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Original Research Article

Trends in assault-related hospitalizations during the SARS-CoV-2 pandemic

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ABSTRACT

Introduction: Violence remains a priority issue in the United States (US) requiring public health input to discern the magnitude and impact of violence on the health system. Concerns over violence and the injuries resulting from violence have increased following the SARS-CoV-2 pandemic which exacerbated an array of individual and economic stressors related to violence including increased unemployment, alcohol intake, social isolation, anxiety and panic and decreased access to health services. The aim of this study was to analyze the trends in violence-related injuries in the state of Illinois during the SARS-CoV-2 lockdown periods and post-lockdown in order to inform future public health policy.

Material and methods: Outpatient and inpatient assault related injuries treated in Illinois hospitals from 2016 through March 2022 were analyzed. Segmented regression models evaluating change in time trends were adjusted for seasonality, serial correlation, overall trend and economic variables.

Results: The annual rate of assault related hospitalizations per one million Illinois residents decreased from 3857.8 pre-pandemic to 3458.7 pandemic period. However, during the pandemic there was an increase in deaths and in the proportion of injuries involving open wounds, internal injuries, and fractures, while there was a reduction in less serious injuries. Segmented regression time series models demonstrated significant increase in firearm violence in all four pandemic periods examined. Firearm violence increased particularly in subgroups including African-American victims, 15–34-year-olds, and Chicago residents.

Conclusion: During SARS-CoV-2, we saw an overall reduction in assault related hospitalization, however, findings demonstrated an increase in serious injuries which may be associated with social and economic stressors of the pandemic, increased gun-violence while decrease in less serious injuries may be linked to hospital avoidance for non-lethal injuries during the peak waves of the pandemic. Our findings have implications for ongoing surveillance, service planning and management of the increased gunshot and penetrating assault cases and further demonstrate the need for public health input into the violence epidemic in the US.

Introduction

Despite declining violent crime rates in the United States (US) from 404.5 to 366.7 violent crimes per 100,000 residents between 2010 and 2019 [1], violence remains a critical issue in the US. Compared to other OECD countries, the US consistently has one of the highest violent crime rates [2]. During the ongoing severe acute respiratory syndrome coronavirus-2 pandemic (SARS-CoV-2 or COVID-19), there continues to be concern that violence and the severity of injury resulting from violence has been exacerbated by individual and community stressors associated with the pandemic including social isolation [3,4], difficulty accessing mental health services [5], increased alcohol consumption [6], work disruptions and high unemployment [7], and generalized anxiety associated with the spread of SARS-CoV-2 [8–9]. During the pandemic, higher stressors are predicated towards people in socially disadvantaged situations based on social stress theory, where increased vulnerability is predicted due to scarce psychological resources and risk of psychological distress [10,11].

On March 16, 2020, public health officials confirmed exponential increases in cases of SARS-CoV-2 in Illinois, and began enforcing social distancing measures impacting work and community activities [12]. In Illinois, crime statistics indicated an initial increase in crimes associated with severe injury during the pandemic; between 2019 and 2020, the homicide rate increased from 6.6 to 9.2 per 100,000 residents and the aggravated assault/battery rate increased from 248.5 to 261.5 [13]. In Chicago where the ma-

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jority of murders occur in Illinois, homicides increased from 500 in 2019 to 774 in 2020 and remained elevated in 2021 at 801 [14].

However, only a fraction of violent crimes are reported to law-enforcement because of barriers to reporting, particularly assaults resulting in minor or moderate injury [15–17], and a smaller fraction of reported cases are cleared by law-enforcement [18]. Because law-enforcement data is incomplete, temporal patterns of assault related injuries may be mischaracterized particularly within subgroups or by mechanisms of injury [19]. For this reason, law-enforcement data are only one source used to track violent injuries. US public health data sources augment law-enforcement data particularly for monitoring non-fatal injuries requiring medical care caused by assaults. These public health data also provide quality demographic and clinical information that is unavailable or unreliable in law-enforcement data. National data confirms that the numbers of violent injuries identified in public health data sources consistently exceeds the number of violent crimes or injuries reported to law-enforcement by over 50% [20–22].

Whilst the increase in homicide and violent crime rates has been described during the pandemic [13–14], use of public health data to assess trends of violent injuries during the pandemic has yet to be described. The aim of this study was to 1) describe all assault-related injuries treated in Illinois hospitals between January 2016 – March 2022, 2) evaluate assault-related injury trends during the first two years of the pandemic by mechanism of assault accounting for quarantine orders, and 3) assess trends during different periods of the pandemic within major gender, age, ethnic and regional subgroups. The State of Illinois (United States) is a good model to study health effects from assault-related injuries during the SARS-CoV-2 pandemic as it experienced severe infection outbreaks during the first and subsequent waves, implemented sweeping statewide public health restrictions, has a population representative of the broader United States [23–25], and has a comprehensive hospital data system that captures nearly all persons seeking medical care in the hospital setting.

Materials and methods

Illinois outpatient and inpatient hospital databases were used to identify assault related injuries treated in Illinois hospitals from January 2016 – March 2022. The outpatient database includes all patients treated in emergency departments for less than 24 h who were not admitted as an inpatient to the hospital. The inpatient database includes all patients treated for 24 h or more in Illinois hospitals for any medical reason. Both datasets include information on patient demographics (age, race, and sex), clinical outcomes (diagnoses, hospital procedures, and discharge status), and economic outcomes (hospital charges and payer source). Based on the annual state audit of hospitals, the hospitals included in the datasets used for this analysis comprise 96.5% of all inpatient admissions statewide [26–27].

In the hospital data, only patients with external causes of morbidity ICD-10-CM codes in any of the diagnosis fields indicating an initial encounter for an assault related injury (X92-X99; Y00-Y09; and sexual assault codes T74.2, T76.2, Z04.4) were included in this analysis; 98.9% had an assault related code as their primary diagnosis code. External cause of injury codes provide information on both the mechanism and perpetrator (Appendix 1). Non-Illinois residents were excluded from the study.

Key variables included in this study are patient characteristics (gender, age, race and ethnicity), facility information, length of stay, total hospital costs, insurance coverage, discharge status, reason for visit, and assault type. Major geographic regions in Illinois were categorized using residential ZIP codes and include: the city of Chicago, suburban Cook County (the same county as Chicago), and the rest of the State of Illinois. Total hospital charges are in 2020 US dollars adjusted for annual inflation using the Bureau of Labor Statistics (BLS) Consumer Price Index (CPI-U) [28]. The Elixhauser Comorbidity Index was used to assess comorbidities [29] and trauma mortality prediction model (TMPM) [30] was used to characterize injury severity which in this patient population TMPM values ranged from 0 to 98.3.

SAS software (v 9.4; Cary, NC) was used for all statistical analyses. We examined the general characteristics of Illinois residents with assault related injuries and the severity of injuries before and during the pandemic. In the descriptive analysis, we present frequencies (percentages) for categorical variables, mean (standard deviation) for continuous variables and the crude annual rate of hospitalization per one million Illinois residents.

Multivariable segmented regression models were developed to evaluate changes in daily hospital utilization rates for assault injuries across four pandemic periods relating to State Executive orders for quarantine measures [31–33]: lockdown 1 (March 16, to May 29, 2020), eased restrictions phase 1 (From May 30, 2020, to November 17,), lockdown 2 (from November 18, 2020, to February 1, 2021) and eased restrictions phase 2 (February 2,2021, to March 31, 2022). By the end of the second lockdown the state had introduced restriction criteria by county, therefore the February 2 date was based on the week most counties moved out of tier 1 to less restrictive measures. These models cover the first two years of the pandemic. To accurately characterize each of the four periods, daily crude hospital utilization rates per million Illinois residents were calculated for all key demographic subgroups using American Community Survey (ACS) population estimates, with five year estimates used to determine rates from descriptive statistics and annual estimates used in segmented regression models that used daily counts [34,35]. Even though each of the four periods are of different duration, the parameter estimates represent the average daily change during that period, not the cumulative change. Duplicate hospital transfer cases were identified and removed using demographic variables, admission date, admission codes, and diagnosis codes. ACS population estimates from 2019 were used for 2020–2022 because population estimates were unavailable at the time of the analysis.

We ran stratified multivariable models to evaluate specific temporal patterns by age, gender, race/ethnicity, geographic region, and mechanism of assault. Each model controlled for overall trend, seasonality, first-order serial correlation (AR1), and population-level covariates associated with violence [36–39]. Population-level covariates included monthly labor force participation rate [36], annual percentage population below poverty line [37], annual violent crime rate [38], and monthly gallons of pure ethanol consumed per 100 capita [39]. At the time of analysis annual covariate data was not available for 2020–2022, therefore 2019 data was used for these years for poverty and crime rate variables. Monthly pure ethanol consumed per 100 capita in Illinois was available until August 2021, therefore monthly data from the previous year was used for the latter seven months of the time series where data was unavailable. A two-sided p-value less than 0.05 was considered statistically significant.

Because of multicollinearity, population level covariates excluding alcohol consumption were combined into a single construct using principal components analysis (PCA). PCA is a data reduction method used for studying multiple variables by identifying underlying linear dependencies among the variables. The eigenvalues and scree plots indicated that three socioeconomic covariates represented a single construct with factor loading coefficients ranging between 0.75 to 0.93. Varimax rotation was performed, which produced a simplified structure by redistributing the explained variance for the principal components (i.e., categories). The three socioeconomic covariates were aggregated and standardized into a

Table 1
General characteristics of violence-related injuries and annual hospital utilization rates per million residents, pre-pandemic period compared to the pandemic period.

	Pre-pandemic Period cases (%)*	Pre-pandemic crude Annual hospital utilization rate per 10^6	First 2 Years of Pandemic cases (%)**	Pandemic crude Annual hospital utilization rate per 10^6
Gender	**(*N* = 206,439)**		**(*N* = 89,891)**	
Male	109,857 (53.22)	4178.8	47,610 (52.96)	3728.9
Female	96,552 (46.77)	3546.7	42,266 (47.02)	3196.7
Unknown	30 (0.01)		15 (0.02)	
Age				
0 to 4 yrs	3682 (1.78)	1158.1	1500 (1.67)	971.4
5 to 9 yrs	4001 (1.94)	1236.7	1423 (1.58)	905.6
10 to 14 yrs	9507 (4.61)	2722.6	3506 (3.90)	2067.3
15 to 19 yrs	25,784 (12.49)	7372.3	9203 (10.24)	5418.0
20 to 24 yrs	34,608 (16.76)	9740.8	13,457 (14.97)	7798.6
25 to 34 yrs	57,613 (27.91)	7761.9	26,240 (29.19)	7278.8
35 to 44 yrs	32,624 (15.80)	4730.9	16,290 (18.12)	4863.8
45 to 54 yrs	21,570 (10.45)	3131.2	9447 (10.51)	2823.6
55 to 64 yrs	12,464 (6.04)	1787.7	6241 (6.94)	1843.1
65 to 74 yrs	3238 (1.57)	671.0	1864 (2.07)	795.4
75 yrs and older	1348 (0.65)	379.6	720 (0.80)	417.5
Mean Age (SD)	31.15 (14.66)		32.65 (14.88)	
Race/Ethnicity				
African-American	85,831 (41.58)	11,545.5	39,204 (43.61)	10,858.0
White, Non-Hispanic	74,511 (36.09)	2288.4	30,578 (34.02)	1933.6
Hispanic or Latino	26,430 (12.80)	2866.9	13,336 (14.84)	2978.5
Asian/Pacific Islander	2246 (1.09)	756.2	1036 (1.15)	718.2
AI/AN	274 (0.13)	4895.2	145 (0.16)	5333.8
Other / Unspecified	17,147 (8.31)	13,476.1	5592 (6.22)	9048.9

* Pre-pandemic dates 01–01–16 to 03–15–20.
** Pandemic dates 03–16–20 to 03–31–22.

single variable by multiplying the observed value by the factor loading coefficients.

Results

In this study, 296,330 assault injuries were treated in Illinois hospitals between January 2016 and March 2022 with cumulative hospital charges of $3146,311,703. Table 1 shows demographic characteristics of assault injuries during the pre-pandemic and pandemic periods. Males were disproportionately the victims of all mechanisms of assault relative to females apart from sexual assaults, which almost exclusively involved females (89.4%). Majority of assault cases involved persons without health insurance or covered by Medicaid (65.1%).

Table 2 presents data on mechanism, type and severity of injury. The most common assault mechanism was bodily force (57.5%) followed by sexual assault (10.7%), with 6.2% of all assaults involving firearms. The proportion of injuries treated in hospitals with level I or II trauma units increased slightly during the pandemic from 47.5% to 51.6%. Of the 23,217 hospital admissions (7.8% of injuries), they were disproportionately male (73.7%) and injured from firearms (34.5%). While mean TMPM dropped modestly during the pandemic, the TMPM injury severity measure demonstrated a reduction in injuries on both ends of the injury severity spectrum. There were fewer injuries in the lowest decile (least severe) of the TMPM severity scale (lowest decile shifted slightly upward during pandemic from 0.485 to 0.494). There were also fewer of the most severe injuries as represented by those cases in the upper decile of the TMPM (upper decile shifted downward during the pandemic from 43.831 to 38.852). The biggest shift in the lowest decile occurred during the second lockdown period (lowest decile 0.531) and the largest shift in the upper decile occurred in the first lockdown (upper decile, 20.902).

Average daily pre-pandemic case load (per 10^6 residents) was 134.4/day but dropped to 94.8/day during the first lockdown, rising to 138.2/day during the eased restrictions of post-lockdown 1. During lockdown 2, we saw a similar reduction in cases to 100.8/day and a subsequent increase to near baseline levels during eased restrictions post-lockdown 2 (121.4/day).

In the multivariable model evaluating the overall trend of daily assault related injury rates, there was a significant daily decrease of 2.55 cases per 1 million residents ($p<0.001$) during the first lockdown of the pandemic (from March 16 to May 29, 2020), compared to pre-pandemic levels. For overall assault injuries, daily violent injury rates did not significantly differ from the baseline period during the first period of eased restrictions on public gatherings (May 30 to November 17, 2020). However, there were significant declines in assault rates during both the second major lockdown (November 18, 2020, to February 1, 2021) and the second period of eased restrictions on public gatherings (post lockdown 2) (Table 3). In the stratified models, nearly all subgroups showed declines in assault injuries during the first lockdown with the largest average daily declines observed among females, age groups 10–34 years, African-Americans, and residents of Chicago.

During the second state mandated lockdown, there were declines in violent injuries across most subgroups and mechanisms as seen during the first lockdown, but the declines were less pronounced (Table 3). These declines continued in most subgroups after easing of restrictions on public gatherings after February 2, 2021, but were tempered relative to the first lockdown period with many subgroups returning to pre-pandemic levels. The largest declines in violent injury rates after the end of the second lockdown was observed among females, African-Americans, and Chicago residents.

While overall violent injuries declined during most of the pandemic, the most lethal mechanism of injury involving firearms increased significantly in all four pandemic periods, particularly among Chicago residents and African-Americans. Other more lethal mechanisms involving sharp and blunt objects showed only muted changes in contrast to overall declines. Admissions, as a proxy for

Table 2
Severity of violence-related injuries pre-pandemic and post-pandemic from illinois inpatient and outpatient hospital databases: January 2016 – March 2022.

	Pre-pandemic cases (%)* (*N* = 206,439)	First 2 Years of Pandemic cases (%)** (*N* = 89,891)
Mechanism of Injury		
Bodily force	119,044 (57.7)	51,397 (57.2)
Sexual assault	21,661 (10.5)	10,144 (11.3)
Firearm	11,826 (5.7)	6539 (7.3)
Sharp object	11,206 (5.4)	5187 (5.8)
Blunt object	10,899 (5.3)	4509 (5.0)
Sport equipment	11,558 (5.6)	3095 (3.4)
Domestic violence***	6891 (3.3)	3096 (3.4)
Hit by motor Vehicle	317 (0.2)	174 (0.2)
Steam, vapor, fire, flame, hot object	216 (0.1)	105 (0.1)
Push from high place	221 (0.1)	78 (0.1)
Other	434 (0.2)	217 (0.2)
Unspecified means	12,166 (5.9)	5350 (6.0)
Type of Injury		
Fracture	36,868 (17.9)	17,683 (19.7)
Dislocation	1800 (0.9)	852 (1.0)
Internal organ injury	15,640 (7.6)	7197 (8.0)
Open wound	58,372 (28.3)	26,922 (30.0)
Amputation	98 (0.1)	59 (0.1)
Blood vessel injury	996 (0.5)	588 (0.7)
Crush injury	92 (0.1)	37 (0.1)
Burn injury	441 (0.2)	227 (0.3)
Foreign body	174 (0.1)	94 (0.1)
Poisoning / toxic effects	915 (0.4)	859 (1.0)
Superficial contusion	74,000 (35.9)	29,266 (32.6)
Injury Severity and Hospital Treatment		
Mean TMPM score (higher value is more severe)	6.69 (SD=14.8)	6.34 (SD=14.4)
Hospital admissions (inpatient cases)	15,210 (7.4)	8007 (8.9)
Inpatient mean days in initial hospital (sd)	6.77 (SD=11.9)	7.40 (SD=11.3)
Underwent operation at initial hospital	12,140 (5.9)	5634 (6.3)
Required mechanical ventilation/intubation	1585 (0.8)	981 (1.1)
Died	985 (0.5)	567 (0.6)

* Pre-pandemic dates 01/01/16–03/15/20.
** Post-pandemic dates 03/16/20–03/31/22.
*** Domestic Violence includes injuries caused through child maltreatment, intimate partner violence and elder mistreatmentOnly major types of traumatic injuries shown. Categories are not independent, patients suffering multiple injuries will be counted more than once.

injury severity, increased modestly throughout the pandemic after the first lockdown.

Discussion

Findings from this study, involving a broad diverse population, document the magnitude and temporal changes in violent injuries treated in Illinois hospitals during the SARS-CoV-2 pandemic. Compared to an extended baseline pre-pandemic period, this study found that overall assault related injuries declined during the pandemic, particularly during both lockdown periods with the most marked declines in violent injuries involving females, 10–34-year-olds, and African-Americans. However, assault related injuries involving firearms demonstrated an overall increase in our analysis.

This analysis paints a complex picture of temporal trends in violent injuries in this broad population. Less lethal mechanism of violence including bodily force, domestic violence, sexual assault all significantly declined, while injuries caused by more lethal mechanisms including sharps, blunt weapons and firearms either showed muted changes or significantly increased during the pandemic. Additionally, descriptive analysis of injury severity based on the TMPM showed a decline in both the most minor and severe injuries. This indicates the concomitant occurrence of three possible patterns: 1) reduction in hospital visits for violent injuries caused by people avoiding hospitals, when possible, particularly during infection surges in the population, 2) an overall reduction of violent injuries primarily involving less lethal mechanisms, and 3) no changes or an increase in violence involving more lethal means.

The initial weeks of the first lockdown saw economic and social stressors in Illinois result in unemployment increasing from 4.9% in March 2020 to 17.4% in April 2020 [36], and increased purchasing of alcohol by 6.3% and 12.1% per capita sales in gallons of ethanol compared to the prior 3-year average [38], and a rise in anxiety and panic related to the pandemic [8,9]. Cook County was one of the hardest hit regions in the US during the first wave. Avoidance of hospitals during the first wave of the pandemic may have contributed to the observed overall reduction in assault-related injuries, specifically the less lethal injuries where immediate care could be delayed or avoided. Measures of injury severity did show a decline in the least severe injuries, particularly during each lockdown. National data found that 12% of US adults had delayed or avoided emergency or urgent care by June 30, 2020, because of concerns about SARS-CoV-2 [40]. Additionally, Emergency Medical Services (EMS) personnel in the field and Emergency Department (ED) physicians may have been diverting patients away from EDs during the first wave when understanding of disease transmission and progression of illness was poorly understood.

However, there is a point where an injury cannot be suitably addressed without specialized medical treatment. While the least and most severe injuries declined in the hospital setting during the pandemic, the general distribution of violent injuries by injury severity remained to a large degree unchanged. This supports the hypothesis that there was also an overall reduction in violent

Table 3
Multivariable Models of daily change in violence-related Injuries Treated in Hospital, annual rates per million people by Pandemic period from Illinois Inpatient and Outpatient Hospital Databases: January 2016 – June 2021.

	Trend (SE)	Lockdown 1 (SE)	Post Lockdown 1 (SE)	Lockdown 2 (SE)	Post Lockdown 2 (SE)
All violent injuries	0.0004 (0.0001)*	−2.55 (0.36)***	0.19 (0.32)	−1.11 (0.40)**	−0.66 (0.26)*
Inpatients	−0.00009 (0.00002)***	0.01 (0.04)	0.17 (0.04)***	0.11 (0.05)*	0.20 (0.03)***
Gender					
Male	0.0007 (0.0003)	−1.88 (0.46)***	0.75 (0.42)	−1.06 (0.51)*	−0.43 (0.33)
Female	0.0007 (0.0001)***	−3.20 (0.31)***	−0.37 (0.27)	−1.19 (0.34)**	−0.90 (0.22)***
Age Group					
0 – 4 years	0.0005 (0.0002)**	−1.34 (0.31)***	−0.26 (0.28)	−1.23 (0.35)**	−0.76 (0.22)**
5 – 9 years	0.0005 (0.0002)**	−2.17 (0.32)***	−1.34 (0.29)***	−1.57 (0.35)***	−0.80 (0.22)**
10 – 14 years	0.0015 (0.0004)***	−4.55 (0.66)***	−1.84 (0.59)**	−2.71 (0.72)**	−0.97 (0.46)*
15 – 19 years	−0.00009 (0.0005)	−5.26 (0.89)***	−0.72 (0.79)	−2.72 (0.98)**	−1.37 (0.63)*
20 – 24 years	−0.001 (0.0007)***	−5.06 (1.36)**	2.35 (1.22)	−0.49 (1.50)	−0.78 (0.96)
Males 20 – 24 years	−0.004 (0.0009)***	−3.10 (1.67)	3.59 (1.49)*	0.43 (1.83)	0.89 (1.18)
Females 20 – 24 years	−0.0002 (0.0008)	−5.85 (1.40)***	2.10 (1.26)	0.37 (1.54)	−0.39 (0.99)
25 – 34 years	0.0008 (0.0006)	−4.93 (1.09)***	1.73 (0.98)	−1.59 (1.20)	−1.54 (0.77)*
35 – 44 years	0.001 (0.0003)**	−2.53 (0.62)***	0.34 (0.55)	−1.07 (0.68)	−0.41 (0.44)
45 – 54 years	0.0004 (0.0002)	−2.06 (0.40)***	−0.60 (0.35)	−1.71 (0.44)***	−1.16 (0.28)***
55 – 64 years	0.0006 (0.0001)***	−0.87 (0.27)**	0.04 (0.24)	−0.80 (0.29)**	−0.50 (0.19)**
65 – 74 years	0.0003 (0.0001)**	−0.43 (0.19)*	−0.03 (0.17)	0.01 (0.21)	−0.01 (0.08)
75 + years	0.0001 (0.00009)	−0.23 (0.17)	0.06 (0.15)	0.12 (0.18)	0.14 (0.12)
Race/Ethnicity					
African-American	0.0028 (0.0006)***	−6.46 (1.12)***	2.03 (1.00)*	−3.39 (1.23)**	−3.70 (0.79)***
Hispanic	0.0008 (0.0002)**	−2.61 (0.44)***	0.46 (0.39)	−0.67 (0.48)	0.60 (0.31)
Non-Hispanic White	−4.11E-7 (0.0001)	−1.81 (0.22)***	−0.29 (0.20)	−0.69 (0.24)**	−0.36 (0.15)*
Region of Residence					
Chicago Resident	0.002 (0.0007)**	−3.91 (0.65)***	0.33 (0.53)	−2.90 (0.68)***	−2.77 (0.50)***
Suburban Cook County Resident	0.0005 (0.0002)*	−3.16 (0.37)***	−0.32 (0.32)	−1.37 (0.40)**	−1.02 (0.26)***
Rest of Illinois Resident	−0.00005 (0.0001)	−1.92 (0.32)***	0.22 (0.29)	−0.51 (0.36)	0.02 (0.23)
Mechanism					
Firearm injuries	−0.0002 (0.00002)***	0.17 (0.05)**	0.33 (0.05)***	0.17 (0.06)**	0.27 (0.04)***
Chicago Resident firearm	−0.0007 (0.0002)	0.68 (0.16)***	1.26 (0.13)***	0.62 (0.17)**	0.96 (0.12)***
Sub Cook County firearm	−0.00009 (0.00005)	0.13 (0.08)	0.20 (0.07)**	0.02 (0.08)	0.16 (0.05)**
Rest of Illinois firearm	−0.00003 (0.00001)*	0.05 (0.03)	0.09 (0.03)**	0.11 (0.04)**	0.09 (0.02)***
15 to 34 firearm	−0.0006 (0.00008)***	0.48 (0.16)**	0.95 (0.14)***	0.42 (0.17)*	0.64 (0.11)***
35 to 64 firearm	−0.00008 (0.0002)**	0.12 (0.04)**	0.16 (0.04)***	0.09 (0.05)	0.22 (0.03)***
65 and over firearm	−0.00001 (0.00001)	0.003 (0.02)	0.02 (0.02)	0.04 (0.02)	0.02 (0.01)
African-American firearm	−0.001 (0.0002)***	0.99 (0.29)**	1.98 (0.26)***	1.16 (0.32)**	1.65 (0.21)***
Bodily Force	0.0006 (0.0001)***	−2.03 (0.23)***	−0.32 (0.20)	−1.04 (0.25)***	−0.84 (0.16)***
Domestic violence	0.00004 (0.00001)**	−0.06 (0.03)*	−0.02 (0.02)	−0.10 (0.03)**	−0.07 (0.02)**
Female domestic violence	0.00007 (0.00003)**	−0.12 (0.05)**	−0.01 (0.04)	−0.17 (0.05)**	−0.09 (0.03)**
Sexual assault	0.0002 (0.00003)***	−0.48 (0.05)***	−0.19 (0.04)***	−0.32 (0.05)***	−0.17 (0.04)***
Female sexual assault	0.0004 (0.00005)***	−0.81 (0.09)***	−0.27 (0.08)**	−0.48 (0.10)***	−0.25 (0.06)**
Sharp objects	0.00003 (0.00002)	−0.03 (0.04)	0.09 (0.04)*	−0.05 (0.05)	−0.07 (0.03)*
Blunt / Sports equipment	−0.0002 (0.00003)***	−0.10 (0.06)	0.16 (0.05)**	0.04 (0.06)	0.05 (0.04)

**=<0.0001, **=<0.01, *=<0.05
(Each model controls for serial correlation (AR1), seasonality, socioeconomic covariates, overall trend)
Intercept dates 01/01/16–03/15/20
Lockdown 1 dates 03/16/20 – 05/29/20
Post lockdown 1 dates 05/30/20 – 11/17/20
Lockdown 2 dates 11/18/20 – 02/01/21
Post lockdown 2 dates 02/02/21–31/03/22.
SE = standard error.

injuries during the pandemic period. Illinois crime data in 2020 showed reductions in most violent crimes compared to the prior year [13]. Trends in violent incidents reported by local law enforcement corresponds with our observations made using hospital data. Chicago police data, which is available through March 2022, shows persistent declines throughout the pandemic in incidents involving sexual assaults, general assaults and battery, but an increase in homicides for the period of April to November 2020 [41]. The lockdown periods during the SARS-CoV-2 pandemic resulted in reductions in use of public spaces and social interactions that would be expected to contribute to a decline in violent conflict.

Finally, crime data demonstrates increases in homicide and aggravated assault which are associated with more severe injury [13,41]. Despite an overall reduction in assault related hospital presentations, our analysis demonstrated an increase in injuries caused by more lethal mechanisms during the pandemic which is consistent with other findings which showed crude increases in penetrating trauma and gunshot wounds [42–43]. In Chicago, criminal homicides, mostly caused from firearms, have increased since the start of the pandemic [14], particularly during lockdown one and post-lockdown one periods, and remains a public health crisis that has likely been impacted by various social and economic factors related to the pandemic.

There are several limitations to our study. First, our findings do not account for assault related injuries that do not present to a hospital (e.g. primary care or urgent care center presentations). Our findings suggest less severe cases may have avoided emergency departments during the peak waves of the pandemic. Major changes were seen in behavior patterns of the public, particularly during lockdown periods, that likely impacted exposure to some sources of violence (e.g. lower engagement with the public, particularly drinking establishments relative to the pre-pandemic

period). However, further research is required to understand what proportion of the observed reduction in hospital visits for less severe injuries were an outcome of changes in incidence compared to a reduction in access or readiness to attend hospital during the pandemic periods. Second, our study does not account for homicides that died from assault before presentation to a hospital. Based on CDC data [44], a total of 5655 Illinois residents were murdered between 2016 and 2020 (last year of available data) compared to 1209 in our data (21.4%), but homicides represent a small fraction of all assault-related injuries. Third, ACS population estimates were not available for 2020/2021. However, ACS data shows that population levels have been relatively stable since 2010: Illinois (−1.2%), suburban Cook County (−1.1%) and Chicago (−0.1%). Fourth, adherence to public health related executive orders by the public was not uniform across the state, particularly early in the pandemic. The lack of a statewide cohesive approach to protecting the public may impact the precision of the first lockdown period. However, regions of Illinois outside of Cook County, where adherence to state executive orders may have been less rigorous, still showed a decline in violent injuries during the first lockdown period.

Conclusion

During six years in Illinois, there were nearly 300,000 hospital visits caused by assaults costing over three billion US dollars of hospital charges. Hospital data paints a far more complex picture of temporal trends in violent injuries compared to law-enforcement data, which likely reflects reporting issues as well as the complex risk factors and effect modifiers of violence. While the focus on injuries caused by firearms is necessary, firearms represent only a small fraction of all injuries, and our findings demonstrate that future research is required on (1) the health and economic consequences of less severe assault related injuries (2) the spectrum of assault related injuries in response to future changes in local policies and community level factors, and (3) that the methodology and data source used in this paper can be translated to other areas of injury research associated with high adverse economic outcomes, have poor traditional surveillance systems, and that require longitudinal studies to understand the impact of local policies and community level factors that play a role in the burden and pattern of injury.

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IRB approval

The University of Illinois at Chicago (UIC) IRB has approved this work (#2012–0116).

Declaration of Competing Interest

The authors have no conflicts of interest in regard to this study.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.injury.2023.02.010.

References

[1] Violent Crime –2019 Crime in the United States. US Department of Justice - Federal Bureau of Investigation Web site. https://ucr.fbi.gov/crime-in-the-u.s/2019/crime-in-the-u.s.-2019/topic-pages/violent-crime. Accessed April 24, 2022.
[2] Grinshteyn E, Hemenway D. Violent Death Rates: the US compared with other high-income OECD Countries, 2010. Am J Med 2016;129:266–73.
[3] Joseph CA, O'Shea BQ, Eastman MR, Finlay JM, Kobayashi LC. Physical isolation and mental health among older US adults during the COVID-19 pandemic: longitudinal findings from the COVID-19 Coping Study. Soc Psychiatry Psychiatr Epidemiol Mar 4 2022:1–10.
[4] Long E, Patterson S, Maxwell K, et al. COVID-19 pandemic and its impact on social relationships and health. J Epidemiol Community Health Feb 2022;76(2):128–32 Epub 2021 Aug 19. PMID: 34413184; PMCID: PMC8380476. doi:10.1136/jech-2021-216690.
[5] Giannouchos TV, Brooks JM, Andreyeva E, et al. Frequency and factors associated with foregone and delayed medical care due to COVID-19 among nonelderly US adults from August to December 2020. J Eval Clin Pract Feb 2022;28(1):33–42.
[6] Barbosa C, Cowell AJ, Dowd WN. Alcohol consumption in response to the COVID-19 pandemic in the United States. J Addict Med 2021;15(4):341–4.
[7] Monthly Labor Review – Unemployment rises in 2020, as the country battles the COVID-19 pandemic. U.S. Bureau of Labor Statistics. Web site. https://www.bls.gov/opub/mlr/2021/article/unemployment-rises-in-2020-as-the-country-battles-the-covid-19-pandemic.htm. Accessed April 24, 2022.
[8] Asmundson GJG, Rachor G, Drakes DH, et al. How does COVID stress vary across the anxiety-related disorders? Assessing factorial invariance and changes in COVID Stress Scale scores during the pandemic. J Anxiety Disord Mar 3 2022;87:102554.
[9] Prati G, Mancini AD. The psychological impact of COVID-19 pandemic lockdowns: a review and meta-analysis of longitudinal studies and natural experiments. Psychol Med Jan 2021;51(2):201–11.
[10] Campo-Arias A, Mendieta CTD. Social determinants of mental health and the COVID-19 pandemic in low income and middle-income countries. Lancet – Global Health 2021;9(8):1029–30.
[11] Landau SF. Trends in violence and aggression a cross-cultural analysis. Int J Comparat Sociol XXV 1984:3–4.
[12] Executive Order 2020-07 (COVID-19 Executive Order No. 5) State of Illinois – coronavirus response. Web site. https://coronavirus.illinois.gov/resources/executive-orders/display.executive-order-number-7.2020.html. Accessed April 24, 2022.
[13] Crime in Illinois 2020. *Annual uniform crime report*. Illinois State Police; 2021
[14] Violence Reduction - Victims of Homicides and Non-Fatal Shootings. City of Chicago - Chicago Data Portal. Web site. https://www.chicago.gov/city/en/sites/vrd/home.html. Accessed April 24, 2021
[15] National Data on Intimate Partner Violence, Sexual Violence, and Stalking. Centers for Disease Control and Prevention – The National Intimate Partner and Sexual Violence Survey (NISVS) 2016-2017. https://www.cdc.gov/violenceprevention/datasources/nisvs/summaryreports.html#anchor_1613064420521. Accessed April 25, 2022
[16] Rape –2018 Crime in the United States. US Department of Justice - Federal Bureau of Investigation Web site. https://ucr.fbi.gov/crime-in-the-u.s/2018/crime-in-the-u.s.-2018/topic-pages/rape. Accessed April 24, 2022.
[17] Victimizations Not Reported to the Police, 2006-2010 – National Crime Victimization Survey. U.S. Department of Justice; 2012
[18] Clearances –2018 Crime in the United States. US Department of Justice - Federal Bureau of Investigation Web site. https://ucr.fbi.gov/crime-in-the-u.s/2018/crime-in-the-u.s.-2018/topic-pages/clearances. Accessed April 24, 2022.
[19] GBD 2019 Police Violence US Subnational CollaboratorsFatal police violence by race and state in the USA, 1980-2019: a network meta-regression. Lancet North Am Ed 2021;398(10307):1239–55.
[20] Crime in the United States –2019 Crime in the United States. US Department of Justice - Federal Bureau of Investigation Web site. https://ucr.fbi.gov/crime-in-the-u.s/2019/crime-in-the-u.s.-2019/topic-pages/tables/table-1. Accessed June 15, 2022.
[21] Injuries treated in any medical facility – National Crime Victimization Survey 2019. U.S. Department of Justice; 2019. Website. https://ncvs.bjs.ojp.gov/single-year-comparison/crimeType Accessed June 15, 2022.
[22] Fatal and non-Fatal injury reports –2019. Centers for Disease Control and Prevention – WISQARS. Web site. https://www.cdc.gov/injury/wisqars/index.html Accessed June 15, 2022.
[23] Kolko J. Normal America' Is Not A Small Town Of White People. ABC News, Five-Thirty Eight. Web site. https://fivethirtyeight.com/features/normal-america-is-not-a-small-town-of-white-people/. Accessed April 23, 2022.
[24] United States Census Bureau. Statistical Abstract of the United States: 2012. Available at: https://www.census.gov/library/publications/2011/compendia/statab/131ed.html. Accessed April 23, 2022
[25] United States Census Bureau. American Community Survey, Ranking Tables. Web site. https://www.census.gov/acs/www/data/data-tables-and-tools/ranking-tables/. Accessed April 23, 2022
[26] Illinois Department of Public Health; Illinois Health Facilities and Services Review. Annual Hospital Questionnaire: hospital Profiles and Annual Bed Reports, 2011. Springfield; 2013. Web site http://www.idph.state.il.us/about/hfpb/HospProf_ABR.htm. Accessed 26 April 2022
[27] Lale A, Krajewski A, Friedman LS. Undertriage of firearm-related injuries in a major metropolitan area. JAMA Surg 2017;152(5):467–74.
[28] Bureau of Labor Statistics. Consumer Price Index (CPI) Inflation Calculator. Web site. https://www.bls.gov/data/inflation_calculator_inside.htm. Accessed April 27, 2022

[29] Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. Med Care 1998;36(1):8–27.
[30] Glance LG, Osler TM, Mukamel, et al. TMPM-ICD9, a trauma mortality prediction model based on ICD-9-CM codes. Ann Surg 2009;249(6):1032–9.
[31] Executive Order 2020-38 (COVID-19 Executive Order No. 38) State of Illinois – Coronavirus response. Web site.
[32] Executive Order 2020-69 (COVID-19 Executive Order No. 69) State of Illinois – Coronavirus response. Web site.
[33] Executive Order 2021-03 (COVID-19 Executive Order No.73) State of Illinois – Coronavirus response. Web site.
[34] United States Census Bureau. American Community Survey, 2020- 5 year Estimates Web site. https://data.census.gov/cedsci/table?g=0400000US17&d=ACS%205-Year%20Estimates%20Data%20Profiles. Accessed April 23, 2022
[35] United States Census Bureau. American Community Survey, 2016-2019- 1 year Estimates Web site. https://data.census.gov. Accessed April 23, 2022
[36] United States Burea of Labor Statistics. Economy at a Glance – Illinois. Website https://www.bls.gov/eag/eag.il.htm. Accessed April 23, 2022
[37] United States Census Bureau. American Community Survey, Demographic and housing estimates. https://data.census.gov/cedsci/table?g=0400000US17&tid=ACSDP1Y2019.DP05. Accessed April 23, 2022
[38] Annual violent Crime in the United States. US Department of Justice - Federal Bureau of Investigation Web site. https://ucr.fbi.gov/crime-in-the-u.s. Accessed June 15, 2022.
[39] Monthly Per Capita Alcohol Consumption in Illinois. National Institute on Alcohol Abuse and Alcoholism. Web site. https://pubs.niaaa.nih.gov/publications/surveillance.htm
[40] Czeisler MÉ, Marynak K, Clarke KEN, et al. Delay or avoidance of medical care because of COVID-19–related concerns — United States, June 2020. MMWR Morb Mortal Wkly Rep 2020;69(35). doi:10.15585/mmwr.mm6935e3.
[41] Crimes –2001 to present. Chicago Data Portal -City of Chicago. Web site. https://data.cityofchicago.org/Public-Safety/Crimes-2001-to-Present/ijzp-q8t2. Accessed August 15, 2022.
[42] Yeates EO, Grigorian A, Barrios C, et al. Changes in traumatic mechanisms of injury in Southern California related to COVID-19: penetrating trauma as a second pandemic. J Trauma Acute Care Surg 2020;90(4):714–21. doi:10.1097/ta.0000000000003068.
[43] Sherman WF, Khadra HS, Kale NN, et al. How did the number and type of injuries in patients presenting to a regional level Itrauma center change during the COVID-19 pandemic with a stay-at-home order?.] Clin Orthop Relat Res 2020. doi:10.1097/CORR.0000000000001484.
[44] Centers for Disease Control and Prevention, National Center for Health Statistics. National Vital Statistics System, Mortality 1999-2020 on CDC WONDER Online Database. Data are from the Multiple Cause of Death Files, 1999-2020, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Available at http://wonder.cdc.gov/mcd-icd10.html. Last accessed on August 16, 2022.