

Trends in Firearm Injuries Treated in Emergency Departments by Individual- and County-Level Characteristics, 2019 to 2023



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Study objective: To understand trends in nonfatal firearm injuries by examining rates of firearm injury emergency department (ED) visits stratified by individual- and county-level characteristics.

Methods: Data from participating EDs within 10 jurisdictions in the United States funded through the Centers for Disease Control and Prevention's Firearm Injury Surveillance Through Emergency Rooms program, including the District of Columbia, Florida, Georgia, New Mexico, North Carolina, Oregon, Utah, Virginia, Washington, and West Virginia, were analyzed. We examined trends in firearm injury ED visits by sex, age group, jurisdiction, county-level urbanicity, and county-level social vulnerability from January 2019 to August 2023. Mean weekly rates of firearm injury ED visits and visit ratios (or the proportion of firearm injury-related ED visits of all visits during the surveillance periods with the same period in 2019) were calculated.

Results: Compared with 2019, the proportion of ED visits for firearm injury was elevated each year during 2020 to 2023 overall, with the largest observed increase in 2020 (visit ratio=1.59). All 10 Firearm Injury Surveillance Through Emergency Rooms jurisdictions experienced an increase in the proportion of firearm injury ED visits in 2020 (visit ratios ranging from 1.26 in West Virginia and 2.31 in Washington, DC) when compared with 2019. By county-level social vulnerability, the mean weekly rate of firearm injury ED visits was highest in counties with the highest social vulnerability over the entire study period.

Conclusion: Results highlight the continued burden of firearm injuries in communities with higher social vulnerability. Timely ED data by community social vulnerability can inform public health interventions and resource allocation at local, state, and national levels. [Ann Emerg Med. 2025;85:295-301.]

Please see page 296 for the Editor's Capsule Summary of this article.

Keywords: Firearm injuries, Injury surveillance, Health disparities.

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INTRODUCTION

Background

Firearm-related injuries are an urgent and worsening public health problem. In 2022, there were more than 48,000 firearm-related injury deaths in the United States, or approximately 132 people dying from a firearm injury each day.¹ National data indicate that there are more than twice the number of victims of firearm injuries as there are deaths.^{1,2} Data from the Centers for Disease Control and Prevention's (CDC) National Syndromic Surveillance program have also indicated that compared with 2019, the weekly number of firearm injury emergency department

(ED) visits was 37%, 36%, and 20% higher during 2020, 2021, and 2022, respectively.³

Rates of firearm injuries are not equally distributed. For example, racial and ethnic minority communities are disproportionately affected by firearm violence due to inequities in the social and structural conditions that drive rates of violence. Racially and economically marginalized communities also saw the largest increases in firearm violence during the COVID-19 pandemic.⁴

Importance

More timely and comprehensive data to address these inequities are crucial, where surveillance systems traditionally used to monitor firearm injury ED visits are

Editor's Capsule Summary*What is already known on this topic*

There are racial, ethnic, and socioeconomic disparities for US firearm injuries and deaths.

What question this study addressed

What are more recent patterns in firearm injury emergency department (ED) visits reported in the 10 US jurisdictions in the Centers for Disease Control and Prevention's Firearm Injury Surveillance Through Emergency Rooms program?

What this study adds to our knowledge

All jurisdictions reported increased proportions of firearm injury ED visits in 2020 to 2023 compared with 2019, with highest rates in counties with the highest Social Vulnerability Index.

How this is relevant to clinical practice

Firearm injuries getting hospital care are increasing, are disparate among groups, and can be observed through ED surveillance.

typically lagged approximately 2 years. Without these data, public health practitioners may not be able to quickly identify trends in firearm injuries to inform tailored and locally driven prevention strategies.⁵ In recent years, CDC has undertaken several initiatives to address major gaps in the national firearm injury data infrastructure. This includes the launch of the Firearm Injury Surveillance Through Emergency Rooms (FASTER) program in 2020, which aims to collect near real-time data on firearm injuries at the state and local levels than were previously available through traditional data sources.⁶

Goals of This Investigation

CDC is committed to advancing equity across health outcomes and reporting timely data on the distribution of firearm injuries across communities to inform prevention activities and facilitate evaluation of their effect over time. This study examined recent trends in firearm injury ED visits by individual- and county-level characteristics, including social vulnerability, in the first 10 US jurisdictions funded through CDC's FASTER program.⁶

MATERIALS AND METHODS**Study Design and Setting**

CDC analyzed ED visit data from January 1, 2019 to August 30, 2023, for 650 counties in 10 FASTER-funded jurisdictions (District of Columbia, Florida, Georgia, New

Mexico, North Carolina, Oregon, Utah, Virginia, Washington, and West Virginia).⁶ Aggregated data were shared through CDC's National Syndromic Surveillance Program platform.⁷ The 10 sites included in this analysis reported data on a minimum of 75% of ED visits occurring within their jurisdictions, including a minimum of 90% of visits from levels 1 to 3 trauma centers. To reduce artifactual effect from changes in reporting patterns, analyses were restricted to facilities with a coefficient of variation 40% and less for total visit volume and 75% and more complete information on discharge diagnoses throughout 2019 to 2023, representing 707 facilities (approximately 72% of total facilities). CDC determined this project to be public health surveillance rather than research that involved human subjects. Thus, institutional review board approval and informed consent were not required.

Measurement

Initial firearm injury ED visits (including those classified as unintentional, intentional self-harm, assault, legal intervention, terrorism, and undetermined intent) were identified using a categorization including administrative diagnosis codes and free-text reason-for-visit, developed and validated by CDC in partnership with state, tribal, local, and territorial health departments (Table E1, available at <http://www.annemergmed.com>).

Analysis

Annual rates of firearm injury ED visits (calculated as the number of ED visits for firearm injuries per 100,000 ED visits) were assessed for calendar years 2020, 2021, 2022, and January to August 2023 and compared with visits from the same period in 2019. Mean weekly rates of firearm injury ED visits and visit ratios (calculated as [ED visits for firearm injury during the surveillance period/all ED visits during the surveillance period]/[ED visits for firearm injury during the comparison period/all ED visits during the comparison period]) with 95% confidence intervals were examined overall, and by sex, age group, jurisdiction, and county-level urbanicity. Urbanicity was categorized according to the 6 strata specified by the National Center for Health Statistics' Urban-Rural Classification Scheme for Counties and based on the location of the patient residence.⁸ Trends in monthly and weekly rates of firearm injury ED visits were also examined using CDC/Agency for Toxic Substances and Disease Registry's county-level Social Vulnerability Index data for 2020 based on the location of the patient residence. The index was constructed using 16 county-level demographic and socioeconomic variables from the American Community

Table. Mean weekly rate* and visit ratios† of firearm injury ED visits, overall and by sex, age group, jurisdiction, and urbanicity—CDC’s FASTER program‡,§, January 2019 to August 2023.

Characteristic	2019 (Reference)	2020		2021		2022		2023	
	Mean Weekly Rate of Firearm Injury ED Visits	Mean Weekly Rate of Firearm Injury ED Visits	Visit Ratio (95% CI)	Mean Weekly Rate of Firearm Injury ED Visits	Visit Ratio (95% CI)	Mean Weekly Rate of Firearm Injury ED Visits	Visit Ratio (95% CI)	Mean Weekly Rate of Firearm Injury ED Visits	Visit Ratio (95% CI)
Overall	60	99	1.59 (1.56-1.62)	86	1.43 (1.40-1.46)	78	1.30 (1.27-1.32)	79	1.35 (1.32-1.38)
Sex									
Female	15	26	1.60 (1.52-1.69)	23	1.52 (1.44-1.60)	21	1.34 (1.27-1.42)	22	1.44 (1.35-1.54)
Male	114	182	1.55 (1.52-1.59)	158	1.38 (1.35-1.41)	142	1.24 (1.21-1.27)	145	1.29 (1.26-1.33)
Age group (y)									
0-14	12	33	2.31 (2.05-2.59)	24	1.92 (1.71-2.16)	20	1.57 (1.40-1.76)	22	1.70 (1.48-1.95)
15-24	167	286	1.65 (1.59-1.70)	241	1.44 (1.39-1.49)	217	1.29 (1.25-1.34)	226	1.37 (1.31-1.43)
25-34	110	174	1.55 (1.49-1.61)	157	1.42 (1.36-1.48)	146	1.32 (1.27-1.37)	146	1.36 (1.29-1.43)
35-64	44	66	1.48 (1.42-1.54)	62	1.41 (1.35-1.47)	58	1.31 (1.26-1.37)	61	1.41 (1.35-1.49)
≥65	19	24	1.20 (1.11-1.31)	20	1.03 (0.95-1.12)	17	0.88 (0.81-0.96)	17	0.92 (0.83-1.03)
Jurisdiction									
DC	113	276	2.31 (2.04-2.61)	244	2.20 (1.95-2.49)	233	2.07 (1.84-2.34)	286	2.88 (2.48-3.34)
Florida	55	91	1.59 (1.54-1.65)	75	1.36 (1.32-1.41)	66	1.20 (1.16-1.24)	66	1.21 (1.16-1.26)
Georgia	51	92	1.72 (1.59-1.87)	89	1.72 (1.59-1.86)	85	1.64 (1.52-1.77)	93	1.87 (1.71-2.06)
New Mexico	121	165	1.33 (1.22-1.45)	167	1.36 (1.26-1.48)	153	1.26 (1.16-1.37)	155	1.26 (1.14-1.39)
North Carolina	88	142	1.57 (1.50-1.63)	117	1.32 (1.27-1.37)	109	1.24 (1.19-1.29)	114	1.33 (1.27-1.40)
Oregon	32	61	1.86 (1.66-2.09)	62	1.94 (1.73-2.17)	51	1.57 (1.40-1.76)	51	1.70 (1.47-1.96)
Utah	56	90	1.59 (1.36-1.85)	70	1.24 (1.06-1.45)	51	0.91 (0.77-1.07)	47	0.90 (0.73-1.11)
Virginia	45	73	1.55 (1.45-1.66)	68	1.47 (1.38-1.58)	61	1.32 (1.24-1.42)	57	1.24 (1.14-1.35)
Washington	45	74	1.60 (1.48-1.73)	76	1.68 (1.56-1.81)	72	1.59 (1.48-1.72)	74	1.67 (1.53-1.84)
West Virginia	40	52	1.26 (1.07-1.48)	36	0.90 (0.76-1.08)	33	0.82 (0.68-0.98)	34	0.85 (0.68-1.06)
Urbanicity¹									
Large central metro	71	123	1.68 (1.61-1.75)	106	1.50 (1.44-1.56)	93	1.31 (1.26-1.37)	95	1.37 (1.30-1.44)
Large fringe metro	42	72	1.65 (1.57-1.73)	60	1.44 (1.37-1.51)	56	1.33 (1.27-1.40)	60	1.40 (1.33-1.49)
Medium metro	67	99	1.43 (1.37-1.49)	86	1.27 (1.22-1.33)	81	1.20 (1.15-1.25)	79	1.20 (1.14-1.26)
Small metro	53	78	1.42 (1.32-1.54)	63	1.18 (1.09-1.27)	65	1.22 (1.13-1.31)	64	1.26 (1.14-1.39)

Table. Continued.

Characteristic	2019 (Reference)			2020			2021			2022			2023			
	Mean Weekly Rate of Firearm Injury ED Visits		Visit Ratio (95% CI)	Mean Weekly Rate of Firearm Injury ED Visits		Visit Ratio (95% CI)	Mean Weekly Rate of Firearm Injury ED Visits		Visit Ratio (95% CI)	Mean Weekly Rate of Firearm Injury ED Visits		Visit Ratio (95% CI)	Mean Weekly Rate of Firearm Injury ED Visits		Visit Ratio (95% CI)	
	Micropolitan	71	114	1.56 (1.47-1.67)	87	97	1.35 (1.27-1.45)	72	72	1.25 (1.13-1.37)	87	1.22 (1.14-1.30)	65	65	1.11 (1.01-1.23)	99
Noncore	57	87	1.47 (1.34-1.62)	87	72	1.25 (1.13-1.37)	72	72	1.25 (1.13-1.37)	64	1.11 (1.01-1.23)	65	65	1.11 (1.01-1.23)	65	1.17 (1.04-1.32)

CDC, Centers for Disease Control and Prevention; CI, confidence interval; DC, District of Columbia; ED, emergency department; FASTER, Firearm Injury Surveillance Through Emergency Rooms.

*Rate of firearm injury ED visits calculated as number of ED visits for firearm injuries per 100,000 ED visits.

[†]Visit ratios = (ED visits for firearm injury [surveillance period]) / all ED visits [surveillance period]) / (ED visits for firearm injury [comparison period]) / all ED visits [comparison period]). For 2020-2022, the surveillance period is calendar weeks 1-52 of each year and the comparison period is calendar weeks 1-52 of 2019 (December 30, 2018 to December 28, 2019). For 2023, the surveillance period is calendar weeks 1-35 of 2023 and the comparison period is calendar weeks 1-35 of 2019. Ratios >1 indicate a higher proportion of ED visits for firearm injury during the surveillance period than the comparison period; ratios <1 indicate a lower proportion during the surveillance period than during the comparison period; 95% CIs that do not include 1 were considered statistically significant.

[‡]CDC's FASTER program represents the Division of Violence Prevention's efforts to collect, analyze, and disseminate data on violence-related ED visits faster than ever before. Timely state- and local-level data on ED visits for firearm and violence-related injuries can support state and local jurisdictions in identifying and responding to emerging public health problems. More information on the FASTER program can be found at <https://www.cdc.gov/firearm-violence/php/funded-surveillance/index.html>.

[§]Conditions of CDC's FASTER program data sharing agreement do not permit the reporting of raw counts.

^{||}Urbanicity categorized according to the 6 strata specified by the National Center for Health Statistics Urban-Rural Classification Scheme for Counties (large fringe metro, large central metro, medium metro, small metro, micropolitan, and noncore) and based on the location of the patient residence. More information on this classification scheme can be found at <https://www.cdc.gov/nchs/data-analysis-tools/urban-rural.html>.

Survey to provide an overall Social Vulnerability Index score, and 4 additional scores representing themes of the overall Social Vulnerability Index, including socioeconomic status, household characteristics, racial and ethnic minority status, and housing type and transportation. Counties were categorized into groups of social vulnerability, where quartile 1 represented the lowest level of county-level of social vulnerability and quartile 4 represented the highest level of social vulnerability.⁹

RESULTS

Compared with 2019, the proportion of ED visits for firearm injury was elevated each year during 2020 to 2023 overall (Table), with the largest observed increase in 2020 (visit ratio=1.59). The increases occurred among both females and males. Youth aged 0 to 14 years experienced the largest increase in visit ratio when compared to all age groups (visit ratio=2.31 in 2020), and this differential increase persisted throughout the study period. By jurisdiction, the mean weekly rate of firearm injury ED visits was consistently highest in District of Columbia, New Mexico, and North Carolina across the entire study period. All jurisdictions experienced an increase in the proportion of firearm injury ED visits in 2020 when compared with 2019. Across all urbanicity categorizations, annual rates in firearm injury ED visits increased during the study period compared with 2019 rates.

Regardless of county-level social vulnerability, the proportion of firearm injury ED visits increased from 2019 to 2020 (Figure 1; Table E2, available at <http://www.annemergmed.com>). By 2023, mean weekly rates of firearm injury ED visits remained above rates observed in 2019 within counties with the highest, high, and low overall social vulnerability whereas rates within counties with the lowest overall social vulnerability declined below rates experienced in 2019 (Table E2). By overall Social Vulnerability Index ranking, the mean weekly rate of firearm injury ED visits was highest in counties with the highest social vulnerability and lowest in counties with the lowest social vulnerability over the entire study period. Aggregated across all study years, the mean weekly rate of firearm injury ED visits was also consistently highest in counties with the highest vulnerability for each theme, with differential risk by theme (Figure 2; Table E2).

LIMITATIONS

This study had several limitations. First, generalizability of our findings is limited given this analysis included data from 10 US jurisdictions. Second, variations in electronic health record data quality and coding practices may over-or

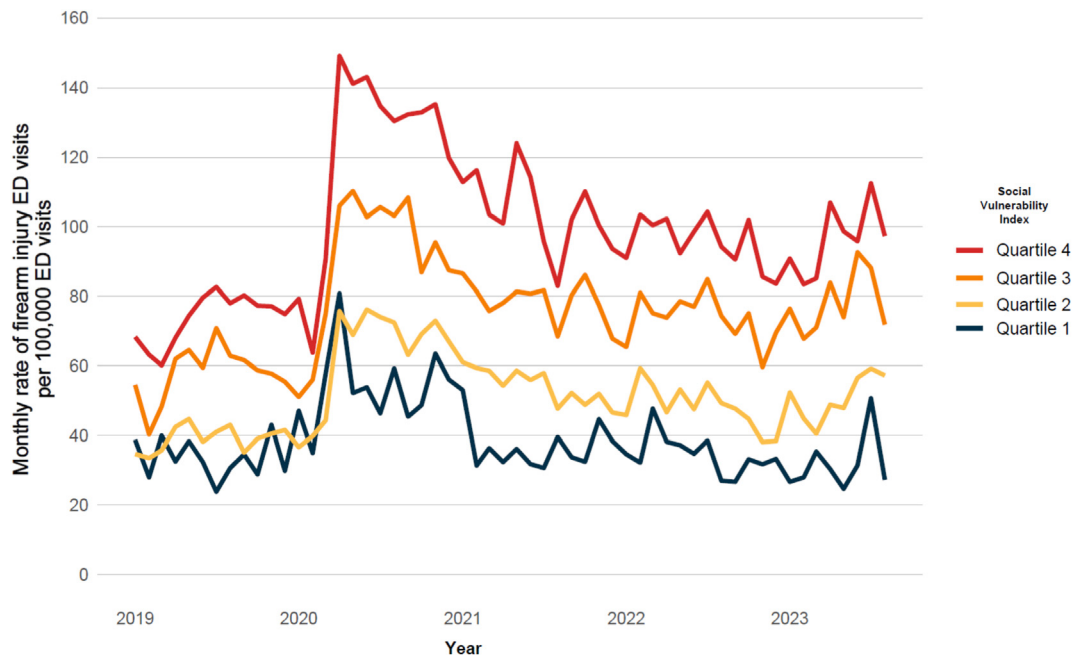


Figure 1. Monthly rate^a of firearm injury ED visits, by county-level Social Vulnerability Index^b quartile – CDC’s FASTER program^{c,d}, January 2019 to August 2023. ATSDR, Agency for Toxic Substances and Disease Registry; CDC, Centers for Disease Control and Prevention; ED, emergency department; FASTER, Firearm Injury Surveillance Through Emergency Rooms. ^a Rate of firearm injury ED visits calculated as number of ED visits for firearm injuries per 100,000 ED visits. ^b County-level social vulnerability data were obtained from the 2020 CDC/ATSDR Social Vulnerability Index and based on the location of the patient residence. Counties were categorized into groups of social vulnerability for the overall Social Vulnerability Index. Quartile 4 represents the highest level of social vulnerability. Quartile 1 represents the lowest level of county-level social vulnerability. More information on the index can be found at <https://www.atsdr.cdc.gov/placeandhealth/svi/index.html>. ^c CDC’s FASTER program represents the Division of Violence Prevention’s efforts to collect, analyze, and disseminate data on violence-related ED visits faster than ever before. Timely state- and local-level data on ED visits for firearm and violence-related injuries can support state and local jurisdictions in identifying and responding to emerging public health problems. More information on the FASTER program can be found at <https://www.cdc.gov/firearm-violence/php/funded-surveillance/index.html>. ^d Conditions of CDC’s FASTER program data sharing agreement do not permit the reporting of raw counts.

underestimate firearm injury ED visits reported, despite the use of data quality measures. Third, we examined firearm injury visits overall and not by intent. Fourth, the cross-sectional nature of the analysis limits causal inferences around changes observed or contributing factors. Lastly, firearm injuries may have comprised a greater proportion of ED visits due to changes in the quantity and type of ED visits during the study period, particularly during the COVID-19 pandemic.

DISCUSSION

The proportion of ED visits for firearm injury increased during 2020 to 2023 when compared with 2019, and counties with higher social vulnerability, overall and across all themes, experienced higher rates of firearm injury ED visits than counties with lower social vulnerability throughout the COVID-19 pandemic. These results build on previous studies that have described higher proportions of

firearm injury ED visits, increased firearm violence in urban areas, increased assault-related firearm deaths among youth, and increased fatal police shootings within communities with higher social vulnerability.¹⁰⁻¹³ Our findings underscore the importance of implementing comprehensive prevention strategies that focus on the needs of the people and places experiencing the greatest risk of firearm injuries and improve underlying conditions that contribute to increased risk. This includes opportunities to address income inequality, diminished economic opportunity, food insecurity, unstable or poor housing conditions, social inclusion, and affordable and quality health services.^{5,14,15}

There have been multiple calls for more timely and granular data on firearm injuries, which could support an improved understanding of the extent and severity of firearm injuries and inform evaluations of prevention strategies and interventions.^{5,16,17} This study used data from CDC’s FASTER program where states engaged in a range of activities to develop public dashboards featuring more timely

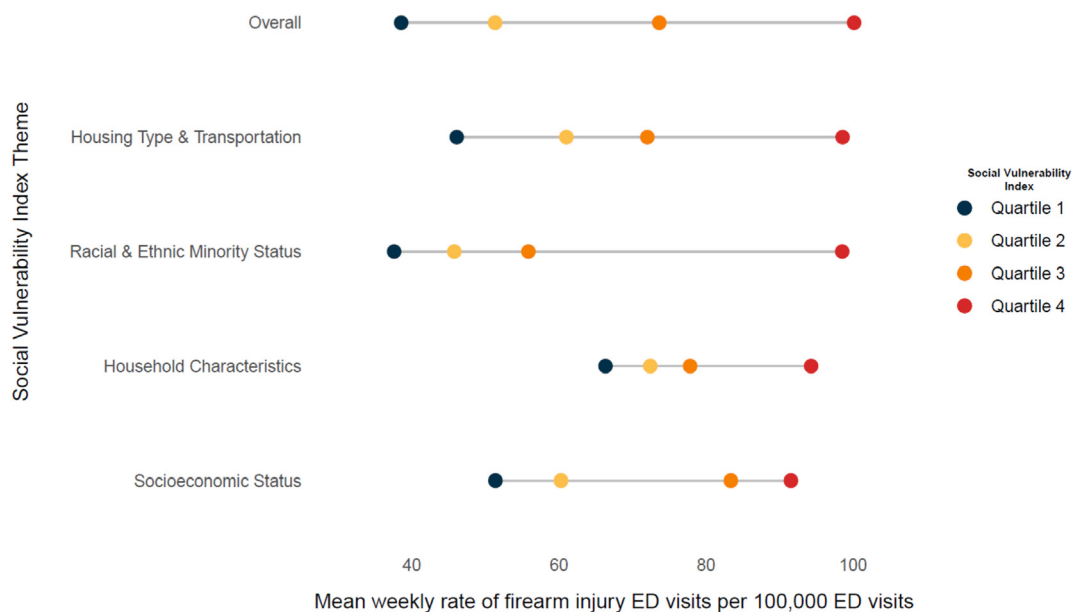


Figure 2. Mean weekly rate^a of firearm injury ED visits, by county-level Social Vulnerability Index^b quartile – CDC’s FASTER program^{c,d}, January 2019 to August 2023. ATSDR, Agency for Toxic Substances and Disease Registry; CDC, Centers for Disease Control and Prevention; ED, emergency department; FASTER, Firearm Injury Surveillance Through Emergency Rooms. ^aRate of firearm injury ED visits calculated as number of ED visits for firearm injuries per 100,000 ED visits. ^bCounty-level social vulnerability data were obtained from the 2020 CDC/ATSDR Social Vulnerability Index and based on the location of the patient residence. Counties were categorized into groups of social vulnerability for the overall Social Vulnerability Index and its 4 themes. Quartile 4 represents the highest level of social vulnerability. Quartile 1 represents the lowest level of county-level social vulnerability. More information on the index can be found at <https://www.atsdr.cdc.gov/placeandhealth/svi/index.html>. ^cCDC’s FASTER program represents the Division of Violence Prevention’s efforts to collect, analyze, and disseminate data on violence-related ED visits faster than ever before. Timely state- and local-level data on ED visits for firearm and violence-related injuries can support state and local jurisdictions in identifying and responding to emerging public health problems. More information on the FASTER program can be found at: <https://www.cdc.gov/firearm-violence/php/funded-surveillance/index.html>. ^d Conditions of CDC’s FASTER program data sharing agreement do not permit the reporting of raw counts.

data on firearm injury ED visits than were previously made available at local and state levels. States have also leveraged their data to inform community-level prevention and response initiatives.⁶ For example, in 2022, the Oregon Legislative Assembly used FASTER data to inform Oregon House Bill 4045, which supports hospital-based violence prevention programs that prevent trauma and retaliatory violence following incidents of community violence.¹⁸ In 2023, CDC launched the FASTER: Advancing Violence Epidemiology in Real Time initiative to provide funding to 12 jurisdictions to improve the timeliness of ED visit data on firearm injuries, as well as other violence-related injuries and mental health conditions, which can increase the risk for or be an outcome of violence-related injuries.⁶

This study underlines the continued burden of firearm injuries and highlights the excess effect on communities with higher social vulnerability. Future work is needed to refine intent-specific definitions and assess trends of firearm injuries by more detailed patient sociodemographic characteristics, including race and ethnicity, and geographic levels. Timely ED data, paired with county-level Social

Vulnerability Index information, can help state and local governments, community partners, and health care and other service providers focus their prevention and response efforts to address the social and structural conditions that contribute to high rates of firearm injuries and inequities.

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Author contributions: MZ conceptualized the study, developed the firearm injury definition, and conducted the analyses. KH

conceptualized the study, assisted with the interpretation of the results. SS, MS, and YC assisted with the analyses and interpretation of results. AW oversaw the programmatic management of the surveillance program. NF and TS assisted with the interpretation of the results. All authors contributed to drafting and revising the article. MZ takes responsibility for the paper as a whole.

Data sharing statement: Conditions of Centers for Disease Control and Prevention's Firearm Injury Surveillance Through Emergency Rooms program data sharing agreement do not permit the reporting of or sharing of raw data.

All authors attest to meeting the four [ICMJE.org](https://www.icmje.org) authorship criteria: (1) Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND (2) Drafting the work or revising it critically for important intellectual content; AND (3) Final approval of the version to be published; AND (4) Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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