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Original Research Article

The effect of the COVID-19 pandemic on community violence in Connecticut[☆]Kathleen M. O'Neill^{a,b,*}, James Dodington^{c,d}, Marcie Gawel^d, Kevin Borrup^{e,f}, David S. Shapiro^{g,h}, Jonathan Gatesⁱ, Shea Gregg^j, Robert D. Becher^a^a Division of General Surgery, Trauma, and Surgical Critical Care, Yale School of Medicine, Department of Surgery, New Haven, CT, 06520, USA^b Investigative Medicine Program, Yale School of Medicine, Yale Graduate School of Arts and Sciences, New Haven, CT, 06510, USA^c Department of Pediatrics, Yale School of Medicine, New Haven, CT, 06510, USA^d Violence Intervention Program, Yale New Haven Hospital, USA^e Injury Prevention Center, Connecticut Children's Medical Center, Hartford, CT, 06106, USA^f Department of Pediatrics, University of Connecticut School of Medicine, Farmington, CT, 06032, USA^g Department of Surgery, Saint Francis Hospital & Medical Center, USA^h Associate Professor of Surgery University of Connecticut School of Medicine & Frank L. Netter Schools of Medicine, USAⁱ Department of Surgery, Hartford Healthcare Hartford Hospital, USA^j Trauma, Burns and Surgical Critical Care, Bridgeport Hospital, USA

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ABSTRACT

Introduction: Natural disasters may lead to increases in community violence due to broad social disruption, economic hardship, and large-scale morbidity and mortality. The effect of the COVID-19 pandemic on community violence is unknown.**Methods:** Using trauma registry data on all violence-related patient presentations in Connecticut from 2018 to 2021, we compared the pattern of violence-related trauma from pre-COVID and COVID pandemic using an interrupted time series linear regression model.**Results:** There was a 55% increase in violence-related trauma in the COVID period compared with the pre-COVID period (IRR: 1.55; 95%CI: 1.34–1.80; p-value<0.001) driven largely by penetrating injuries. This increase disproportionately impacted Black/Latinx communities (IRR: 1.61; 95%CI: 1.36–1.90; p-value<0.001).**Conclusion:** Violence-related trauma increased during the COVID-19 pandemic. Increased community violence is a significant and underappreciated negative health and social consequence of the COVID-19 pandemic, and one that excessively burdens communities already at increased risk from systemic health and social inequities.

1. Introduction

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was initially discovered in late 2019 in Wuhan, Hubei province, China.¹ Over the next several months, the resulting clinical condition, COVID-19, spread to become a pandemic with devastating consequences worldwide. In the United States (US), by January 2022 there were over 76 million confirmed cases and almost 900,000 deaths.²

The COVID-19 crisis is a unique historical event with unprecedented

public health consequences, such as the institution of mandatory social distancing restrictions, quarantines, and mask wearing mandates. In Connecticut, Governor Lamont issued the "Stay Safe, Stay Home" executive order on March 23rd, 2020. This order required nonessential businesses and not-for-profit entities to stop all in-person services.³ This led to the temporary closure of many businesses resulting in broad social disruption. The order expired on May 21st, 2020, but the mandatory social distancing restrictions continued in varying forms through the end of 2020.

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Initial studies on the epidemiology of morbidity and mortality related to COVID-19 suggested that minoritized and low socioeconomic status communities are among the hardest hit by COVID-19.⁴⁻⁹ As more research emerges on the COVID-19 pandemic, a consensus in the literature has begun to develop that Black and Latinx populations experienced disproportionately higher rates of SARS-CoV-2 infection and mortality.^{10,11} While some of this can be attributed to health risks associated with severe COVID-19 illness, other social determinants of health including types of employment, household composition, access to care and socioeconomic status likely played an even more important role in the differential effects of the pandemic by minoritized status.¹²⁻¹⁴

Research on natural disasters such as hurricanes, earthquakes and tornadoes suggests that these catastrophic events may lead to increases in child abuse, domestic violence, suicide and interpersonal violence.¹⁵⁻²⁰ The COVID-19 pandemic recreates some of the traits of a natural disaster including broad social disruption, economic hardship and job loss, and large-scale morbidity and mortality. It is possible that the COVID-19 pandemic could have a similar effect on community violence, but more research is needed to answer this question.

Early data from the pandemic suggests that some forms of community violence increased in the first few months. In the six weeks following stay-at-home orders in Philadelphia, PA, one study found a 23% relative decrease in falls from standing in tandem with a near 100% relative increase in intentional gun-related injuries.²¹ Several other studies and news stories have noted similar increases in all forms of community violence in the wake of the COVID-19 pandemic.²²⁻³⁰ Longer term studies on the immediate and long-term effects of the pandemic on community violence have yet to be thoroughly examined, including whether the effect of the COVID-19 pandemic on community violence differs by racial and ethnic minoritized status.

1.1. Methods

We used a retrospective cohort study design to analyze the pattern of violence-related trauma presentations and determine whether there is an increase of violence-related trauma presentations since the onset of the COVID-19 pandemic. We then stratified this analysis to determine whether this disproportionately affected racial and ethnic minoritized communities. Using the trauma registries at all three Level 1 American College of Surgeons (ACS) Committee on Trauma (COT) verified adult trauma centers in the state of Connecticut (Yale-New Haven Hospital in New Haven; Saint Francis Hospital in Hartford; Hartford Hospital in Hartford) as well as the Level II Center at Bridgeport Hospital in Bridgeport, we collected data for all violence-related-trauma presentations in the emergency room from January 1st, 2018 to January 1st, 2021. The data from the level 2 trauma center in Bridgeport was included for two reasons: (1) there was anecdotal evidence of an increase in violence-related trauma following the COVID-19 pandemic from our members on the Connecticut Hospital-based Violence Intervention Program (HVIP) collaborative and (2) it is CT's largest city by population and therefore not including it was thought to miss a large portion of CT population.³¹ The violence-related trauma presentations were defined by trauma type and included gunshot wounds, stabbings, and assault. Data collection included basic demographics (race, ethnicity, zip code, age, gender), injury severity, discharge disposition, need for intensive care, need for admission, and length of stay.

For the purposes of this study, we are using violence-related trauma presentations as a proxy measurement for the level of violence in the geographic area served by our hospitals. We also stratify our analysis by racial/ethnic minoritized status as it is recorded in the trauma registry under the assumption that this can specifically analyze the amount of violence seen in minoritized communities served by the different hospital systems. While the Black and Latinx communities in Connecticut are not homogenous, there is evidence that regardless of geographic location or socioeconomic status, minoritized communities disproportionately suffered as a result of the COVID-19 pandemic. As such, we use

the racial/ethnic minoritized status as it is recorded in the trauma registry as a proxy for identifying those individuals as more likely coming from communities already at increased risk from systemic health and social inequities due to systemic racism. We use the term "community violence" to describe both violence within the geographic area as well as in minoritized communities.

The Connecticut (CT) Hospital-based Violence Intervention Program (HVIP) Collaborative was established in 2019 and was comprised of all Level 1 adult and child Trauma Centers in the state of CT (from Yale New Haven Health System, Saint Francis-Trinity Health of New England, Hartford Healthcare and Connecticut Children's Medical Center). These systems receive transfers of major trauma from around the state. These hospital systems together represent over 80% of the market share in the state of Connecticut overall and encompass all three major metropolitan areas in the state.³² The purpose of the collaborative is to coordinate and combine resources and efforts across the state to better serve victims of violence. The collaborative meets regularly to discuss progress in a variety of areas including joint research projects.

This study was approved by the Yale University Institutional Review Board (IRB). The study was reviewed by officials at participating institutions and approved by their IRBs for data-sharing. Data use agreements were processed by participating institutions. Each institution provided de-identified information on all violence-related traumas included in their trauma registries from January 1st, 2018 to December 31st, 2020. To avoid potential identifying information, all individuals included in the dataset that were 80 years of age and older were listed as being 80 years old. Reported income was based on the median income by the patient's home zip code from the US Census Bureau.

We described violence-related trauma presentations from before and after the onset of the COVID-19 pandemic and the institution of social distancing restrictions in CT using descriptive statistics. Dividing the cohort into pre-COVID and COVID (onset defined as the beginning of social distancing restrictions put in place by Governor Lamont on March 23rd 2020),³ we completed a bivariate analysis of differences in major covariates using chi-square or *t*-test statistics for categorical and continuous variables, respectively. Covariates included age, race, ethnicity, gender, need for admission, need for intensive care, income level, injury severity score and length of stay. We then compared the pattern of weekly violence-related trauma presentations from pre-COVID and COVID using a time series linear regression model, adjusted for seasonality. Incidence rate ratios (IRR) with 95% confidence intervals (CI) were calculated assuming a relatively stable population over the last three years. Using this data set, we stratified the analysis by race and ethnicity (Black/Latinx patients compared with white patients) to determine whether race and ethnicity acted as an effect modifier on community violence during the COVID-19 pandemic. We also stratified by type of injury defined alternatively as assault, stab wound, or gunshot wound. Stab wounds and gunshot wounds were also grouped altogether as "penetrating injuries" for analysis. The period of the stay-at-home order, March 23rd – May 21st, 2020 presented multiple confounding factors and therefore was interpreted as a transition period between pre-COVID and COVID pandemic for all analyses. We performed all statistical analyses using Stata 14 (StataCorp LLC, College Station, TX).

2. Results

2.1. Descriptive statistics

There was a total of 2563 violence-related trauma presentations from Yale New Haven Hospital, Bridgeport Hospital, Hartford Hospital and Saint Francis Hospital in the 34-month period from January 1st, 2018 to January 1st, 2021 (excluding CT's stay-at-home period, March 23rd-May 21st, 2020). Of those, 1907 violence-related traumas occurred in the 27 months before the onset of the COVID-19 pandemic and 656 occurred in the 7 months after the beginning of the pandemic. There was

no significant difference in age, gender, race/ethnicity, admission to the intensive care unit (ICU) or injury severity score between the pre-COVID and COVID groups. The COVID group was more likely to be admitted to the hospital following their injuries as compared with the pre-COVID group ($p = 0.009$) (Table 1).

2.2. Time series linear regression analysis for all violence-related injuries

Overall, there was a 55% increase in violence-related trauma presentations in Connecticut in the COVID period as compared with the pre-COVID period (IRR: 1.55; 95%CI: 1.34–1.80; p -value<0.001) (Table 2 & Fig. 1). There were significant differences between hospitals. Significant increases in violence-related trauma presentations were observed at Hospital 2 (IRR: 1.56, 95%CI: 1.12–2.16; p -value = 0.009), Hospital 3 (IRR: 2.84; 95%CI: 1.97–4.09; p -value<0.001) and Hospital 4 (IRR: 1.70; 95%CI: 1.21–2.40; p -value = 0.002). However, there was no significant change in violence-related trauma presentations at Hospital 1 (IRR: 1.11; 95%CI: 0.89–1.38; p -value = 0.362)

2.3. Stratification by racial/ethnic minority status

When the data was stratified by racial/ethnic minoritized status (including only patients that were Black and/or Latinx), there were significant differences between groups. Racial/ethnic minoritized patients experienced a 61% increase in violence-related trauma presentations in the COVID period as compared with the pre-COVID period (IRR: 1.61; 95%CI: 1.36–1.90; p -value<0.001). White patients by comparison had no significant change in violence-related trauma presentations in the COVID period as compared with the pre-COVID period (IRR: 0.91; 95%CI: 0.61–1.36; p -value = 0.659) (Table 2 & Fig. 2).

2.4. Stratification by type of injury

There was a 76% increase in penetrating injuries in the COVID period as compared with the pre-COVID period (IRR: 1.76; 95%CI: 1.46–2.13; p -value<0.001). There was a 57% increase in gunshot wounds (IRR: 1.57; 95%CI: 1.24–1.98; p -value<0.001) and 93% increase in stab wounds (IRR: 1.93; 95%CI: 1.42–2.62; p -value<0.001) in the COVID period as compared with the pre-COVID period. The difference in assaultive injuries in the pre-COVID and COVID period was not statistically significant (IRR: 1.27; 95%CI: 1.00–1.61; p -value = 0.050) (Table 2 & Fig. 3).

Table 1

Distribution of baseline characteristics of violence-related trauma before and after onset of COVID-19.

	All	Pre-COVID	COVID	p-value
Total # of presentations (N)	2563	1907	656	n/a
Race/Ethnicity				
White	20.9%	20.2%	16.6%	.202
Black	51.8%	51.2%	53.7%	
Latinx	26.5%	26.5%	26.5%	
Asian	0.4%	0.3%	0.4%	
Other	2.1%	1.8%	2.7%	
Age (mean)	34.1	34.1	34.2	.903
Gender				
Men	83.9%	83.5	84.9%	.849
Women	16.1%	16.5	15.1%	
Severity of presentation				
% Admitted	65.1%	63.7%	69.5%	.009
% ICU	21.6%	20.6%	24.7%	.055
ISS (mean)	9.2	9.2	9.3	.888

CI: Confidence interval. ICU: Intensive care unit. ISS: Injury severity score. Continuous data are presented as mean with standard deviation (SD); categorical variables are presented as a percentage and number (N). P-values are from linear regression for continuous variables and logistic regression for categorical variables. All definitions of variables can be found in the manuscript.

Table 2

Rate ratio calculation from the interrupted time series regression analysis.

Violence-related trauma presentation	Rate Ratio	95% Confidence interval	p-value
All	1.55	1.34–1.80	<.001
Hospital 1	1.11	0.89–1.38	.362
Hospital 2	1.56	1.12–2.16	.009
Hospital 3	2.84	1.97–4.09	<.001
Hospital 4	1.70	1.21–2.40	.002
Among racial and ethnic minorities	1.61	1.36–1.90	<.001
Among white population	0.91	0.61–1.36	.659
Penetrating injury	1.76	1.46–2.13	<.001
GSW injury	1.57	1.24–1.98	<.001
Stab injury	1.93	1.42–2.62	<.001
Assault injury	1.27	1.00–1.61	.050

Racial and ethnic minorities were defined as Black and Latinx patients. All incidence rate ratios are assuming a relatively stable population over the last three years.

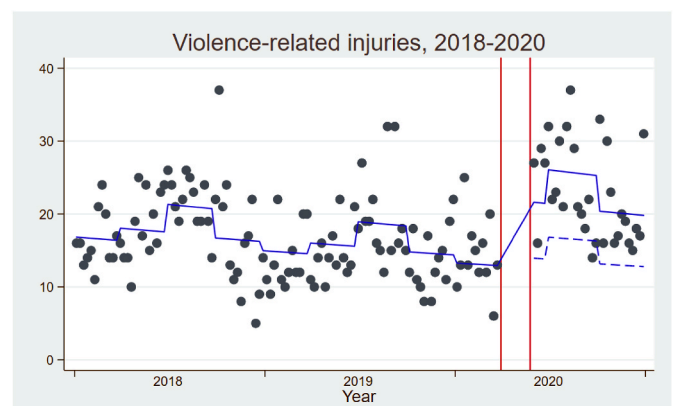


Fig. 1. Time series linear regression analysis for all violence-related injuries Interrupted time series regression analysis for all violence-related injuries in combined dataset, adjusted for seasonality. Data points are weekly violence-related trauma presentations. Blue line = predicted mean violence by the model; Dashed blue line = predicted mean violence with removal of effect of COVID-19 pandemic; Red lines = lockdown period (March 23 – May 21, 2020). (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

3. Discussion

Violence-related trauma presentations to Connecticut’s major trauma centers increased by 55% after the onset of the COVID-19 pandemic, driven mainly by an escalation of penetrating injuries. This increase occurred exclusively in racial and ethnic minoritized communities. This is the first-ever study examining the effect of the COVID-19 pandemic on community violence encompassing trauma centers throughout an entire state. These findings contribute to a body of literature on long-term effects of natural disasters on community violence, provides further evidence for the differential effect of the COVID-19 pandemic on minoritized communities, and has implications for COVID-19 relief efforts and health policy at local and national levels, particularly around violence prevention.

When the data was stratified by racial/ethnic minoritized status (including only patients that were Black and/or Latinx), those patients experienced a 61% increase in violence-related trauma presentations to the ED in the COVID period as compared with the pre-COVID period. By comparison, white patients had no significant change in violence-related trauma presentations in the COVID period as compared with the pre-COVID period. The stark difference in community violence by racial and ethnic minoritized status gives further evidence of systemic social and health inequities placing minoritized communities at the greatest

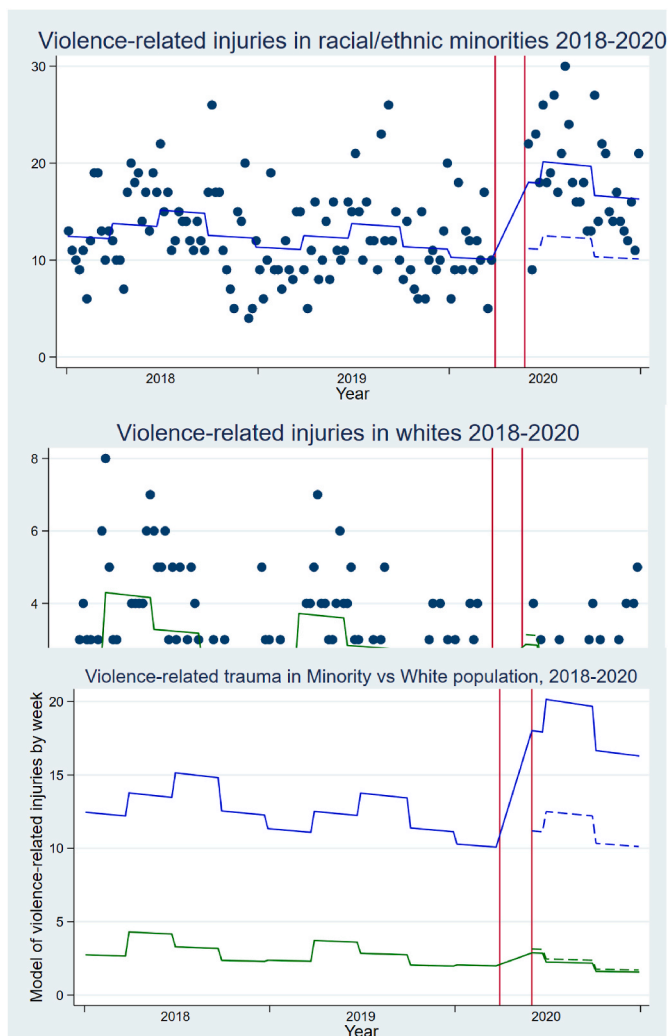


Fig. 2. Stratified time series linear regression analyses
Interrupted time series regression analysis for all violence-related injuries in racial and ethnic minorities (defined as either Black or Latinx) (top), in the white population (middle), and plotted on the same graph (bottom) from combined dataset, adjusted for seasonality. Data points (y-axis) are weekly violence-related trauma presentations. Blue line = predicted mean violence for racial/ethnic minorities. Dashed blue line = predicted mean violence for racial/ethnic minorities with removal of effect of COVID-19 pandemic; Green line = predicted mean violence for non-minority population. Dashed green line = predicted mean violence for non-minority population with removal of effect of COVID-19 pandemic; Red line = lockdown period (March 23 – May 21, 2020). . (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

risk for the long-term effects of the COVID-19 pandemic.^{4-9,11,33} Much has been written about the reasons why interpersonal violence is perpetuated in minoritized communities including historical segregation and social inequity,³⁴ intensive policing practices within Black communities and resultant distrust in the criminal justice system,³⁵ exposure to violence,^{36,37} and they ways in which violence spreads concentrated within particular communities.³⁸⁻⁴⁰ It is beyond the scope of this paper to analyze the myriad causes detailed in the literature except to say that it is likely that the COVID-19 pandemic has exacerbated all of those contributing factors leading to the increase in violence-related trauma seen in this study.

There was a 76% increase in penetrating injuries (defined as stab wounds and gunshot wounds) in the COVID time period as compared with the pre-COVID time period. By comparison, the difference in

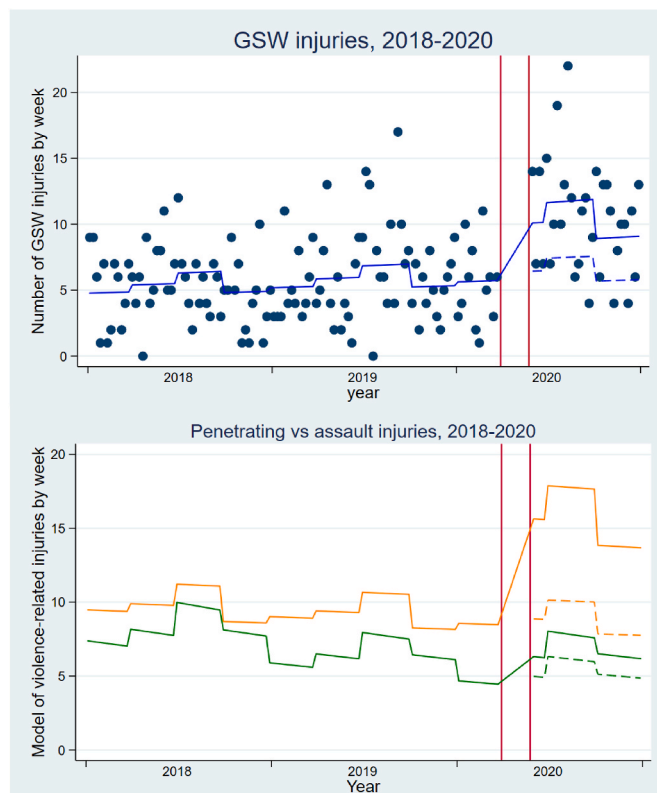


Fig. 3. Time series regression analyses stratified by mode of injury
Data points are weekly violence-related trauma presentations. Blue line = predicted mean GSW (gunshot wound) injuries by week; Dashed blue line = predicted mean GSW injuries by week with removal of effect of COVID-19 pandemic; Orange line = predicted mean penetrating injuries (defined as gunshot wound or stabbing) by week; Dashed orange line = predicted mean penetrating injuries by week with removal of effect of COVID-19 pandemic; Green line = predicted mean assault injuries by week; Dashed Green line = predicted mean assault injuries by week with removal of effect of COVID-19 pandemic; Red line = lockdown period (March 23 – May 21, 2020). . (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

assaultive injuries in the pre-COVID and COVID time period was not statistically significant. This trend has been seen in other parts of the United States (US) as well.^{21,29,30} There are a number of possible explanations for this trend including that social distancing and the stay-at-home orders in effect during the COVID-19 pandemic had a negative effect on individual mental health (including increases in substance use) and collective social wellbeing leading to exacerbation of a variety of factors that lead to interpersonal violence.⁴¹⁻⁴⁶ In tandem with this, the US population saw an increase in access to guns following the onset of the COVID-19 pandemic as gun sales surged with an estimated increase of 2.1 million gun purchases from March through May 2020 (as compared with previous years).⁴⁷⁻⁵¹ In times of emergency and uncertainty, sales of guns in the US historically increase.⁵² Even with nationwide stay-at-home orders, the majority of states included gun retailers as essential businesses and therefore gun sales continued.⁵³ While CT has much lower rates of gun ownership compared to other states (18% compared with Montana the state with the highest rate of 60.4%),⁵⁴ the overall trend in increased access to guns in the population offers another explanation for the increase in penetrating injuries seen following the onset of the COVID-19 pandemic.⁵⁵⁻⁵⁸

In light of the findings of this study and others, targeted interventions such as those for prevention of gun violence should be key focuses of the long-term COVID-19 relief effort. An example of this is investment in hospital- and community-based violence intervention programs which have been shown to prevent violent injury and be cost-effective.⁵⁹⁻⁶⁶

Victims of interpersonal violence have unique and specific needs separate from other types of trauma and in particular require special care to prevent known downstream sequelae including post-traumatic stress disorder and re-injury through violence.⁶⁷⁻⁷⁴ These violence intervention programs have a focus on prevention as well as treatment by connecting victims of violent injury to needed services.⁷⁵ In addition, legislators should consider strategies shown to be effective in decreasing firearm-related mortality such as universal background checks and a national firearm identification system.⁷⁶ For states that already have many of these measures in place like CT, emphasis should be placed on eliminating readily available secondary illegal markets for guns.^{77,78}

There were several limitations in this study. Trauma registry data may not fully reflect the impact of the COVID-19 pandemic on community violence because it does not capture all intentional injuries within a community. Less seriously injured patients that do not come to the attention of the trauma department are not included in the trauma registries. These registries also would not capture those violence-related injuries that do not come to the hospital—individuals that die before transport to the hospital and those patients that did not seek care in an emergency department. The strength of using the trauma registry, however, is that these limitations are mostly consistent throughout the time period of the study allowing for accurate comparison between time periods. The one notable exception being that patients may have chosen to avoid the hospital specifically during the COVID-19 pandemic due to fear of infection—in which case this analysis would under-estimate the effect of the COVID-19 pandemic on community violence. In this analysis we include all level 1 trauma centers in the state as well as a level 2 trauma center. It is possible that further analysis of level 2 trauma centers would yield more nuanced results, city by city within the state. However, as we did not have access to data from all level 2 trauma centers we were unable to include their registries in this analysis and therefore assume that the data from these centers represent a general trend throughout the state.

4. Conclusion

This research on the effect of the COVID-19 pandemic on community violence demonstrated a significant increase in violence-related trauma presentations to trauma centers throughout Connecticut after the onset of the pandemic, which was most pronounced in racial/ethnic minoritized communities. Most of this increase in community violence was the result of penetrating injuries, including stabbings and gunshot wounds. Long term relief efforts for the COVID-19 pandemic should include policies and programs for community violence prevention and mental health treatment for victims of community violence to prevent known downstream sequelae, particularly mental health disorders such as post-traumatic stress disorder. Funding for these efforts should specifically target racial/ethnic minoritized communities. Policymakers should further consider legislation that limits individual access to guns, prevents gun trafficking and improves relationships between police and communities of color to help curb the community violence epidemic.

Author contributions

KMO, JD, KB, DSS, JG, SG and RDB were involved in the design of the project and procurement of the data. KMO was responsible for the statistical analysis. All authors contributed to the writing/editing of the manuscript and approval of the final version.

Disclosures

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Declaration of competing interest

All authors have no conflicts of interest to disclose.

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