

ED Visits for Motor Vehicle Crashes Associated with Elevated Risk of Subsequent Firearm Injury for Young Male Patients

Team A: Kersten Bartelt, RN; Michael Levas, MD; Maria Beyer, MPH; Joe Deckert, PhD

Team B: Dave Little, MD; Eric Barkley

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Key Findings:

- Male patients aged 10 to 15 who had an ED visit for a motor vehicle crash (MVC) were as much as four times as likely to experience a subsequent firearm injury compared with those whose ED visit was for a fall, in some parts of the United States.
- Male patients aged 16 to 25 who had an MVC-related ED visit were up to 81% more likely to sustain a subsequent firearm injury compared with those whose ED visit was for a fall, in some parts of the United States.
- Female patients in all age groups and adults over age 25 did not experience a consistent change in firearm-injury risk after an ED MVC visit.

Motor vehicle crashes (MVCs) and firearm injuries are two major contributors to injury-related morbidity in the United States.¹ Prior clinical and public health research has shown that patterns of traumatic injury, risk-taking behavior, and exposure to violence frequently cluster in adolescence and early adulthood.^{1,2} While both MVCs and firearm injuries disproportionately affect adolescents and young adults, limited evidence exists on whether an ED presentation for one type of traumatic exposure may identify patients at elevated risk for another. Identifying ED-based markers of elevated future risk could inform targeted prevention strategies, resource allocation, and community-based violence-intervention programs. We aimed to understand the relationship between ED visits for MVCs and the likelihood of future firearm injury.

We studied more than 2 million U.S. patients with an ED visit for an MVC and another 2 million U.S. patients with an ED visit for a fall between 2017 and November 11, 2025. Patients were excluded if they had a documented history of firearm injury, MVC, or fall before the ED visit of interest. Patients with an ED visit for an MVC were matched with patients whose ED visit was for a fall based on age, sex, race and ethnicity, census region, and month of the ED encounter. We additionally accounted for rurality based on residence, social vulnerability based on residence, ED acuity score, smoking history, prior health care utilization, and history of comorbidities including mental health conditions, traumatic brain injury, pervasive developmental disorders, and lead poisoning.

Across most census regions, male patients aged 10 to 15 experienced the clearest pattern of elevated firearm-injury risk following an ED visit for an MVC, with as much as four times as likely as those whose ED visit was for a fall, as seen in Figure 1. For male patients aged 16 to 25, the association persisted across many census regions but was smaller in magnitude; depending on region, patients were 81% more likely to have a firearm injury following an MVC compared to a fall.

Firearm Injury Risk Following an ED Visit Among Males by Age and Region

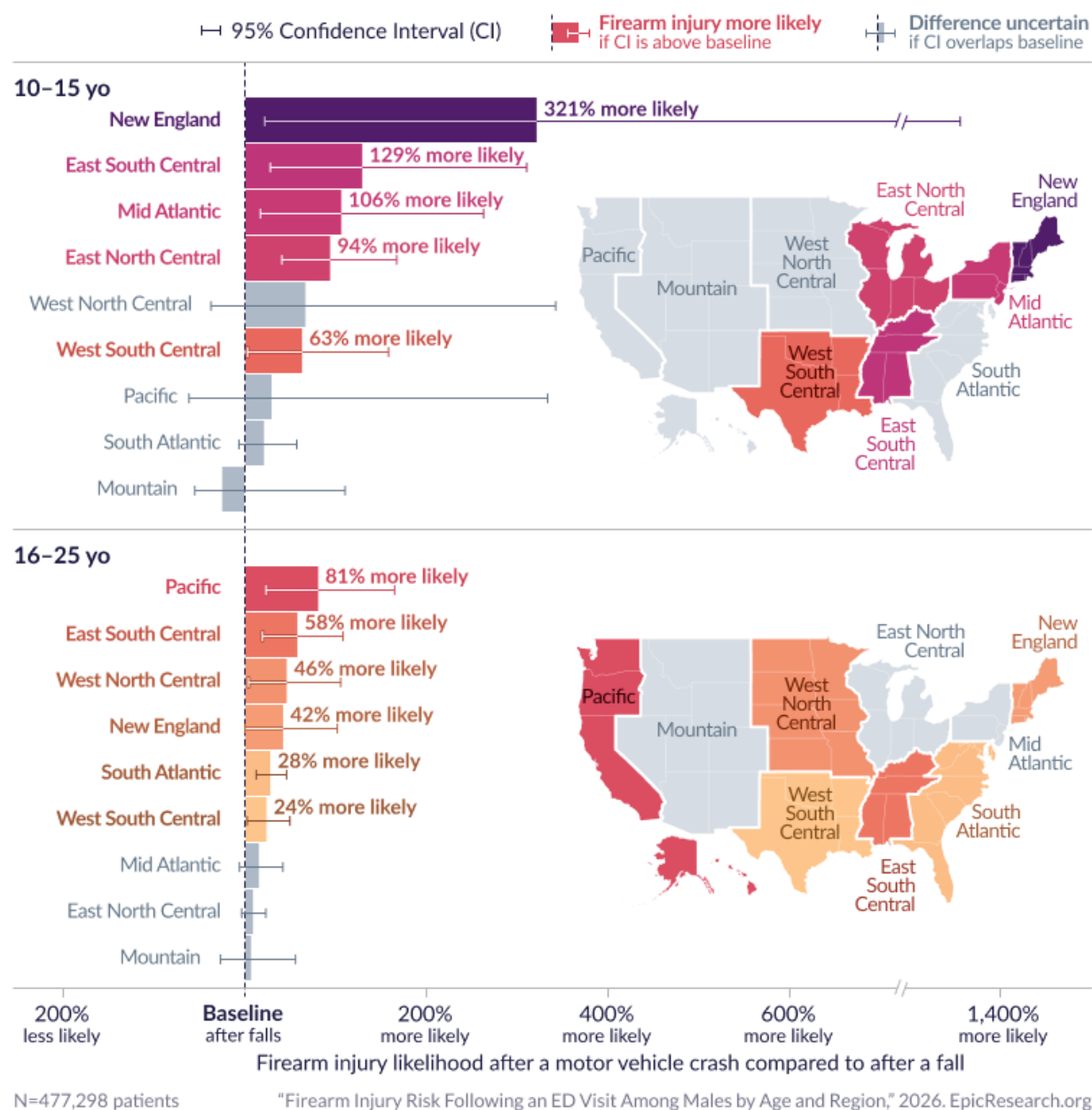


Figure 1. The risk of a firearm injury following an ED visit for an MVC compared to after a fall among males by age and geographic region.

Of note, significance was not observed for female patients or adults over age 25 in nearly all stratifications.

These data come from Cosmos, a dataset created in collaboration with a community of Epic health systems representing more than 300 million patient records from 1,800 hospitals and more than 41,000 clinics from all 50 U.S. states, Canada, Lebanon, and Saudi Arabia. This study was completed by two teams that worked independently, each composed of a clinician and research scientists, in collaboration with researchers from Children's Wisconsin. The two teams came to similar conclusions. Graphics by Brian Olson.

References

1. Cunningham RM, Walton MA, Carter PM. The major causes of death in children and adolescents in the United States. *N Engl J Med*. 2018;379(25):2468-2475. doi:10.1056/NEJMSr1804754
2. Sims DW, Bivins BA, Obeid FN, Horst HM, Sorensen VJ, Fath JJ. Urban trauma: a chronic recurrent disease. *J Trauma*. 1989;29(7):940-947.

Data Definitions

Term	Definition
Study period	1/1/2017 to 11/11/2025
Study population: inclusion	Patients with: • An emergency department (ED) visit • An evaluated sex of female or male • A state of residence in the U.S. documented • A face-to-face visit in the two years prior to their ED visit
Study population: exclusion	History of firearm injury , MVC , or fall before index ED visit
Censoring	Last face-to-face visit
Exposures	ED visit for MVC: Billing or encounter diagnosis with ICD-10-CM code V2[0-9].**XA, V3[0-9].*XXA, V4[0-9].*XXA, V5[0-9].*XXA, V87.*XXA, V88.*XXA, V89.[02]XXA, Y03.8XXA, or SNOMED code 407153006
Outcomes	Firearm injury from an ED, urgent care, or office visit encounter Negative control outcomes: • Type 1 diabetes: Billing or encounter diagnosis with ICD-10-CM code E10* • Eczema: Billing or encounter diagnosis with ICD-10-CM code L20* • Crohn's disease: Billing or encounter diagnosis with ICD-10-CM code K50*
Reference population	ED visit for a fall: Billing or encounter diagnosis with ICD-10-CM code W00*-W19*
Face-to-face visit	An encounter with a type of Emergency, Office Visit, Well Child, Follow-up, Telemedicine, Urgent Care, Walk-in, Routine Prenatal, Postpartum Visit, Fetal Care Consult, Emergency to Inpatient, Inpatient Admission, Hospital Outpatient Visit, or Hospital Outpatient Visit to Inpatient
Firearm Injury	Accidental: Billing or encounter diagnosis with ICD-10-CM code W32.[01]XX[AD], W33.[01][01239]X[AD], W34.00X[AD], W34.01[AD], W34.09X[AD], W34.1**[AD] Intentional: Billing or encounter diagnosis with ICD-10-CM code X72.XXX[AD], X73.[01289]XX[AD], X74.0XA, X74.[89]XX[AD] Assault: Billing or encounter diagnosis with ICD-10-CM code X93.XXA, X94.[01289]XX[AD], X95.0[129]X[AD], X95.[89]XX[AD] Undetermined: Billing or encounter diagnosis with ICD-10-CM code Y22.XXX[AD], Y23.[012389]XX[AD], Y24.XX[AD] Legal: Billing or encounter diagnosis with ICD-10-CM code Y35.0[012349][123][AD] Terrorism: ICD-10-CM code Y38.4X[AD] SNOMED code 219257002, 219338008, or 219334005

Confounders	Age: • <10 • 10-15 • 16-25 • 26-35 • 36-54 • 55+ Race and ethnicity RUCA Census region Smoking history ED acuity score Legal sex Social Vulnerability Index quintile Comorbidities prior to index date (including problem list) • ADHD: ICD-10-CM code F90* • Depression/PTSD: ICD-10-CM code F32*, F33*, F06.31*, F06.32*, or F34.1* • Substance use disorder: (diagnosis or ever positive urine drug screen) ICD-10-CM code F10*-F19* • History of suicidal ideation/attempt: ICD-10-CM code R45.851, T14.91 • Lead poisoning: ICD-10-CM code R78.71, T56.0 • Pervasive developmental disorders: ICD-10-CM code F84* • Conduct disorder: ICD-10-CM code F91* • TBI: ICD-10-CM code S06* or SNOMED code 127295002
Race and ethnicity	Non-exclusive flags for Black/African American patients and Hispanic patients
Census region	West north central: Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota East north central: Illinois, Indiana, Michigan, Ohio, Wisconsin New England: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont Middle Atlantic: New Jersey, New York, Pennsylvania South Atlantic: Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia East south central: Alabama, Mississippi, Kentucky, Tennessee West south central: Arkansas, Louisiana, Oklahoma, Texas Mountain: Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, Wyoming Pacific: Alaska, California, Hawaii, Oregon, Washington
Matching	Exposures matched 1:1 to controls Index event for exposure is first ED visit for MVC in the study period Index event for controls is first ED visit for fall in the study period Matched on: • Age • Year and month of ED visit • Census region • Race and ethnicity

	• Legal sex
Model specifications	Cox Proportional Hazard model
Sensitivity analysis	Negative-control outcomes including type 1 diabetes, eczema, and Crohn's disease showed no meaningful associations, supporting specificity of the main findings.

Table 1. Firearm Injury Risk Following an ED Visit Among Males by Age and Region

Sex	Age Group	Region	N	Hazard Ratio	Lower CI	Upper CI
Male	0 to 9	MW - East North Central	40778	1.33	0.59	3.01
Male	0 to 9	MW - West North Central	7942	4.63	0.48	44.62
Male	0 to 9	NE - Mid Atlantic	18046	5.60	0.65	47.91
Male	0 to 9	NE - New England	10808	4.23	0.45	39.97
Male	0 to 9	S - East South Central	13780	1.90	0.70	5.15
Male	0 to 9	S - South Atlantic	60128	1.51	0.88	2.60
Male	0 to 9	S - West South Central	30638	2.07	0.77	5.54
Male	0 to 9	W - Mountain	8736	2.29	0.21	25.23
Male	0 to 9	W - Pacific	7804	2.28E+08	0.00	Inf
Male	10 to 15	MW - East North Central	24416	1.94	1.41	2.67
Male	10 to 15	MW - West North Central	6528	1.67	0.63	4.42
Male	10 to 15	NE - Mid Atlantic	12176	2.06	1.17	3.63
Male	10 to 15	NE - New England	6448	4.21	1.22	14.56
Male	10 to 15	S - East South Central	7806	2.29	1.28	4.10
Male	10 to 15	S - South Atlantic	31176	1.21	0.93	1.57
Male	10 to 15	S - West South Central	15974	1.63	1.03	2.58
Male	10 to 15	W - Mountain	5978	0.75	0.29	1.95
Male	10 to 15	W - Pacific	5574	1.29	0.39	4.33
Male	16 to 25	MW - East North Central	95950	1.09	0.96	1.23
Male	16 to 25	MW - West North Central	22284	1.46	1.04	2.05
Male	16 to 25	NE - Mid Atlantic	47316	1.15	0.94	1.42
Male	16 to 25	NE - New England	23852	1.42	1.00	2.02
Male	16 to 25	S - East South Central	18342	1.58	1.19	2.08
Male	16 to 25	S - South Atlantic	82818	1.28	1.12	1.46
Male	16 to 25	S - West South Central	33970	1.24	1.02	1.50
Male	16 to 25	W - Mountain	17286	1.07	0.73	1.56
Male	16 to 25	W - Pacific	19404	1.81	1.23	2.65
Male	26 to 35	MW - East North Central	88180	1.09	0.95	1.25
Male	26 to 35	MW - West North Central	17998	0.92	0.62	1.37
Male	26 to 35	NE - Mid Atlantic	45858	1.16	0.94	1.43
Male	26 to 35	NE - New England	23486	1.02	0.71	1.46
Male	26 to 35	S - East South Central	16794	1.06	0.76	1.47

Male	26 to 35	S - South Atlantic	80360	1.00	0.87	1.16
Male	26 to 35	S - West South Central	30600	0.96	0.75	1.24
Male	26 to 35	W - Mountain	17336	0.82	0.52	1.29
Male	26 to 35	W - Pacific	20222	1.07	0.75	1.50
Male	36 to 54	MW - East North Central	147612	1.08	0.93	1.24
Male	36 to 54	MW - West North Central	28544	1.24	0.86	1.80
Male	36 to 54	NE - Mid Atlantic	77266	1.08	0.86	1.35
Male	36 to 54	NE - New England	40802	1.38	0.94	2.01
Male	36 to 54	S - East South Central	33980	1.43	1.06	1.93
Male	36 to 54	S - South Atlantic	160400	0.94	0.82	1.08
Male	36 to 54	S - West South Central	60594	1.29	1.03	1.60
Male	36 to 54	W - Mountain	27346	1.11	0.71	1.76
Male	36 to 54	W - Pacific	33390	1.12	0.79	1.59
Male	55+	MW - East North Central	146020	0.99	0.77	1.28
Male	55+	MW - West North Central	30940	0.92	0.49	1.74
Male	55+	NE - Mid Atlantic	85652	1.35	0.89	2.05
Male	55+	NE - New England	44342	2.00	0.87	4.60
Male	55+	S - East South Central	39588	1.70	1.06	2.73
Male	55+	S - South Atlantic	186088	0.98	0.78	1.22
Male	55+	S - West South Central	64390	0.90	0.62	1.30
Male	55+	W - Mountain	27324	0.74	0.37	1.47
Male	55+	W - Pacific	33630	1.27	0.62	2.58
Female	0 to 9	MW - East North Central	38846	0.87	0.35	2.20
Female	0 to 9	MW - West North Central	7096	NA	NA	NA
Female	0 to 9	NE - Mid Atlantic	17468	0.81	0.18	3.65
Female	0 to 9	NE - New England	10406	9.30E+08	0.00	Inf
Female	0 to 9	S - East South Central	13038	0.59	0.12	3.05
Female	0 to 9	S - South Atlantic	57106	1.78	0.67	4.74
Female	0 to 9	S - West South Central	29316	2.09	0.51	8.62
Female	0 to 9	W - Mountain	8300	0.00	0.00	Inf
Female	0 to 9	W - Pacific	7636	NA	NA	NA
Female	10 to 15	MW - East North Central	24382	1.13	0.63	2.04
Female	10 to 15	MW - West North Central	5732	2.50	0.45	13.90
Female	10 to 15	NE - Mid Atlantic	10866	0.66	0.24	1.86
Female	10 to 15	NE - New England	5754	0.93	0.19	4.62
Female	10 to 15	S - East South Central	7690	0.57	0.19	1.74
Female	10 to 15	S - South Atlantic	31080	1.86	0.97	3.57
Female	10 to 15	S - West South Central	15938	2.02	0.76	5.36
Female	10 to 15	W - Mountain	5492	1.17E+09	0.00	Inf
Female	10 to 15	W - Pacific	4540	NA	NA	NA
Female	16 to 25	MW - East North Central	143696	1.07	0.86	1.33

Female	16 to 25	MW - West North Central	31918	2.11	1.21	3.67
Female	16 to 25	NE - Mid Atlantic	68136	0.99	0.66	1.49
Female	16 to 25	NE - New England	32246	1.15	0.56	2.37
Female	16 to 25	S - East South Central	31710	1.03	0.65	1.64
Female	16 to 25	S - South Atlantic	128184	1.20	0.94	1.52
Female	16 to 25	S - West South Central	59478	0.87	0.62	1.23
Female	16 to 25	W - Mountain	27498	0.93	0.42	2.08
Female	16 to 25	W - Pacific	27786	0.89	0.42	1.88
Female	26 to 35	MW - East North Central	132970	1.03	0.80	1.32
Female	26 to 35	MW - West North Central	25942	1.93	0.94	3.95
Female	26 to 35	NE - Mid Atlantic	70070	0.70	0.45	1.08
Female	26 to 35	NE - New England	32018	1.45	0.63	3.30
Female	26 to 35	S - East South Central	30524	1.06	0.62	1.80
Female	26 to 35	S - South Atlantic	139352	1.12	0.85	1.48
Female	26 to 35	S - West South Central	59586	1.02	0.68	1.53
Female	26 to 35	W - Mountain	25744	0.95	0.37	2.46
Female	26 to 35	W - Pacific	29246	1.49	0.75	2.96
Female	36 to 54	MW - East North Central	183816	1.35	1.01	1.79
Female	36 to 54	MW - West North Central	33306	1.82	0.72	4.62
Female	36 to 54	NE - Mid Atlantic	99282	0.77	0.50	1.20
Female	36 to 54	NE - New England	48938	0.69	0.31	1.55
Female	36 to 54	S - East South Central	49668	1.11	0.61	2.03
Female	36 to 54	S - South Atlantic	234444	0.85	0.66	1.11
Female	36 to 54	S - West South Central	93656	0.75	0.51	1.11
Female	36 to 54	W - Mountain	34494	0.97	0.40	2.38
Female	36 to 54	W - Pacific	40578	0.84	0.35	2.02
Female	55+	MW - East North Central	160462	0.85	0.52	1.39
Female	55+	MW - West North Central	31084	0.47	0.11	2.02
Female	55+	NE - Mid Atlantic	96570	0.36	0.14	0.93
Female	55+	NE - New England	46564	0.58	0.14	2.36
Female	55+	S - East South Central	47044	1.81	0.67	4.86
Female	55+	S - South Atlantic	224474	0.90	0.57	1.41
Female	55+	S - West South Central	80668	0.78	0.38	1.62
Female	55+	W - Mountain	28798	0.83	0.17	4.14
Female	55+	W - Pacific	34174	0.90	0.12	6.44