs, respectively. In total, 24% of alcohol- and 29% of drug-related injuries resulted in hospital admissions, compared to 15% of non-alcohol- and 15% of non-drug-related injuries ($p < .001$ and $p = .002$, respectively). Overall, 29% of bicycle injuries involved the head. Alcohol and drug usage were involved in 12% and 3% of head injuries, respectively. Injuries related to alcohol were significantly more likely to result in more severe injury such as those involving the head ($p < .001$), internal organs ($p < .001$), and lacerations ($p < .001$) compared to non-alcohol-related injuries.

People aged 35–54 years accounted for 44% and 41% of all alcohol and drug-related injuries, respectively. Males constituted a higher percentage of alcohol-related injuries ($p < .001$) and drug-related injuries ($p = .002$) compared to non-alcohol- and non-drug-related injuries. Urban hospitals received 82% of injured bicyclists.

E-scooters

A weighted total of 28,702 (95% CI: 13,975–43,428) e-scooter injuries occurred in the United States during 2019 (780 NEISS cases); alcohol and drug use were associated with 8% and 1% of all injuries, respectively (Table 2). Total, alcohol-related, drug-related, non-alcohol-related, and non-drug-related age-adjusted e-scooter injury incidence per 100,000 was 37, 3, 0.4, 34, and 36, respectively. A total of 3573 hospital admissions were recorded, 16% and 4% of which were associated with alcohol and drugs, respectively. Overall, 25% and 38% of alcohol-related and drug-related e-scooter injuries resulted in admissions, compared to 11% and 12% of non-alcohol-related ($p = .005$) and non-drug-related injuries ($p = .03$), respectively. During the study

Table 1. Characteristics of alcohol and drug use in bicycle injuries and hospital admissions in 2019 presented as numbers or percentages (95% confidence intervals).

	Total	Alcohol	Non-alcohol	P value	Drug	Non-drug	P value
Injury cases ^a	270,571 (204,517–336,625)	18,636 (12,997–24,274)	251,935 (189,703–314,168)	—	6074 (3635–8512)	264,497 (199,666–329,327)	—
Age-adjusted incidence ^b	328 (236–421)	22 (14–31)	306 (218–394)	—	7 (4–11)	321 (230–412)	—
Hospital admissions	41217 (26,916–55,518)	4490 (2778–6202)	36,727 (23,336–50,119)	<0.001	1787 (665–2908)	39,431 (25,545–53,316)	0.002
%	15 (13–18)	24 (18–31)	15 (12–17)	—	29 (20–41)	15 (13–18)	—
Type of injury							
Head ^c	78,070 (57,398–98,742)	9609 (62,64–12,954)	68,461 (50,192–86,729)	<0.001	2203 (999–3406)	75,867 (55,960–95,774)	0.10
%	29 (26–31)	52 (44–59)	27 (25–30)	—	36 (27–47)	29 (26–31)	—
Torso ^d	49,954 (34,204–65,705)	1844 (1002–2687)	48,110 (32,814–63,407)	<0.001	721 (249–1193)	49,233 (33,595–64,872)	0.04
%	18 (16–21)	10 (7–13)	19 (17–21)	—	12 (8–18)	19 (17–21)	—
Upper extremity	79,567 (62,393–96,741)	2635 (1506–3764)	76,932 (60,218–93,646)	<0.001	1210 (672–1748)	78,357 (61,332–95,383)	0.01
%	29 (27–32)	14 (11–19)	31 (28–33)	—	20 (14–27)	30 (28–32)	—
Lower extremity	56,575 (42,469–70,680)	2622 (1627–3697)	53,912 (40,098–67,727)	0.007	991 (495–1487)	55,584 (41,611–69,557)	0.15
%	21 (19–22)	14 (11–19)	21 (20–23)	—	16 (11–23)	21 (20–23)	—
Diagnosis of injury							
Fractures	65,699 (48,467–82,932)	3847 (2434–5261)	61,852 (45,299–78,405)	0.16	1194 (298–2091)	64,505 (47,553–81,457)	0.37
%	24 (22–26)	21 (16–26)	25 (23–27)	—	20 (12–31)	24 (22–27)	—
Contusion/abrasions	51,519 (38,393–64,645)	3024 (1683–4366)	48,495 (35,853–61,137)	0.28	694 (309–1078)	50,825 (37,762–63,889)	0.06
%	19 (18–21)	16 (12–22)	19 (18–21)	—	11 (6–20)	19 (18–21)	—
Internal organ injury	32,797 (22,065–43,529)	4144 (2429–5859)	28,653 (19,132–38,174)	<0.001	995 (419–1571)	31,802 (21,326–42,277)	0.07
%	12 (11–14)	22 (17–29)	11 (10–13)	—	16 (12–22)	12 (11–14)	—
Laceration	26,642 (20,199–33,085)	2892 (1671–4113)	23,750 (18,074–29,426)	<0.001	421 (90–753)	26,220 (19,830–32,611)	0.34
%	10 (9–11)	16 (12–20)	9 (8–11)	—	7 (3–14)	10 (9–11)	—

(continued)

Table 1. Continued.

	Total	Alcohol	Non-alcohol	P value	Drug	Non-drug	P value
Age							
18-34	88805 (67,441-1101,68)	4073 (2514-5632)	84732 (64,432-1050,31)	<0.001	2100 (1042-3158)	86705 (65,900-1075,09)	0.70
%	33 (28-38)	22 (17-27)	34 (29-39)	—	35 (26-44)	33 (28-38)	—
35-54	85710 (68,549-1028,71)	8226 (53,58-110,94)	77484 (61,989-929,79)	<0.001	2518 (1332-3704)	83192 (66,811-995,73)	0.07
%	32 (28-36)	44 (37-51)	31 (27-35)	—	41 (32-52)	31 (28-36)	—
>54	96056 (57,194-1349,18)	6337 (4011-8662)	89719 (52,206-1272,33)	0.73	1456 (783-2128)	94600 (55,851-1333,49)	0.03
%	36 (28-44)	34 (27-42)	36 (28-44)	—	24 (18-31)	36 (28-44)	—
Male	203329 (15,6964-2496,94)	16643 (11,563-217,23)	186686 (14,3841-2295,31)	<0.001	5263 (3213-7312)	198067 (15,2881-2432,52)	0.002
%	75 (72-78)	89 (85-93)	74 (71-77)	—	87 (80-91)	75 (72-78)	—
Urban hospital	222690 (16,6546-2788,35)	15811 (10,554-210,68)	206879 (15,4065-2596,93)	0.33	5663 (3260-8067)	217027 (16,2283-2717,71)	0.06
	82 (68-91)	85 (72-93)	82 (68-91)	—	93 (82-98)	82 (68-91)	—

^aCounts from National Electronic Injury Surveillance System (NEISS) database for people aged 18+ years.

^bAge adjustment performed using direct standardization. Incidence displayed as population estimate of injured bicyclists per 100,000 persons in the US population (95% CI).

^cIncludes neck injuries.

^dIncludes public region and internal injuries.

Table 2. Characteristics of alcohol and drug use in electric scooter injuries and hospital admissions in 2019, presented as numbers or percentages (95% confidence intervals).

	Total	Alcohol	Non-alcohol	P value	Drug	Non-drug	P value
Injuries ^a	28,702 (13,975–43,428)	2322 (336–4309)	26,379 (13,494–39,264)	—	332 (46–617)	28,370 (13,871–42,869)	—
Age-adjusted incidence ^b	37 (15–58)	3 (0–6)	34 (15–53)	—	0.4 (0–6)	36 (15–53)	—
Hospital admissions	3573 (1305–5841)	571 (0–1237)	3002 (1295–4709)	0.005	126 (0–272)	3447 (1232–5662)	0.03
%	12 (9–18)	25 (15–38)	11 (8–17)	—	38 (12–73)	12 (8–17)	—
Type of injury							
Head ^c	8759 (3427–14,092)	1399 (221–2578)	7360 (3147–11,573)	<0.001	108 (0–232)	8651 (3356–13,945)	0.90
%	31 (26–35)	60 (47–72)	28 (24–32)	—	33 (10–67)	30 (26–35)	—
Torso ^d	2525 (1167–3883)	98 (0–262)	2427 (1167–3687)	0.17	16 (0–49)	2509 (1163–3854)	0.48
%	9 (6–12)	4 (2–11)	9 (7–13)	—	5 (1–23)	9 (6–12)	—
Upper extremity	8763 (4165–13,360)	360 (0–735)	8402 (4135–12,670)	<0.001	18 (0–55)	8744 (4150–13,339)	0.03
%	31 (26–35)	16 (10–23)	32 (27–37)	—	6 (1–33)	31 (26–36)	—
Lower extremity	8133 (4225–12,041)	303 (0–684)	7830 (4204–11,457)	0.006	71 (0–184)	8062 (4153–11,972)	0.67
%	28 (23–34)	13 (7–22)	30 (25–35)	—	21 (4–62)	28 (23–34)	—
Diagnosis of injury							
Fractures	7798 (2858–12,738)	734 (0–1749)	7064 (3062–11,066)	0.63	34 (0–81)	7764 (2837–12,691)	0.07
%	27 (22–33)	32 (14–56)	27 (23–32)	—	10 (3–29)	27 (22–33)	—
Contusion/abrasions	5759 (3399–8120)	304 (41–568)	5455 (3236–7674)	0.21	16 (0–49)	5743 (3399–8087)	0.04
%	20 (16–25)	13 (6–26)	21 (16–26)	—	5 (1–23)	20 (16–25)	—
Laceration	3819 (1095–6543)	494 (0–1048)	3325 (1108–5542)	0.008	71 (0–186)	3747 (1046–6449)	0.57
%	13 (10–17)	21 (13–33)	13 (10–16)	—	22 (4–66)	13 (10–17)	—
Internal organ injury	3004 (1903–4106)	414 (74–753)	2591 (1673–3508)	0.13	18 (0–55)	2985 (1907–4065)	0.40
%	10 (7–15)	18 (7–39)	10 (7–14)	—	6 (1–25)	11 (7–15)	—
Strain/sprain	2183 (1308–3059)	35 (0–104)	2148 (1303–2994)	0.02	0 (0–0)	2183 (1308–3059)	0.38
%	8 (5–12)	2 (0–8)	8 (5–13)	—	0 (0–0)	8 (4–12)	—

(continued)

Table 2. Continued.

	Total	Alcohol	Non-alcohol	P value	Drug	Non-drug	P value
Age							
<18	4287 (2750–5824)	0 (0–0)	4287 (2750–5824)	0.049	0 (0–0)	4287 (2750–5824)	0.23
%	15 (8–27)	0 (0–0)	16 (9–28)	—	0 (0–0)	15 (8–27)	—
18–34	13460 (51,29–217,91)	1064 (106–2022)	12396 (49,50–198,41)	0.81	70 (0–179)	13390 (51,06–216,75)	0.12
%	47 (40–53)	46 (39–53)	47 (40–54)	—	21 (5–57)	47 (41–54)	—
35–54	6900 (21,89–116,11)	879 (41–1716)	6022 (2087–9957)	<0.001	126 (0–274)	6775 (21,00–114,49)	0.41
%	24 (19–30)	38 (28–48)	23 (18–28)	—	38 (12–73)	24 (19–30)	—
>54	4055 (1978–6132)	380 (46–713)	3675 (1738–5612)	0.67	136 (0–317)	3918 (1971–5866)	0.06
%	14 (11–18)	16 (8–30)	14 (11–18)	—	41 (13–77)	14 (11–18)	—
Male	18891 (82,79–295,03)	1915 (303–3526)	16977 (77,91–261,63)	<0.001	313 (48–579)	18578 (81,82–289,74)	0.002
%	66 (58–72)	82 (77–87)	64 (56–72)	—	94 (75–99)	65 (58–72)	—

^aCases from National Electronic Injury Surveillance System (NEISS) database for all ages.

^bAge adjustment performed using direct standardization. Incidence displayed as population estimate of injured scooter riders per 100,000 persons in the US population (95% CI).

^cIncludes neck injuries.

^dIncludes public region and internal injuries.

period, 31% of e-scooter injuries involved the head. The proportion of alcohol-related injuries resulting in head trauma (60%) was significantly greater than that of non-alcohol-related injuries (28%) ($p < .001$).

Those aged 18–34 years accounted for the majority of all injuries, and this proportion remained unchanged for injuries involving alcohol and those not. However, the proportion of injuries significantly increased among those aged 35–54 years for cases involving alcohol compared to those not intoxicated ($p < .001$). Sixty-six percent (95% CI: 58–72) of people injured were men, and men made up a significantly larger proportion of injuries involving alcohol than those not ($p < .001$). Admissions related to e-scooter injuries were far more commonly seen in urban hospitals (93% (95% CI: 86–96)), compared to rural (6% (95% CI: 3–12)) and children's (1% (95% CI: 0–2)) hospitals.

Discussion

We report that both alcohol and drug use heighten the likelihood of bicycle injury and hospital admission, while alcohol use increased rates of head injuries, internal organ injuries, and lacerations in bicycle injuries. This report additionally details significant associations between alcohol use and e-scooter injuries, hospital admissions, and head injuries, which became the most injured body part with alcohol use. Overall, the findings highlight the dangers of bicycle and e-scooter usage while intoxicated and the need to educate these increased risks to the public, particularly males, bicycle riders aged 35–54 years and e-scooter riders aged 18–34 years, as these groups constituted the highest burden of impairment-related injuries.

These findings are consistent with previous studies identifying associations between alcohol use and increased bicycle head trauma, injury severity, and hospital usage,^{12,16} while also recognizing drug usage as an additional risk factor for hospital admission. Sethi et al. found 15.1% of injured cyclists at a large trauma hospital were under the influence of alcohol or other substance at the time of injury.¹⁶ Other groups report alcohol use prevalent among 13–37% of injured bicyclists.^{5,6,17} These studies, however, are limited in sample size and derive from single, large, urban hospitals that may receive disproportionately higher alcohol-associated trauma relative to rural settings. Our study utilized a national sample representing both urban and rural hospitals, while also distinguishing between alcohol- and drug-associated injuries. These factors may lend toward our lower rates of alcohol usage among bicyclist injuries in our study. Moreover, we found that alcohol doubled the rate of head injury and over half of alcohol-related injuries involved head trauma. This is consistent with Chiara et al. who found 63% of alcohol-related bicycle injuries resulted in head trauma,¹³ and Crocker et al. who demonstrated a 2.68 increased odds of head or brain injury with alcohol use.¹⁸

The literature suggests that a significant proportion of bicyclists are not aware of the risks or legality of riding while intoxicated.^{19,20} Studies have suggested prevention campaigns may aid in lowering the prevalence of alcohol use while bicycling, similar to those for drunk driving.^{13,21} To our knowledge, no such national campaigns for public awareness of bicycling while intoxicated exist in the United States, despite evidence that education campaigns encouraging helmet use in bicyclists are effective and can substantially increase helmet usage.^{22,23} Improved non-auto infrastructure, particularly in dense urban settings, serve as an important opportunity to protect riders. Such safety measures may include policies to slow traffic, encourage safety systems like Vision Zero to include e-scooter reporting in addition to bicycles,²⁴ and propel environmental changes such as adding lanes and wider pedestrian sidewalks. The disparity of injuries in urban compared to rural areas is striking, suggesting targeted interventions should prioritize specific areas.

Our e-scooter findings demonstrate 96% and 160% increases in e-scooter injuries and hospital admissions, respectively, since 2018,²⁵ highlighting a growing public health concern associated with e-scooters. Legislature has prohibited alcohol or drug use while riding e-scooters, though 8% and 1% of injuries included in this study involved alcohol and drugs, respectively. Alcohol-associated injuries in e-scooter riders occurred in younger age groups compared to bicyclists, which is similar to findings from Trivedi et al. and Liew et al. who reported injured riders to have average ages of 33.7 and 34 years, respectively.^{7,26} We found that head injuries occurred in 33% of e-scooter injuries, consistent with a previous report where 40.2% of e-scooter riders sustained head injuries.⁷ Our rates of alcohol and drug usage, however, are generally lower than those found in the literature. Dhillon et al. found 17.2% and 13.8% of injured e-scooter riders to have used alcohol and cannabis, respectively.²⁷ Other studies have reported varying rates of alcohol use,^{2,3,7–10} and one other has reported self-reported cannabis use in e-scooter riders as 2%.²⁸

We found alcohol more than doubled likelihood of head trauma in e-scooter injuries, which is greater than that in bicycle injuries. A recent case series demonstrated craniofacial fractures and intracranial injuries as sequelae of e-scooter head trauma.¹⁰ Despite numerous e-scooter companies providing helmets to riders, several studies have reported no helmet usage among riders,^{2,8,9} while others document between 2% and 18% of injured riders wearing helmets.^{3,7,27} Moreover, many states do not require e-scooter riders to use helmets.²⁹ Notably, alcohol use is associated with doubled rates of e-scooter hospital admissions and head injuries. As e-scooter expansion proliferates, e-scooter companies and policy makers should collaborate to promote rider and bystander safety by limiting risky behavior, particularly alcohol and drug use, provide more

protective precautions, and design safer environments for e-scooters and other forms of non-automobile transportation.

Study limitations include the under-estimation of alcohol-related e-scooter trauma as some patients may have presented to the ED after becoming sober or avoided the ED altogether. On the other hand, head injuries may be falsely elevated in injuries associated with intoxication, as these subjects may have been diagnosed clinically with a concurrent concussion. Hospitals selected in the NEISS sample may have had different thresholds for admitting subjects for observation, which may result in over-estimation of national hospital admissions if the sampled hospitals had greater tendency to admit intoxicated subjects for observation. We intend to further study type of admission (i.e., intensive care unit, floor, and observation) and the differences in admission decisions based on hospital type in future studies. Drug use may also be underestimated as only drug use directly contributory to injury or injury severity was included. We further lack granularity regarding specific drugs, collision situation, and helmet usage. Creating separate coding for gas-powered scooters may provide more accurate estimations of e-scooter injuries. Blood alcohol levels may lend more insight into effects of alcohol on rider injury. We did not have data on the time of day of injury. Bicycle injuries associated with alcohol have been shown to be more likely to occur between 6:00 pm and midnight,^{6,16} suggesting the increase in alcohol-related injuries may be confounded by visibility during time of injury.

Conclusion

Although our reported rates of alcohol and drug usage are lower than those found in the literature, our national study demonstrated in 2019 alone nearly 24,710 bicyclists sustained injuries related to alcohol and drugs. E-scooter riders sustained 2654 injuries associated with alcohol and drugs, which will increase if e-scooter popularity continues to grow. With transport by bicycle and e-scooter being accessible, individual healthy behaviors, public awareness, and policy regarding safe riding habits are critical. Injury prevention policies should emphasize the perils of riding while intoxicated, similar to drunk driving campaigns, in addition to strategies that make roads safer for all users, including design considerations for non-automobile traffic, awareness programs, and education campaigns to limit intoxication while riding and encourage helmet usage.

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Contributorship

Concept and design: NKN, BNB. Acquisition, analysis, or interpretation of data: NKN, AWL, GMA, JV, BNB. Drafting of the manuscript: NKN, AWL. Critical revision of the manuscript for important intellectual content: NKN, AWL, GMA, JV, BNB. Statistical analysis: NKN. Supervision: GMA, JV, BNB.

Ethical approval

The data source was institutional review board exempt because the data was from a public, de-identified source (NEISS).

Guarantor

NKN.

Informed consent

NEISS did not obtain informed consent because NEISS is a federal organization that randomly sampled anonymized ED visits from a set of hospital strata.

Trial registration

(where applicable): NEISS is a federally collected database of ED visits and hence not a clinical trial. This manuscript is using the NEISS database and hence also not a clinic trial. Trial registration is not applicable because this study did not perform a clinical trial and rather used the publicly available federal database.

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