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RESEARCH ARTICLE

Trends and Disparities in Firearm Injuries Among Emerging Adults: A 15-Year Analysis of Emergency Department Admissions in the U.S.

Morayo O. Akande, MPH,[1] Jason T. Carbone, PhD,[2] Michael G. Vaughn, PhD,[3] Dylan B. Jackson, PhD,[1,5] Cassandra K. Crifasi, PhD, MPH[4,5]

Introduction: Firearm injuries in the U.S. are rising, with emerging adults (aged 18–24 years) experiencing disproportionately high rates of fatal and nonfatal incidents. This study examines trends, intent-specific patterns, and disparities in fatal and nonfatal firearm injuries among this high-risk age group.

Methods: Data were from the Healthcare Cost and Utilization Project's Nationwide Emergency Department Sample (2006–2020), analyzing emergency department admissions for firearm injuries among participants aged 18–24 years. Firearm injuries were classified by intent (assault, unintentional, intentional self-injury, undetermined, other) using International Classification of Diseases, Ninth and Tenth Revisions, Clinical Modification diagnosis codes. Trend analyses, descriptive statistics, and logistic regression models were employed to identify patterns and associations by intent and key socioeconomic and geographic indicators. Analysis was conducted in April 2024.

Results: Firearm injuries increased annually during Quarter 3 and spiked during the COVID-19 pandemic, particularly for unintentional injuries and assaults. Males had significantly higher odds of firearm injury admissions across all intents than females. Intentional self-injury was more prevalent in rural areas, whereas assault and unintentional injuries were higher in urban areas and among those with Medicaid/Medicare insurance or uninsured. Firearm injury admissions were more likely among individuals from ZIP codes with lower median household incomes, except for intentional self-injury, which showed unique patterns across most indicators. The Northeast had substantially lower firearm-related emergency department admissions across all intents than other U.S. regions.

Conclusions: Findings underscore the need for comprehensive strategies to mitigate firearm injuries among emerging adults in the U.S. The significant increase in unintentional firearm injuries and assaults during COVID-19, coupled with the decline in nonfirearm injuries during this time, underscores the complex interplay of social isolation, increased firearm exposure, and broader societal disruptions. Disparities based on sex, insurance status, and geography further emphasize the necessity for public health interventions. Addressing these multifactorial influences and disparities

From the [1]Department of Population, Family and Reproductive Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland; [2]School of Social Work, Wayne State University, Detroit, Michigan; [3]School of Social Work, Saint Louis University, St. Louis, Missouri; [4]Department of Health Policy and Management, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland; and [5]Center for Gun Violence Solutions, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland

Address correspondence to: Morayo Akande, MPH, Department of Population, Family and Reproductive Health, Bloomberg School of Public Health, Johns Hopkins University, 615 North Wolfe Street, Baltimore MD 21205. E-mail: makande3@jhu.edu.

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is essential to developing effective, evidence-based policies. Future research should prioritize enhancing data collection on nonfatal firearm injuries and standardizing reporting systems to support these efforts.

INTRODUCTION

Firearm injuries and deaths in the U.S. are starkly high compared with those in other high-income and many low- and middle-income countries. Although firearm deaths are increasingly scrutinized, the impact of nonfatal firearm injury is frequently overlooked. For every individual fatally shot by a firearm, 2 more are injured,[1] emphasizing the need to consider nonfatal outcomes alongside fatalities. To effectively address the gun violence crisis, it is essential to understand the circumstances surrounding such incidents. Particularly, understanding the intent behind firearm injuries (e.g., assault, unintentional, intentional self-injury) can guide the development of preventative measures, resource allocation, and targeted interventions. Although prior studies have highlighted overall trends in firearm injuries, there is limited research integrating intent-specific patterns with demographic, socioeconomic, and geographic disparities in a single framework, particularly among emerging adults—a uniquely vulnerable population.

Firearm injuries and deaths are disproportionately high among persons aged 18−24 years,[1−4] a life stage marked by increased independence and emerging mental health conditions that may heighten the risk of firearm injuries.[5,6] Between 2001 and 2021, firearms were the leading cause of homicide and suicide in this age group, accounting for 85.6% of homicides and 48.9% of suicides.[7] Nonfatal firearm injury rates for those aged 20−24 years (the age group for which data are available and reported) are similarly alarming, at 73.53 per 100,000.[1,7] Despite these stark statistics, much research aggregates data across broader age ranges, potentially obscuring unique risks and injury patterns within this transitional life stage.[8]

Demographic disparities—including those related to sex, race, ethnicity, and geography—further underscore the urgency of understanding firearm injuries.[9−14] Rates of firearm homicide are substantially higher among Black non-Hispanic and Hispanic men than among White non-Hispanic men, and rates of suicide are higher among older White men than among non-White men and women.[12,14] However, the intersection of demographic factors with intent-specific injury patterns in emerging adults remains underexplored, particularly in relation to nonfatal injuries.[8,15]

Nonfatal firearm injuries represent a significant and often hidden burden, leading to long-term physical and psychological consequences for survivors[16−19] and imposing substantial healthcare costs.[20−22] Economically, firearm injuries can reduce workforce productivity and increase reliance on public assistance,[23,24] while also perpetuating a cycle of violence where firearms become normalized as tools for conflict resolution.[25,26] Yet, many studies focus exclusively on firearm deaths, limiting insights into nonfatal firearm injury trends and their implications.[12,14,15,27,28] Furthermore, existing research often evaluates firearm injuries at a population level, which may overlook critical nuances tied to life stage, intent, or regional disparities.[9−11,13]

This study advances prior research using nationally representative emergency department (ED) admissions data to examine firearm injuries and deaths among emerging adults aged 18−24 years in the U.S. This study approach is novel because of its integration of intent-specific patterns with geographic and socioeconomic disparities within this uniquely vulnerable age group. By focusing on nonfatal firearm injuries, alongside fatalities, and leveraging detailed ED data, the authors provide new insights into the characteristics and contexts of firearm injuries. These findings can inform targeted strategies to reduce firearm violence and its far-reaching effects on individuals and communities.

METHODS

Study Sample

This study utilizes data from the Healthcare Cost and Utilization Project's 2006 through 2020 Nationwide Emergency Department Sample (NEDS). NEDS is a 20% stratified sample of all hospital-owned EDs in the U.S. With the utilization of survey weights, it is possible to construct national estimates of all admissions to community, nonrehabilitation hospital EDs in the U.S.[29] Data analysis was conducted in April 2024. Observations without missing data on variables used in the analyses were included, which resulted in a sample of 452,415,507 observations weighted to represent

2,006,499,285 ED admissions (2.33% of the sample excluded as missing). Although the full sample was utilized for calculating SEs,[30] the analysis was subset to the focal population of those aged 18−24 years. This resulted in an analytic sample of 48,840,647 observations weighted to represent 216,716,633 ED admissions.

Measures

The main outcome, firearm injury, was operationalized using the International Classification of Diseases (ICD), Ninth Revision, Clinical Modification and ICD-10-CM diagnosis codes. Although the hospitals contributing data to NEDS may differ in coding practices, the ICD system provides standardized categories for classifying firearm injuries. The major intent categories—assault, unintentional, intentional self-injury, undetermined, and legal intervention—are derived from ICD codes. Despite some potential variability in hospital coding, these categories remain broadly comparable across ICD-9 and ICD-10 systems, ensuring consistency in identifying and analyzing firearm injury intent on a national and regional scale.[31,32] On the basis of all ICD codes on a given record, a variable was constructed that included the following categories on the basis of the type of injury: no firearm injury, assault, unintentional, intentional self-injury, undetermined, and other. An Appendix Table (available online) is provided with specific codes for each category. Dichotomous variables (yes/no) were also created for each of the 5 firearm injury categories and for the presence of any firearm-related code.

A time variable was constructed on the basis of 2 existing variables in the data set: year of admission and quarter of admission. Quarters are defined as Quarter 1 (January−March) Quarter 2 (April−June), Quarter 3 (July−September), and Quarter 4 (October−December).

The following covariates were included in the analyses: age (continuous), sex (female, male), insurance coverage type/status (private insurance, Medicaid/Medicare, uninsured, other), discharge status (routine discharge, admitted as inpatient, hospital transfer, other type of transfer, died in the ED, not admitted, status unknown), patient location/residence urbanicity based on the 2013 National Center for Health Statistics' urban−rural classification scheme for counties (central city, suburban area, medium/small city, rural area),[33] patient ZIP code median household income quartile (1=lowest to 4=highest), and hospital region (Northeast, Midwest, South, and West).

Statistical Analysis

Data analyses were completed in multiple steps, including trend analysis, descriptive statistics, and bivariate and multivariate logistic regression models. The authors conducted a descriptive trend analysis to examine quarterly counts of firearm-related and nonfirearm-related ED admissions from 2006 to 2020. This analysis used raw and weighted counts of ED visits to visualize changes over time, stratified by injury intent (e.g., assault, unintentional, intentional self-injury). No formal statistical modeling of trends (e.g., time series analysis, smoothing techniques, or spline regression) was performed. The purpose of this analysis was to provide an overview of patterns in ED admissions for firearm injuries, particularly during key periods such as the coronavirus disease 2019 (COVID-19) pandemic. Descriptive statistics were estimated for any firearm injury as well as each of the firearm injury intent categories and all nonfirearm injury admissions. Logistic regression models were used to examine the association between covariates and firearm injury outcomes, with any firearm-related injury and individual intent categories (i.e., assault, unintentional, intentional self-injury, other) analyzed as dichotomous outcomes. Each intent category was compared with all other ED admissions, including nonfirearm and other firearm injuries. Importantly, the injury categories in this study were not mutually exclusive because they were defined by ICD codes that allow for overlap (e.g., an injury may be coded as both assault and unintentional). Therefore, binary logistic regression was chosen to preserve the flexibility of intent-specific comparisons and to avoid the oversimplification that would be required for a multinomial model. Multivariate logistic regression models were then used to assess the relationship between all covariates on each firearm intent category. All analyses were completed in Stata/MP 16.1, and the svy command was employed to account for the structure of the survey data.

RESULTS

Figure 1 displays the descriptive trends in firearm-related and nonfirearm-related ED admissions from 2006 to 2020 by quarter. There was clear seasonality for most forms of firearm and nonfirearm injuries, with spikes occurring in Quarter 3 annually. Assaults and unintentional injuries were the main drivers for the overall trend line of any firearm-related injury. Assault injuries trended downward, reaching lowest counts between Quarter 1 of 2018 and Quarter 1 of 2020 before trending back up. Unintentional firearm injuries showed an inverse pattern, appearing generally stable through Quarter 1 of 2015 and then trending upward until it overtook assault injuries and reaching its highest counts in Quarter 4 of 2020. All other intent categories of firearm injuries (i.e., intentional self-injury, undetermined, and other) showed substantially lower counts and more

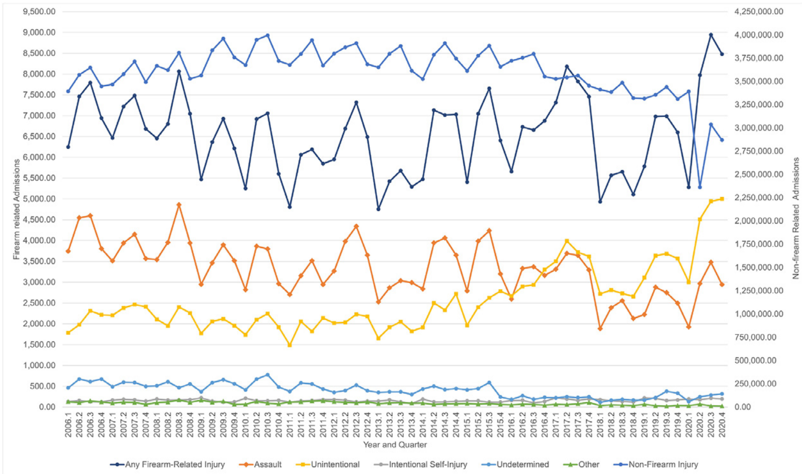

Figure 1. *Note:* The Any Firearm-Related Injury category is the total of all the firearm-related intent categories (i.e., assault, unintentional, intentional self-injury, undetermined, and other).

stable trends across the study period. Nonfirearm injuries appeared relatively stable, although it perhaps showed a slight upward trend between Quarter 1 of 2006 and Quarter 3 of 2016, before trending slightly downward from Quarter 4 of 2016 until Quarter 1 of 2020, followed by a distinct drop in Quarter 2 of 2020 and remaining lower than the prior trend through the study period.

Table 1 presents the descriptive statistics for ED admissions, stratified by firearm involvement and intent. Patients with firearm injuries were predominantly male (90.05% for any firearm-related injury; 88.00%−94.10% across intent categories), compared with 37.92% for nonfirearm injuries. Firearm-related admissions were more frequently from central city counties across most intent categories: assaults (50.27%), unintentional injuries (37.39%), undetermined intent (45.46%), and other firearm injuries (38.59%). However, intentional self-injury admissions were more common in rural counties (27.22%) than in central city counties (7.48%−16.32% for other categories).

Firearm injury admissions were more likely to involve uninsured patients (42.31% for any firearm-related injury; 33.11%−48.87% across intent categories) than nonfirearm injuries (25.63%). Routine ED discharges occurred in 90.04% of nonfirearm injuries but were less common among firearm injuries, ranging from 44.08% for assaults to 61.04% for unintentional injuries. Intentional self-injury was an exception, with only 12.49% discharged routinely; more than half of these patients (56.89%) were admitted as inpatients than just 5.23% of nonfirearm injury patients.

Most firearm injury admissions occurred among individuals from ZIP codes in the lowest income quartile (0th−25th percentile), with rates of 55.43% (assaults), 52.18% (unintentional injuries), and 57.50% (undetermined). Admissions for intentional self-injury (35.50%) and other firearm injuries (39.58%) were similar to those for nonfirearm injuries (36.44%).

Unadjusted and adjusted logistic regression results for firearm injury intent categories are displayed in Table 2. Among individuals admitted to the ED, males had significantly higher odds of firearm-related injuries across all intent categories than females. This sex difference was most pronounced for the other intent category (AOR=21.11, 95% CI=16.32, 27.30) and least pronounced for intentional self-injury (AOR=8.48, 95% CI=7.34, 9.80).

Living in suburban areas, medium/small cities, or rural areas was associated with lower odds of assault, unintentional, undetermined, and other intent firearm injuries but with higher odds of intentional self-injury than living in central cities. For example, individuals in rural communities had over twice the odds of intentional self-injury with a firearm compared with those in central cities (AOR=2.18, 95% CI=1.85, 2.58).

Firearm injuries categorized as assaults, unintentional, and undetermined were more likely among individuals with Medicaid/Medicare or no insurance than among those with private insurance. For instance, the odds of an assault-related firearm injury were higher among those on Medicaid/Medicare (AOR=1.69, 95% CI=1.56, 1.83) and those uninsured (AOR=2.69, 95% CI=2.47, 2.92) than among individuals with private insurance. However, intentional self-injury had lower odds among Medicaid/Medicare patients (AOR=0.80, 95% CI=0.71, 0.91).

Table 1. Descriptive Statistics for Weighted Sample, Stratified by Firearm-Related Injury and Intent

	Nonfirearm injuries (*n*=216,323,503)		Any firearm-related injury (*n*=393,129)		Firearm-related injury subcategories by intent									
					Assault (*n*=200,128)		Unintentional (*n*=154,021)		Intentional self-injury (*n*=9,451)		Undetermined (*n*=24,254)		Other (*n*=5,275)	
Variables	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Sex														
Female	62.08	61.88, 62.28	9.95	9.68, 10.22	9.55	9.20, 9.92	10.55	10.18, 10.93	12.00	10.61, 13.54	9.51	8.72, 10.36	5.90	4.62, 7.50
Male	37.92	37.72, 38.12	90.05	89.78, 90.32	90.44	90.08, 90.80	89.45	89.07, 89.39	88.00	86.46, 89.39	90.49	89.64, 91.28	94.10	92.50, 95.38
Urbanicity														
Central city	28.07	26.64, 29.55	44.09	40.67, 47.58	50.27	46.14, 54.39	37.39	34.28, 40.61	22.17	19.64, 24.93	45.46	38.47, 52.63	38.59	34.27, 43.10
Suburban area	20.77	19.62, 21.97	16.63	14.37, 19.15	16.90	14.11, 20.11	16.44	14.55, 18.51	17.68	15.24, 20.43	14.92	11.65, 18.90	17.88	14.31, 22.10
Medium/small city	32.51	31.12, 33.86	27.55	24.91, 30.36	25.36	22.31, 28.68	29.85	27.34, 32.49	32.93	29.96, 36.05	28.16	22.86, 34.15	31.01	26.03, 36.48
Rural	18.65	17.88, 19.44	11.73	10.59, 12.97	7.48	6.38, 8.74	16.32	14.96, 17.78	27.22	24.74, 29.83	11.46	10.02, 13.08	12.52	9.88, 15.75
Insurance status														
Private insurance	33.80	33.29, 34.31	20.09	19.34, 20.85	17.82	16.88, 18.80	22.64	21.85, 23.46	35.72	33.58, 37.92	16.32	14.91, 17.85	20.68	17.00, 24.92
Medicaid/Medicare	34.77	34.26, 35.28	30.40	29.03, 31.81	32.68	30.96, 34.45	28.37	27.12, 29.66	24.10	22.05, 26.27	28.63	26.53, 30.83	22.61	19.91, 25.57
Uninsured	25.63	25.17, 26.10	42.31	40.83, 43.09	41.61	39.63, 43.61	42.78	41.39, 44.17	33.11	30.87, 35.43	48.87	46.78, 50.97	41.74	38.07, 45.50
Other	5.80	5.57, 6.05	7.20	6.35, 8.15	7.89	6.71, 9.25	6.21	5.55, 6.94	7.06	6.71, 9.25	6.17	5.09, 7.47	14.96	14.489, 17.83
Discharge status														
Routine discharge	90.04	89.72, 90.35	50.82	49.74, 51.90	44.08	42.76, 45.41	61.04	59.82, 62.24	12.49	11.01, 14.14	56.20	53.43, 58.92	52.14	47.32, 56.92
Admitted as inpatient	5.23	5.10, 5.36	35.04	33.77, 36.33	43.93	42.45, 45.41	23.61	22.25, 25.02	56.89	54.14, 59.61	26.16	23.67, 28.81	33.23	29.15, 37.59
Hospital transfer	0.74	0.69, 0.78	6.61	6.02, 7.26	5.20	4.60, 5.87	8.23	7.54, 8.98	9.99	8.57, 11.60	7.35	5.88, 9.16	3.61	2.52, 5.15
Other transfer	0.91	0.85, 0.97	1.24	1.08, 1.43	0.97	0.78, 1.21	1.21	1.03, 1.41	5.64	4.56, 6.96	1.54	1.07, 2.21	3.43	2.27, 5.16
Died in ED	0.03	0.03, 0.03	4.04	3.79, 4.31	3.76	3.37, 4.20	3.42	3.17, 3.68	13.97	12.36, 15.74	6.42	5.55, 7.42	4.24	3.10, 5.76
Not admitted/unknown	3.06	2.80, 3.34	2.24	1.68, 2.99	2.06	1.44, 2.95	2.50	1.97, 3.18	1.02	0.60, 1.72	2.33	1.72, 3.15	3.35	1.88, 5.87
Median household income for patient's ZIP code														
0th–25th percentile	36.44	35.49, 37.39	53.59	51.49, 55.68	55.43	53.06, 57.78	52.18	50.19, 54.17	35.30	32.77, 37.92	57.50	53.53, 61.39	39.58	35.50, 43.82
26th–50th percentile	27.97	27.32, 28.62	24.33	23.07, 25.64	23.57	22.11, 25.09	25.06	23.88, 26.28	29.49	27.42, 31.65	22.94	20.40, 25.70	29.11	25.57, 32.92
51st–75th percentile	21.02	20.40, 21.65	15.03	14.09, 16.02	14.30	13.23, 15.44	15.60	14.61, 16.65	21.77	19.84, 23.83	13.67	12.08, 15.42	20.61	17.65, 23.92
76th–100th percentile	14.58	13.95, 15.24	7.05	6.48, 7.65	6.70	6.02, 7.46	7.15	6.60, 7.75	13.43	11.83, 15.21	5.89	5.11, 6.77	10.70	8.63, 13.18

(*continued on next page*)

Table 1. Descriptive Statistics for Weighted Sample, Stratified by Firearm-Related Injury and Intent (*continued*)

	Nonfirearm injuries		Any firearm-related injury		Firearm-related injury subcategories by intent									
					Assault		Unintentional		Intentional self-injury		Undetermined		Other	
	(*n*=216,323,503)		(*n*=393,129)		(*n*=200,128)		(*n*=154,021)		(*n*=9,451)		(*n*=24,254)		(*n*=5,275)	
Variables	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Region														
Northeast	18.79	17.65, 19.98	10.92	8.73, 13.57	12.33	9.61, 15.69	9.35	7.40, 11.75	6.45	5.16, 8.03	11.70	8.37, 16.11	7.82	6.11, 9.96
Midwest	23.87	22.65, 25.13	23.29	19.58, 27.13	24.10	19.39, 29.52	22.19	19.27, 25.41	26.46	23.00, 30.25	23.06	17.85, 29.24	20.36	16.42, 24.97
South	40.40	38.79, 42.03	47.01	42.76, 51.29	42.21	37.19, 47.40	48.35	39.48, 57.33	48.49	44.42, 52.57	48.35	39.48, 57.33	37.05	31.53, 4.29
West	16.95	16.13, 17.80	18.78	16.44, 21.37	21.37	18.13, 25.01	16.89	13.17, 21.39	18.60	16.14, 21.35	16.89	13.17, 21.39	34.77	29.85, 40.05
	Mean (SD)	95% CI	Mean (SD)	95% CI	Mean (SD)	95% CI	Mean (SD)	95% CI	Mean (SD)	95% CI	Mean (SD)	95% CI	Mean (SD)	95% CI
Age, year	21.09 (1.96)	21.09, 21.10	20.90 (1.93)	20.88, 20.92	20.84 (1.92)	20.82, 20.87	20.96 (1.94)	20.93, 20.98	21.14 (1.89)	21.05, 21.23	20.85 (1.94)	20.79, 20.91	21.26 (1.86)	21.14, 21.37

ED, emergency department.

Discharge status was highly associated with firearm injury intent. Firearm injuries had significantly higher odds of inpatient admission, hospital transfer, and death in the ED than nonfirearm injuries. The association was most pronounced for intentional self-injury, with a near 82-fold increased odds of inpatient admission (AOR=81.79, 95% CI=70.55, 94.82) and a nearly 1,705-fold increased odds of death in the ED (AOR=1,704.85; 95% CI=1,393.35; 2,085.98), compared with all other ED admissions. Assault-related injuries also had increased odds of inpatient admission (AOR=16.56, 95% CI=15.70, 17.48) compared with all other ED admissions. Among firearm injuries, unintentional injuries had the lowest association with death in the ED (AOR=81.79, 95% CI=74.91, 89.30).

Socioeconomic disparities were evident because individuals from ZIP codes in the lowest income quartile (0th−25th percentile) had higher odds of firearm-related ED admissions across all injury intents, except intentional self-injury, than those from wealthier areas. In addition, individuals residing in the Midwest, South, or West were more likely to present with firearm injuries than individuals residing in the Northeast.

DISCUSSION

The findings of this study underscore the urgent need for comprehensive strategies to address firearm injuries among emerging adults aged 18−24 years in the U.S. Notably, the trend analysis identified a significant spike in unintentional firearm injuries and firearm assaults at the beginning of the COVID-19 pandemic, which stayed high through Quarter 4 of 2020. This trend should be interpreted with caution owing to potential misclassification inherent to ICD coding, which may inflate estimates of unintentional injuries.[34] However, other studies have reported increases in firearm injuries during the COVID-19 pandemic, particularly in intentional injuries compared with unintentional injuries.[35,36] Increased time spent at home may have elevated exposure and/or access to firearms, potentially without adequate knowledge of proper handling, use, or storage, leading to firearm accidents and injuries.[23] However, the broader context of 2020—including social unrest, social isolation policies, and other societal disruptions—may also have exacerbated disparities in firearm injury rates.[35−44] The interaction between stay-at-home orders, increased exposure to domestic firearms, and broad social unrest is critical to understanding the observed patterns of firearm injury during this period.[44,45] The trend analysis also revealed clear seasonality in firearm injuries, with notable spikes during Quarter 3 annually. This seasonality has been identified in prior studies, with underlying

Table 2. Logistic Regression Results Comparing Firearm-Related Injuries, Overall and by Intent Categories, With All Other ED Admissions (N=216,716,633)

	Firearm-related injury versu s nonfirearm-related injury				Firearm-related injury subcategories by intent versus all other ED admissions[a]							
					Assault				Unintentional			
Variables	**OR**	**95% CI**	**AOR[b]**	**95% CI**	**OR**	**95% CI**	**AOR[b]**	**95% CI**	**OR**	**95% CI**	**AOR[b]**	**95% CI**
Sex												
Female	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
Male	**14.81**	14.37, 1.27	**13.77**	13.19, 14.37	**15.47**	14.84, 16.13	**14.22**	13.49, 15.00	**13.84**	13.30, 14.42	**13.05**	12.44, 13.70
Age, year	**0.95**	0.95, 0.96	**0.91**	0.91, 0.92	**0.94**	0.93, 0.94	**0.90**	0.89, 0.90	**0.96**	0.96, 0.97	**0.94**	0.93, 0.94
Urbanicity												
Central city	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
Suburban area	**0.51**	0.43, 0.60	**0.67**	0.57, 0.78	**0.45**	0.37, 0.56	**0.65**	0.54, 0.79	**0.59**	0.52, 0.69	**0.71**	0.61, 0.81
Medium/small city	**0.54**	0.47, 0.62	**0.54**	0.47, 0.62	**0.44**	0.37, 0.52	**0.47**	0.39, 0.55	**0.69**	0.60, 0.79	**0.65**	0.57, 0.74
Rural	0.40	0.35, 0.46	**0.33**	0.29, 0.38	**0.22**	0.19, 0.27	**0.20**	0.17, 0.24	0.66	0.58, 0.74	**0.50**	0.44, 0.57
Insurance status												
Private insurance	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
Medicaid/Medicare	**1.47**	1.39, 1.56	**1.50**	1.42, 1.59	**1.78**	1.65, 1.93	**1.69**	1.56, 1.83	**1.22**	1.15, 1.29	**1.34**	0.27, 1.42
Uninsured	**2.78**	2.64, 2.93	**2.33**	2.21, 2.46	**3.08**	2.85, 3.32	**2.69**	2.47, 2.92	**2.49**	2.36, 2.62	**1.91**	1.82, 2.01
Other	**2.09**	1.83, 2.38	**1.74**	1.55, 1.95	**2.58**	2.16, 3.07	**2.14**	1.83, 2.51	**1.60**	1.43, 1.78	**1.31**	1.18, 1.44
Discharge status												
Routine discharge	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
Admitted as inpatient	**11.87**	11.27, 12.51	**11.76**	11.23, 12.32	**17.09**	16.12, 18.12	**16.56**	15.70, 17.48	**6.60**	6.15, 7.09	**6.49**	6.05, 6.96
Hospital transfer	**15.94**	14.33, 17.73	**15.17**	13.75, 16.73	**14.32**	12.55, 16.33	**13.99**	12.29, 15.92	**16.39**	14.76, 18.19	**14.75**	13.43, 16.19
Other transfer	**2.41**	2.11, 2.77	**1.98**	1.71, 2.28	**2.17**	1.77, 2.67	**1.75**	1.41, 2.15	**1.95**	1.65, 2.29	**1.62**	1.37, 1.92
Died in ED	**263.92**	240.60, 289.51	**156.95**	144.88, 170.01	**247.88**	219.01, 280.56	**129.86**	115.08, 146.53	**157.41**	143.71, 172.42	**81.79**	74.91, 89.30
Not admitted/status unknown	**1.30**	1.01, 1.67	1.08	0.87, 1.34	1.38	0.99, 1.91	1.14	0.86, 1.49	1.21	0.99, 1.48	1.01	0.84, 1.22
Median household income for patient’s ZIP code												
0th–25th percentile	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	-
26th–50th percentile	**0.63**	0.58, 0.67	**0.60**	0.56, 0.64	**0.55**	0.51, 0.61	**0.56**	0.52, 0.61	**0.63**	0.58, 0.67	**0.65**	0.61, 0.69
51st–75th percentile	**0.52**	0.48, 0.56	**0.45**	0.41, 0.48	**0.45**	0.40, 0.50	**0.39**	0.35, 0.43	**0.52**	0.48, 0.56	**0.52**	0.48, 0.57
76th–100th percentile	**0.34**	0.31, 0.38	**0.28**	0.26, 0.32	**0.30**	0.27, 0.34	**0.24**	0.21, 0.27	**0.34**	0.31, 0.38	**0.35**	0.31, 0.39
Region												
Northeast	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
Midwest	**1.87**	1.43, 2.45	**1.70**	1.32, 2.20	**1.54**	1.09, 2.18	**1.62**	1.17, 2.56	**1.87**	1.43, 2.45	**1.79**	1.39, 2.31
South	**2.65**	2.06, 3.40	**1.94**	1.54, 2.46	**1.59**	1.20, 2.12	**1.59**	1.22, 2.07	**2.65**	2.06, 3.40	**2.47**	1.95, 3.14
West	**1.80**	1.40, 2.31	**1.76**	1.41, 2.20	**1.92**	1.44, 2.57	**1.77**	1.36, 2.29	**1.80**	1.40, 2.31	**1.65**	1.31, 2.08

(*continued on next page*)

Table 2. Logistic Regression Results Comparing Firearm-Related Injuries, Overall and by Intent Categories, With All Other ED Admissions (N=216,716,633) (*continued*)

	Firearm-related injury versu s nonfirearm-related injury				Firearm-related injury subcategories by intent versus all other ED admissions[a]							
					Assault				Unintentional			
Variables	**OR**	**95% CI**	**AOR[b]**	**95% CI**	**OR**	**95% CI**	**AOR[b]**	**95% CI**	**OR**	**95% CI**	**AOR[b]**	**95% CI**
	Firearm-related injury subcategories by intent versus all other ED admissions[a]											
	Intentional self-Injury				Undetermined				Other			
Sex												
Female	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
Male	**11.96**	10.42, 13.74	**8.48**	7.34, 9.80	**15.52**	14.11, 17.07	**13.81**	14.42, 15.36	**26.01**	20.10, 33.65	**21.11**	16.32, 27.30
Age	1.01	0.99, 1.04	0.99	0.96, 1.01	**0.94**	0.92, 0.95	**0.90**	0.88, 0.91	**1.04**	1.01, 1.08	1.01	0.98, 1.04
Urbanicity												
Central city	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
Suburban area	1.08	0.89, 1.32	1.08	0.90, 1.31	**0.44**	0.32, 0.62	**0.60**	0.42, 0.86	**0.63**	0.49, 0.80	0.89	0.70, 1.13
Medium/small city	**1.28**	1.09, 1.51	**1.48**	1.26, 1.73	**0.54**	0.38, 0.75	**0.53**	0.37, 0.77	**0.69**	0.55, 0.88	0.78	0.61, 1.01
Rural	**1.85**	1.56, 2.19	**2.18**	1.85, 2.58	**0.38**	0.30, 0.48	**0.30**	0.23, 0.40	**0.49**	0.37, 0.64	**0.55**	0.42, 0.74
Insurance status												
Private insurance	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
Medicaid/Medicare	**0.66**	0.58, 0.74	**0.80**	0.71, 0.91	**1.70**	1.49, 1.94	**1.71**	1.51, 1.93	1.06	0.82, 1.38	1.21	0.90, 1.62
Uninsured	**1.22**	1.09, 1.36	**1.29**	1.15, 1.45	**3.94**	3.53, 4.41	**3.01**	2.69, 3.38	**2.66**	2.07, 3.40	**2.40**	1.85, 3.12
Other	1.15	0.96, 1.38	0.99	0.83, 1.19	**2.20**	1.78, 2.72	**1.80**	1.47, 2.20	**4.21**	3.11, 5.69	**3.25**	2.37, 4.48
Discharge status												
Routine discharge	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
Admitted as inpatient	**77.57**	66.85, 90.02	**81.79**	70.55, 94.82	**7.93**	6.94, 9.06	**7.89**	6.85, 9.08	**10.85**	8.82, 13.36	**10.57**	8.59, 13.01
Hospital transfer	**96.49**	77.93, 119.48	**72.89**	59.12, 89.87	**15.80**	12.33, 20.25	**15.16**	11.96, 19.21	**8.36**	5.66, 12.36	**7.18**	4.87, 10.57
Other transfer	**44.51**	34.66, 57.16	**38.47**	30.08, 49.20	**2.70**	1.85, 3.94	**2.25**	1.52, 3.34	**6.49**	4.21, 10.02	**4.96**	3.21, 7.64
Died in ED	**2,974.77**	2,432.89, 3,637.34	**1,704.85**	1,393.35, 2,085.98	**305.16**	256.58, 362.95	**142.70**	117.82, 172.84	**213.04**	149.62, 303.34	**101.13**	71.19, 143.64
Not admitted/status unknown	**2.40**	1.42, 4.04	**2.37**	1.40, 4.00	1.22	0.91, 1.63	0.98	0.72, 1.33	**1.89**	1.08, 3.30	**1.78**	1.02, 3.08
Median household income for patient's ZIP code												
0th–25th percentile	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
26th–50th percentile	1.09	0.96, 1.23	1.11	0.98, 1.25	**0.52**	0.44, 0.62	**0.55**	0.48, 0.63	0.96	0.79, 1.17	0.90	0.73, 1.11
51st–75th percentile	1.07	0.93, 1.24	**1.15**	1.00, 1.32	**0.41**	0.35, 0.49	**0.41**	0.35, 0.47	0.90	0.73, 1.11	**0.75**	0.58, 0.95
76th–100th percentile	0.95	0.81, 1.12	1.08	0.92, 1.28	**0.26**	0.21, 0.31	**0.25**	0.21, 0.30	**0.67**	0.52, 0.88	**0.52**	0.39, 0.71

(*continued on next page*)

Table 2. Logistic Regression Results Comparing Firearm-Related Injuries, Overall and by Intent Categories, With All Other ED Admissions (N=216,716,633) (*continued*)

Variables	Firearm-related injury versus nonfirearm-related injury				Firearm-related injury subcategories by intent versus all other ED admissions[a]							
					Assault				Unintentional			
	OR	95% CI	AOR[b]	95% CI	OR	95% CI	AOR[b]	95% CI	OR	95% CI	AOR[b]	95% CI
Region												
Northeast	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—	1.00	—
Midwest	**2.23**	2.51, 4.15	**3.05**	2.42, 3.85	**1.55**	1.06, 2.27	**1.51**	1.03, 2.19	**2.05**	1.50, 2.80	**2.05**	1.51, 2.78
South	**3.49**	2.76, 4.43	**3.43**	2.77, 4.26	**1.92**	1.23, 3.00	**1.76**	1.07, 2.88	**2.20**	1.64, 2.95	**2.05**	1.53, 2.75
West	**3.19**	2.48, 4.10	**3.06**	2.43, 3.86	**1.60**	1.11, 2.30	**1.45**	1.04, 2.03	**4.93**	3.73, 6.51	**4.43**	3.34, 5.89

Note: Boldfaces indicate statistical significance ($p<0.05$).
[a]These columns represent the intent category of the firearm injury compared to all other ED admissions. This includes admissions that are not a firearm-related injury as well as all other firearm-related injuries.
[b]AORs have been adjusted for all the covariates listed in the table.
ED, emergency department.

mechanisms such as temperature and social patterns identified.[46,47]

The regression findings provide evidence of firearm injury disparities by income and geographic region. Individuals from ZIP codes with higher median household income quartiles had lower odds of presenting with firearm-related ED admissions across all injury types, except intentional self-injury. Firearm injuries in lower-income neighborhoods are likely influenced by structural disadvantages, such as poverty, lack of healthcare access, and social instability—factors that may increase both exposure to firearm violence and barriers to timely medical care.[28,48,49] COVID-19 may have exacerbated existing disparities in firearm injury rates,[12,14] especially in neighborhoods already facing structural disadvantage such as poverty, lack of healthcare access, and social instability.[36] Study findings highlight the complex interplay between socioeconomic factors and the risk of firearm injuries, suggesting that addressing disparities in income and neighborhood context is crucial for understanding and preventing firearm injury.

Males exhibited significantly higher odds of presenting with firearm injuries across all intent categories than females. This finding is consistent with prior literature[12,14,50] and reflects the gendered nature of firearm exposure, possession, and use.[51] For intentional self-injury, females are more likely to use less lethal means,[52] whereas firearm ownership, which is more prevalent among males, is strongly associated with increased suicide lethality.[53]

Intentional self-injury by firearm exhibited distinct patterns, consistent with prior findings highlighting its association with older age, rural settings, and demographic factors such as being White and male. These patterns may reflect underlying mental health issues, social isolation, and access to firearms, factors that are often implicated in firearm suicides.[54] Rural residents had more than twice the odds of presenting with firearm-related intentional self-injury than those in central cities. This may reflect limited access to mental health resources, higher levels of social isolation, or other environmental stressors in rural areas. Individuals presenting with intentional self-injury were significantly more likely to be admitted as inpatients, transferred to specialized facilities, or die in the ED than those with other firearm injury types. These outcomes underscore the lethality of firearm-related self-injury and the critical need for targeted mental health interventions in rural communities.

Intentional self-injury by firearm exhibited patterns distinct from those of other firearm injury categories. Rural residents had more than double the odds of presenting with firearm-related intentional self-injury than those in central cities, consistent with literature linking rural settings to higher firearm suicide rates among youth.[55,56] These differences may be attributed to limited access to mental health resources, greater levels of social isolation, and other environmental stressors in rural areas.[57,58] Individuals presenting with intentional self-injury were admitted as inpatients, were transferred to specialized units (e.g., mental health facilities), or died in the ED much more often than those presenting with other firearm injury types. This aligns with the high short-term risk for repeat self-injury and suicide observed in this population[59–62] as well as the lethality of firearms in self-directed violence.[54,63,64] These findings underscore the critical need for targeted mental health interventions, particularly in rural communities where such injuries are more prevalent.[65,66]

Geographic disparities were also evident across all firearm injury categories. Firearm-related ED admissions were significantly more likely in the Midwest, South, and West than in the Northeast. This could be due to the prevalence of firearm ownership, which tends to be lower in the Northeast than in other regions.[67] Studies have shown robust correlation between firearm ownership and firearm injuries and deaths.[68,69] Although firearm ownership is most common among White men, Black and Hispanic men experience disproportionately higher rates of firearm injury and death, reflecting intersecting social, economic, and structural inequities.[12,14] These findings highlight the need for strategies that address not only firearm ownership but also systemic disparities that increase firearm injury risk for minoritized populations.

Firearm injuries showed substantially higher rates of inpatient admissions, especially for assault and other intent categories, than nonfirearm injuries. Furthermore, firearm injuries were associated with markedly higher odds of ED death across all categories, underscoring the severe consequences associated with firearm incidents. These findings highlight the profound individual, healthcare, and societal costs associated with firearm injuries, which often exceed the median annual household income in the U.S. and impose a substantial burden on public resources.[23,70]

Limitations

This study examines firearm-related injuries among ED admissions, which limits the ability to draw conclusions about firearm injury rates at the population level. Reliance on ED data may underestimate the true prevalence of nonfatal firearm injuries because individuals with less severe injuries may not seek medical attention or may visit urgent care centers instead.[71,72] In addition, although the data include individuals who died after hospital admission, they do not capture those who died without being transported to the ED.

The study relies on ICD-coded intent classifications. The ICD system often defaults to unintentional when documentation is unclear, potentially inflating the proportion of unintentional firearm injuries compared with estimates from other sources.[34] Administrative coding practices also vary widely across healthcare facilities, which may further contribute to inconsistencies in the classification of intentional and unintentional injuries.[73,74] This limitation affects both the accuracy of intent-specific trends and comparisons with fatal firearm injury data, which are more reliably captured by data sets such as the National Violent Death Reporting System or CDC WONDER.[75] Despite these challenges, disaggregating firearm injuries by intent categories remains critical for identifying disparities and informing targeted interventions because intent categories reflect distinct risk factors and public health contexts. Future research should prioritize improving the reliability of firearm injury intent classifications through standardized reporting systems.

Regional disparities observed in firearm-related ED admissions may also reflect differences in the overall volume of nonfirearm ED visits rather than population-level firearm injury rates. For example, the Northeast showed a lower proportion of firearm-related ED admissions, which could reflect either lower firearm injury rates or higher rates of nonfirearm ED visits. Future studies incorporating population-based data are necessary to clarify these patterns and provide a more accurate understanding of regional disparities.

This study is further limited by the socioeconomic variables available in NEDS. Although ZIP code–level median household income and urbanicity serve as proxies for broader socioeconomic conditions, they do not fully capture the complexity of social determinants such as education, employment, and social capital.[76] In addition, variables related to mental health status, substance use, and other behavioral factors are not available in NEDS, which may confound relationships between covariates and firearm injuries. Future studies integrating NEDS with other data sets, such as census data or state-level behavioral health surveys, could provide a more nuanced understanding of socioeconomic disparities and behavioral factors associated with firearm injuries.

Finally, this study did not include race/ethnicity owing to its limited availability in NEDS, which reports these data only for 2019 and 2020. Although this ensures consistency across the study period, it precludes exploration of racial disparities, particularly during the COVID-19 pandemic. Future research focusing on race and ethnicity is needed to assess their intersection with firearm injuries and pandemic-related disruptions.

CONCLUSIONS

This study leveraged data from the 2006−2020 Healthcare Cost and Utilization Project's NEDS to provide a comprehensive analysis of trends, characteristics, and disparities in firearm injuries among emerging adults aged 18−24 years in the U.S. Study findings highlight critical disparities in firearm injury patterns by intent, socioeconomic indicators, and geographic region, underscoring the disproportionate burden on rural communities, lower-income populations, and those with limited access to health insurance. By examining both fatal and nonfatal firearm injuries, this study emphasizes the importance of addressing not only the immediate clinical outcomes but also the broader socioeconomic and structural factors that contribute to firearm injury disparities. These findings provide a foundation for developing evidence-based interventions tailored to the unique risks faced by specific populations. Targeted public health initiatives—such as expanding mental health resources in rural areas, addressing structural inequities in urban communities, and promoting firearm safety and storage—are essential to reducing the incidence of firearm injuries and their devastating consequences. Continued research integrating population-level data and detailed contextual factors is vital for refining strategies and promoting equity in firearm injury prevention.

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SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.focus.2025.100332.

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