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Trends of Trauma Admissions in a Rural Trauma Center During Coronavirus Disease 2019 Pandemic

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TITLE PAGE

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A Bashiri and R Behm conceptualized the thesis of this study to investigate the effect of COVID-19 pandemic on trauma admissions. A Morada and S Senepathi did the statistical analysis. S Silverman and M Sultany reviewed the patient charts. M Sultany also helped with manuscript write up. All the authors helped with the writing and editing of the manuscript. S Casos helped with all aspects of the project.

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Abstract

Introduction: The spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) led to implementing strict social distancing mandates nationwide. This study evaluates the trauma trends during the pandemic at a rural level II trauma center in Pennsylvania.

Methods: A retrospective review of all trauma registries between 2018 to 2021 was performed overall and on a 6-monthly basis. Injury severity score (ISS), injury types – blunt vs. Penetrating – and mechanisms of injury were compared across the years.

Results: A total of 3,056 patients in 2018-2019, and 2,506 patients in 2020-2021 were evaluated as the historic control and study group, respectively. The median age of the patients was 63 and 62 in the control and the study group respectively ($p=0.616$). There was an overall significant decline in blunt injuries and an increase in penetrating injuries (Blunt: 2945 vs 2329, Penetrating: 89 vs 159, $p<0.001$). Injury severity score was not different across the eras. Falls, motorcycle accidents (MCA), motor-vehicle accidents (MVA) and all-terrain vehicles (ATVs) comprised most of the blunt traumas. Penetrating injuries secondary to assault with firearms and sharp weapons had an increasing trend.

Conclusion: There was no association between trauma numbers and the beginning of the pandemic. Overall, there was a decline in trauma numbers during the second 6 months of the pandemic. There was an increase in injuries involving firearms and stabbing. Rural trauma centers have a unique demographic and admission trend that should be considered while advising regulatory changes during pandemics.

Keywords: COVID-19 Pandemic, Trauma, Violence, Penetrating trauma

Introduction

First appearing in the United States (US) during February 2020, the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has created the most significant challenge to our healthcare system to date. More than 74 million cases of COVID-19 infections and 882,000 deaths have been reported in the US. Beginning March 16th, 2020, both New York and Pennsylvania implemented stay-at-home mandates to limit the spread of COVID-19 with the intention to reduce the burden on the already saturated healthcare system. Many level I and level II trauma centers have reported the association between the trauma numbers and the pandemic. However, most of these reports focused on the first few months of the pandemic. Rhodes *et al.* (2020) and Kamine *et al.* (2020) reported an overall decline in trauma volumes at rural centers, with significant increase in substance abuse, and violence.^{1,2} Many other studies in both urban and some rural trauma centers have shown comparable results. A combination of early studies, and the need for safety precautions against the spread of the virus led to implementation of guidelines such as reduction in trauma bay staff or mobilization of trauma surgeons to COVID-19 intensive care units (ICU) because of their unique capability to act as both a surgeon and an intensivist.³ While such strategies might have been crucial in centers with early, rapid peak in COVID-19 cases, it could have been detrimental to rural centers with a different pattern of COVID-19 surge. Here, the association between the spread of COVID-19 and the number and pattern of trauma admissions at a rural level II trauma center with a wide referral base is presented over a span of two years. Our trauma center is located at Guthrie Robert Packer Hospital, in Sayre, Pennsylvania.

Methods

A retrospective review of all trauma registries between 2018 to 2021 was performed, including trauma alerts and trauma evaluations presenting to a rural American College of Surgeons (ACS) verified level II trauma center. Trauma alerts were further divided to level I trauma alerts, and Protocol T – equivalent to level II trauma alerts. Our hospital is a tertiary care teaching hospital that provides 267 licensed inpatient beds and 16 observation beds and serves the northern tier of Pennsylvania and the southern tier of New York, covering approximately 15 counties, over 9,000 square miles and about 1.2 million people. An Institutional Review Board (IRB) approval was obtained prior to data collection. The IRB approved waiver of informed consent for participation in the study. Social distancing mandates were implemented on March 18, 2020, across Pennsylvania and New York States. In Pennsylvania, the stay at home mandate was lifted in the end of May 2020, while the mask mandates and social distancing continued until late 2021. In New York, the stay at home mandate was lifted towards the end of June 2020, while the mask mandate and social distancing mandates continued until early 2022. The trauma admissions before this date were used as a control (Pre-COVID), while the registries after this date were used as Post-COVID data. The study period was further divided to 6-months phases. The periods included Pre-COVID 1 (2018-03-19 to 2018-9-19), Pre-COVID 2 (2018-09-19 to 2019-3-19), Pre-COVID 3 (2019-03-19 to 2019-9-19), Pre-COVID 4 (2019-09-19 to 2020-03-19), Post-COVID 1 (2020-03-19 to 2020-9-19), Post-COVID 2 (2020-09-19 to 2021-3-19), Post-COVID 3 (2021-03-19 to 2021-9-19), Post-COVID 4 (2021-09-2021 to 2021-12-31). The demographic data included age and gender. Injury severity score (ISS) was used to evaluate and compare the severity of cases. The data was analyzed further for differences in total length of stay (LOS), ICU LOS, and penetrating versus blunt trauma cases. Further mechanisms of injury were also compared across the years. The patient charts who had both gunshot wounds and stabbing wounds were individually reviewed to determine any component of assault vs. Accidental injuries.

The data analysis was performed using RStudio. GraphPad Prism 6.0 was used for plotting the data. Median with interquartile ranges (IQRs) was used for reporting continuous data. Categorical variables were reported as frequencies and percentages. Quantitative variables were summarized using mean and standard deviation for normally distributed parameters as well as median with interquartile range (IQR) for skewed parameters. A Fisher's exact test and Chi-square test were used to compare the categorical parameters. Student t-test was used to compare the mean differences of normally distributed parameters. Mann-Whitney U test was used to compare non-parametric data. Univariate analysis was used to compare the mechanism of injury between Pre-COVID and Post-COVID. Analysis of variance (ANOVA) was used to compare the data from multiple groups. A two-sided $p < 0.05$ was used to determine statistical significance.

Results:

A total of 5562 data points were obtained. The total number of trauma cases decreased with 3,056 in the Pre-COVID, and 2,506 patients in the Post-COVID ($p < 0.001$). Table 1 represents the demographic data and the general distribution of the trauma evaluation. Overall, there were no statistically significant differences in the age or gender of the patients. Males represented the dominant group across all eras. There were less blunt traumas [2945 (97.1) vs. 2329(93.6), $p < 0.001$], and more penetrating traumas [89 (2.9) vs. 159 (6.4), $p < 0.001$] during the Post-COVID era (Figure 1A-B). Overall, a lower percentage of patients were admitted to the hospital during the Post-COVID era (Table 1). There was no statistical difference in ISS, LOS, or ICU LOS (Table 1).

Next, the mechanisms of injury were compared across all eras. Overall, the highest number of trauma admissions were due to falls, which decreased during the Post-COVID era [1724(56.4) vs. 1398 (55.8), $p = 0.658$] (Table 2, Figure 2A). There was a statistically significant decrease in Motor Vehicle Accidents

(MVA) during the Post-COVID era [611(20) vs. 404 (16.1), $p=0.001$] (Table 2, Figure 2A). Both Motorcycle Accidents (MCA) [135(4.4) vs. 157 (16.3), $p=0.001$] and All-Terrain Vehicle accidents (ATV) [73(2.4) vs. 96 (3.8), $p=0.001$] had a marginally, yet statistically significant increase during the post-COVID era (Table 2, Figure 2A).

Assaults involving gunshot wounds (GSW), and stabbing or blunt mechanisms, such as altercations not involving sharp objects or firearms were compared across the eras (Figure 2B). Accidental GSW occurring during cleaning firearms, or accidental stabbing caused during cleaning sharp objects or cooking are presented as a separate category. Overall, there was an increase in the total number of assaults [87 (2.8) vs. 113 (4.5), $p<0.001$]. There was a significant increase in assaults involving stabbing [18 (0.6) vs. 38 (1.5), $p=0.001$] and an increasing trend in assaults involving GSW [18 (0.6) vs. 24 (1.0), $p=0.154$]. The number of penetrating traumas requiring operating management were doubled in the Post-COVID era [44 (1.4) vs. 88 (3.3), $p<0.05$]. The alcohol use could not be evaluated due to 50 percent of the data missing.

Since COVID-19 pandemic had different peaks across the nation and our center, both the control and the study periods were divided into 6 months phases. Overall, the total change in trauma numbers was statistically significant across the groups (Figure 3A). During Post-COVID 1 and 3 (2020-03-19 to 2020-9-19 and 2021-03-19 to 2021-09-19), there was a significant increase in trauma admissions (758 and 867, $p<0.001$) (Table 3, Figure 3A). Similar seasons during the historic control groups showed the same pattern of increase in trauma admissions (Pre-COVID1: 767, Pre-COVID 3: 714) (Table 3, Figure 3A). Furthermore, both Post-COVID 2 (2020-09-19 to 2021-3-19) and Post-COVID 4 (2021-9-19 to 2021-12-31) phases showed a significant decrease in admissions (Post-COVID 2: 516, Post-COVID 4: 365, $p<0.001$) compared to historical controls.

Injuries secondary to Fall, MVA, MCA and ATV were compared to historic data across the 6-months phases. Injuries related to Fall had a significant decline in Post-COVID 2 (2020-9-19 to 2021-3-19), and a historic high in Post-COVID 3 (2021-3-19 to 2021-9-19) [Post-COVID 2: 299 (57.9), Post-COVID 3: 492 (56.7), $p<0.001$] (Table 4, Figure 3B). Motor-vehicle accidents declined in Post-COVID 1 (2020-3-19 to 2020-9-19) and 2 (2020-9-19 to 2021-3-19), followed by a return to baseline in Post-COVID3 (2021-3-19 to 2021-9-19) [Post-COVID 1: 133(17.5), Post-COVID 2: 102 (19.8), $p<0.001$] (Table 4, Figure 3B). Interestingly, both MCA and ATV related injuries had historic highs in Post-COVID 1 (2020-3-19 to 2020-9-19) and 3 (2021-3-19 to 2021-9-19).. The total assaults and the nature of them were analyzed across the phases. Post-COVID era showed a uniform increase in assault numbers. While assaults not involving firearms or stabbing (e.g. punching, physical altercation) were reduced in Post-COVID 1 (2020-3-19 to 2020-9-19) and 2 (2020-9-19 to 2021-3-19), assaults involving GSW and stabbing were increased (Table 4, Figure 3C).

Discussion:

In this retrospective study, the association between COVID-19 pandemic and trauma numbers and pattern at a level II rural trauma center is presented. First, this study is unique as the rural location—at the border of New York and Pennsylvania—has created a wide catchment area. Secondly, this is the first study to evaluate the association of the pandemic and trauma admissions over a span of 2 years. Numerous studies have cited short interval analysis as their main limitation.⁴ Overall, we saw a decreasing trend in the number of trauma alerts during the pandemic; however, a sub-analysis of the data by dividing it to 6-months periods revealed a unique pattern unlike other studies. The decision to divide the data to 6-months periods stemmed from the fact that our region saw a peak in COVID-19 cases during October and November of 2020. This contrasted with other centers where the peak of the disease happened in the

beginning of the pandemic between March 2020 to June 2020. By dividing the data to 6-months semiannual basis, we also captured the true correlation with the trauma admission trends. For an equal comparison, and considering that trauma trends are seasonal in nature, the historic control was also divided to 6-months periods. The data from each period is compared to its respective control in order to control for the seasonal changes in trauma admissions.

A significant number of our patients lacked COVID-19 testing. In the beginning of the pandemic in 2020, the emergency department did not have a testing protocol and only symptomatic people were being tested. This led to a significant number of untested patients. Later during the pandemic, in 2020 and 2021, only the patients being admitted to the hospital were tested for COVID-19. Despite the lack of testing, the regions covered by our trauma center all had a peak of infection beginning October and November of 2020⁵.

Despite the social distancing mandates during Post-COVID 1 phase (2020-3-19 to 2020-9-19), there was a peak in trauma cases at our center, which was followed by a historic low during Post-COVID 2 (2020-9-19 to 2021-3-19). A similar peak was observed during the same seasons previously. Many studies showed an overall decline in trauma numbers in the beginning of the pandemic, March to May 2020.^{2,6-12} Interestingly, while Ghafil *et al.* showed a decreasing trend in trauma numbers in the first few weeks of the pandemic, they saw a rebound to baseline levels, just prior to lifting the mandates⁶. Most studies published to date also suffer from solely evaluating a few weeks to months post-pandemic. This is the first study to evaluate a span of 2 years.

The trend observed at our center could be due to multiple factors. Firstly, our rural area did not see the initial surge in COVID-19 infection observed in most urban areas. This could be due to lower population density, leading to lower transmission rate of COVID-19.⁵ We speculate that this could have caused the population to not follow the social-distancing mandates as stringently as in urban areas and participate in high-risk activities. This is evident in a higher number of Fall, ATV and MCA related injuries. Secondly, the sustained number of trauma admissions could correlate with a shift in trauma referrals and other hospitals being on diversion while dealing with the rampant spread of the virus.

Interestingly, we only saw a marginal decline in MVA related injuries, as opposed to many urban areas that showed a clear significant decrease in car accidents.^{8,9} Lara-Reyna *et al.* showed a higher number of MVA related brain injuries and argued that early decline in public transportation, and lower traffics during the pandemic led to car owners driving at higher speeds and leading to more severe accident.¹³⁻¹⁵ Based on our finding and the literature review, we highly recommend a more rigorous nationwide initiative for traffic control during pandemics whether through increasing surveillance or public education initiatives.

Similar to other centers in the US,^{1,6,7,11,16-18} we saw a decreasing trend in blunt traumas and a historic high in penetrating traumas, most of which required operative management. Further analysis of Post-COVID phases, showed a significant increase in assault related injuries. Both GSW and stabbing secondary to assault increased during Post-COVID 1 (2020-03-19 to 2020-9-2020) and Post-COVID 3 (2021-3-19 to 2021-9-19) months compared to the historic controls, despite the seasonal trends seen in trauma admissions. Interestingly, between March 2020 to September 2020, National Instant Criminal Background Check System (NICS) Firearm Background Checks for Pennsylvania was 849,434, compared to 551,440 during the same period in 2019.¹⁹ Gun ownership also significantly increased during this time. It is well established that the rising gun ownership is a risk factor for increase gun-related assaults, and self-inflicted injuries. McGraw *et al.* showed increased GSW during 2020 correlating with increased alcohol use disorder, and mental illness.^{20,21} Considering this rising trend in Pennsylvania and

across the nation, our data suggest not only a more rigorous firearm background check, but also a demand for gun-safety educational protocols, mental and health initiatives across the nation. Bulger *et al.* performed a survey evaluating both Level I and Level II trauma centers' response to reduce firearm violence vents, post-traumatic stress disorder (PTSD), alcohol and drug use problems and major depression and suicidal ideation during the COVID-19 pandemic.²² While they showed the value of the American College of Surgeons Committee on Trauma (ACSCOT)'s alcohol screening and brief intervention services at both helping and reducing alcohol abuse, based on their survey, only 34% of centers reported measures to support violence prevention. Our trauma center has started incorporating such programs and clearly there is still quite a lot of room for improvement across the nation.

Our trauma center followed Centers for Disease Control (CDC) and the American College of Surgeons Committee on Trauma (ACSCOT) guidelines for resource allocation, similar to many other centers. In the beginning of the pandemic, the surgical residents' schedule was adjusted to limit exposure, which led to having only 2 surgical residents available in the trauma bay. The trauma bays' resources were rationed to save personal protective equipment. In addition, the staff, including respiratory therapist and nursing staff were limited in the trauma bay. The surgical ICU beds were allocated to COVID-19, non-surgical patients. The resource assembly in the operating rooms occurred at a slower rate to ensure safety measures for COVID-19 exposure. These adaptations happened while the trauma numbers remained high in the beginning of the pandemic. More importantly, while the absolute number of penetrating traumas at our center is low compared to Level I urban areas, almost all the penetrating injuries required operative management. While it is true that the clinical outcomes such as LOS, ICU LOS, etc. were not significantly affected, the transition of the patient from the trauma bay to the operating room, and the care provided in the operating room were affected. One limitation of this study is the lack of objective data to support this claim, which could be addressed in future publication through developing prospective, quality improvement projects during future pandemics. Overall, while safety measures are a crucial part of facing a pandemic, our recommendation is to ensure adequate allocation of resources to trauma centers during catastrophes to ensure safe patient care.

One of the main limitations of this study is the retrospective, single center design and relying on accurate data collection from electronic medical records. Furthermore, another limitation was the nature of our trauma center receiving patients from both New York and Pennsylvania. These states had numerous differences in mandates and population's adherence to them. Another major limitation was the limited data on alcohol consumption and whether it contributed to the higher rate of violence.

Overall, here we attempted to represent a trend of trauma admissions during 2 years of the COVID-19 pandemic, while other similar studies limited their data collection to a few months in the beginning of the pandemic. The trend of injuries and the trauma numbers correlated with our region's COVID-19 spread. During the beginning of the pandemic while most urban areas were dealing with a wide spread of the virus, our rural area appeared to have a lower infections rate. Hence, the trauma admissions remained at a higher level compared to other centers. In addition, we have had a historic increasing trend in assaults and penetrating injuries. While ISS was similar across the years, the rise in violence involving firearms and other weapons were real. This is a similar trend across the nation that demands better initiatives for gun ownership safety protocols and psychosocial support.

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		Pre-COVID	Post-COVID	p
Number		3,056	2,506	
Alert Level (%)	Level I	876 (37.0)	622 (28.8)	<0.001
	Level II	875 (37.0)	831 (38.5)	
	Trauma Consults	616 (26.0)	708 (32.8)	
Age		63.00 [38.00, 79.00]	62.00 [37.00, 78.00]	0.616
Gender (%)	Female	1341 (43.9)	1104 (44.1)	0.918
	Male	1715 (56.1)	1402 (55.9)	
Injury Type	Blunt	2945 (97.1)	2329 (93.6)	<0.001
	Penetrating	89 (2.9)	159 (6.4)	
ISS (median [IQR])		5.00 [2.00, 9.00]	5.00 [4.00, 9.00]	0.171
Destination (%)	Home	573 (20.7)	529 (24.0)	0.038
	ICU/Critical Care Unit	357 (12.9)	273 (12.4)	
	Interventional Angiography	7 (0.3)	3 (0.1)	
	Labor & Delivery	7 (0.3)	9 (0.4)	

	Med/Surg Unit	1483 (53.5)	1147 (52.1)	
	Other	2 (0.1)	0 (0.0)	
	Step Down Unit/Intermediate	279 (10.1)	183 (8.3)	
	Blunt Trauma to OR	781 (25.5)	770 (30)	
	Penetrating Trauma to OR	44 (1.4)	83 (3.3)	
	Transfer to Other Hospital/Trauma Center	64 (2.3)	58 (2.6)	
Living Status (%)	Alive	2974 (97.3)	2429 (96.9)	0.432
	Dead	82 (2.7)	77 (3.1)	
LOS (median [IQR])		2.00 [1.00, 5.00]	2.00 [1.00, 5.00]	0.247
ICU LOS (median [IQR])		0.00 [0.00, 0.00]	0.00 [0.00, 0.00]	0.211
COVID Status (%)	NO = Negative COVID19	0 (0.0)	1439 (57.4)	<0.001
	Not Tested	3056 (100.0)	1031 (41.1)	
	YES = Positive COVID19	0 (0.0)	36 (1.4)	

Table 1. Demographic data, Injury type, destination of patients after evaluation by the trauma team, living status, length of stay, ICU duration and COVID status. LOS: Length of Stay; ISS: Injury Severity Score, IQR: interquartile range; IR: interventional radiology; ICU: Intensive Care Unit , OR: Operating Room

Mechanisms of Injury	Pre-COVID	Post-COVID	p-value
Fall	1724 (56.4)	1398 (55.8)	0.658
MVA	611 (20.0)	404 (16.1)	<0.001
MCA	135 (4.4)	157 (6.3)	0.003
All assaults	87 (2.8)	113 (4.5)	0.001
ATV	73 (2.4)	96 (3.8)	0.002
Pedestrian Struck by Car	66 (2.2)	42 (1.7)	0.229
Industrial Farm Accident	52 (1.7)	48 (1.9)	0.62
Blunt assaults	51 (1.7)	51 (2.0)	0.361
Bicycle	49 (1.6)	44 (1.8)	0.737
Assault involving stabbing	18 (0.6)	38 (1.5)	0.001
Assault involving GSW	18 (0.6)	24 (1.0)	0.154
Table saw Accident	16 (0.5)	11 (0.4)	0.797
Tree Related Injuries	15 (0.5)	4 (0.2)	0.061
Laceration	14 (0.5)	32 (1.3)	0.001
Dog Bit	12 (0.4)	21 (0.8)	0.048
Accidental GSW	10 (0.3)	9 (0.4)	1
Accidental stabbing	6 (0.2)	1 (0.0)	0.209
Suicide	5 (0.2)	16 (0.6)	0.008
Sports Related Injuries	5 (0.2)	0 (0.0)	0.115
Other	27 (0.9)	31 (1.2)	>0.05

Table 2. Mechanism of Injury during Pre-COVID and Post-COVID eras. MVA: Motor Vehicle Accident; ATV: All-terrain Vehicle; MCA: Motorcycle Accident; GSW: Gunshot wound. Other categories include electrical shock, self-harm, injuries related to furniture, horse related injuries, traumatic amputations, playground related injuries, car fall in in garage, animal assaults, punched glass, lawnmower related injuries, chainsaw related injuries, motorized car accident, fence related injuries, facial injuries, crushed by heavy object, hit by cellar door, drug overdose, hiking related accidents, hammer fell on head, drowning, hit by lumbar, boat related injuries

		Pre-COVID 1	Pre-COVID 2	Pre-COVID 3	Pre-COVID 4	Post-COVID 1	Post-COVID 2	Post-COVID 3	Post-COVID 4	p
Number		767	638	714	661	758	516	867	365	
Type of Trauma	Protocol T	225 (37.2)	184 (39.1)	191 (34.5)	210 (38.5)	195 (30.8)	124 (29.2)	211 (27.7)	92 (27.0)	<0.001
	Trauma Alert	258 (42.6)	165 (35.1)	212 (38.3)	173 (31.7)	295 (46.5)	158 (37.3)	262 (34.4)	116 (34.0)	
	Trauma Evaluation	122 (20.2)	121 (25.7)	150 (27.1)	163 (29.9)	144 (22.7)	142 (33.5)	289 (37.9)	133 (39.0)	
Destination	Home	157 (22.8)	127 (22.2)	135 (21.2)	115 (18.6)	156 (23.0)	115 (25.0)	175 (23.2)	83 (26.7)	0.027
	ICU	83 (12.0)	78 (13.6)	81 (12.7)	85 (13.7)	107 (15.8)	54 (11.7)	84 (11.2)	28 (9.0)	
	IR	2 (0.3)	2 (0.3)	1 (0.2)	2 (0.3)	3 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)	
	Labor & Delivery	2 (0.3)	2 (0.3)	1 (0.2)	2 (0.3)	2 (0.3)	3 (0.7)	2 (0.3)	2 (0.6)	
	Surgical Floor	360 (52.2)	303 (53.0)	332 (52.0)	344 (55.6)	327 (48.2)	251 (54.6)	406 (53.9)	163 (52.4)	

	Other	0 (0.0)	0 (0.0)	2 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
	Intermediate ICU	62 (9.0)	47 (8.2)	71 (11.1)	66 (10.7)	62 (9.1)	28 (6.1)	64 (8.5)	29 (9.3)	
	Transfer to outside	24 (3.5)	13 (2.3)	15 (2.4)	5 (0.8)	21 (3.1)	9 (2.0)	22 (2.9)	6 (1.9)	
Age (median [IQR])		57.00 [32.00, 76.00]	66.00 [42.00, 81.00]	61.00 [37.00, 77.00]	66.00 [42.00, 80.00]	57.00 [32.00, 74.00]	64.00 [41.00, 79.00]	64.00 [36.00, 80.00]	66.00 [47.75, 80.00]	<0.001
Gender (%)	Female	342 (44.6)	269 (42.2)	317 (44.4)	280 (42.4)	317 (41.8)	230 (44.6)	387 (44.6)	170 (46.6)	0.749
	Male	425 (55.4)	369 (57.8)	397 (55.6)	381 (57.6)	441 (58.2)	286 (55.4)	480 (55.4)	195 (53.4)	
Injury Type	Blunt	733 (97.7)	607 (95.7)	687 (96.2)	649 (98.2)	711 (93.8)	486 (94.7)	800 (93.2)	332 (92.5)	<0.001
	Penetrating	17 (2.3)	27 (4.3)	27 (3.8)	12 (1.8)	47 (6.2)	27 (5.3)	58 (6.8)	27 (7.5)	
ISS (median [IQR])		5.00 [2.00, 9.00]	5.00 [4.00, 9.00]	5.00 [2.00, 9.00]	5.00 [1.00, 9.00]	5.00 [2.00, 9.00]	5.00 [4.00, 9.00]	5.00 [4.00, 9.00]	8.00 [4.00, 9.00]	0.024
Living Status	Alive	748 (97.5)	622 (97.5)	694 (97.2)	639 (96.7)	740 (97.6)	494 (95.7)	842 (97.1)	353 (96.7)	0.586

	Dead	19 (2.5)	16 (2.5)	20 (2.8)	22 (3.3)	18 (2.4)	22 (4.3)	25 (2.9)	12 (3.3)	
LOS (median [IQR])		2.00 [1.00, 4.00]	2.00 [1.00, 5.00]	2.00 [1.00, 5.00]	2.00 [1.00, 5.00]	2.00 [1.00, 4.00]	2.00 [1.00, 5.00]	2.00 [1.00, 4.00]	2.00 [1.00, 5.00]	0.035

Table 3. Demographic data across different phases of COVID-19 pandemic and historic control. LOS: Length of Stay; ISS: Injury Severity Score, IQR: interquartile range; IR: interventional radiology; ICU: Intensive Care Unit. Pre-COVID 1 (2018-03-19 to 2018-9-19), Pre-COVID 2 (2018-09-19 to 2019-3-19), Pre-COVID 3 (2019-03-19 to 2019-9-19), Pre-COVID 4 (2019-09-19 to 2020-03-19), Post-COVID 1 (2020-03-19 to 2020-9-19), Post-COVID 2 (2020-09-19 to 2021-3-19), Post-COVID 3 (2021-03-19 to 2021-9-19), Post-COVID 4 (2021-09-19 to 2021-12-31).

Mechanisms	Pre-COVID 1	Pre-COVID 2	Pre-COVID 3	Pre-COVID 4	Post-COVID 1	Post-COVID 2	Post-COVID 3	Post-COVID 4	p
Fall	378 (49.3)	395 (61.9)	385 (53.9)	399 (60.4)	380 (50.1)	299 (57.9)	492 (56.7)	227 (62.2)	<0.001
MVA	162 (21.1)	116 (18.2)	119 (16.7)	155 (23.4)	133 (17.5)	102 (19.8)	118 (13.6)	51 (14.0)	<0.001
MCA	57 (7.4)	5 (0.8)	65 (9.1)	8 (1.2)	83 (10.9)	10 (1.9)	54 (6.2)	10 (2.7)	<0.001
ATV	24 (3.1)	10 (1.6)	25 (3.5)	13 (2.0)	42 (5.5)	11 (2.1)	36 (4.2)	7 (1.9)	<0.001
All assaults	21 (2.7)	21 (3.3)	22 (3.1)	14 (2.1)	30 (4.0)	29 (5.6)	36 (4.2)	18 (4.9)	0.03

Blunt assaults	15 (2.0)	12 (1.9)	11 (1.5)	8 (1.2)	7 (0.9)	14 (2.7)	19 (2.2)	11 (3.0)	0.14
GSW due to assault	4 (0.5)	6 (0.9)	5 (0.7)	1 (0.2)	10 (1.3)	8 (1.6)	4 (0.5)	2 (0.5)	0.076
Stabbing due to assault	2 (0.3)	3 (0.5)	6 (0.8)	5 (0.8)	13 (1.7)	7 (1.4)	13 (1.5)	5 (1.4)	0.059

Table 4. Mechanisms of injury compared across the different phases of the pandemic. Pre-COVID 1 (2018-03-19 to 2018-9-19), Pre-COVID 2 (2018-09-19 to 2019-3-19), Pre-COVID 3 (2019-03-19 to 2019-9-19), Pre-COVID 4 (2019-09-19 to 2020-03-19), Post-COVID 1 (2020-03-19 to 2020-9-19), Post-COVID 2 (2020-09-19 to 2021-3-19), Post-COVID 3 (2021-03-19 to 2021-9-19), Post-COVID 4 (2021-09-19 to 2021-12-31). MVA: Motor Vehicle Accident, MCA: Motorcycle Accident, ATV: All-terrain Vehicle, GSW: Gunshot Wound. Blunt assaults include injuries as a result of physical altercation without penetrating injuries.

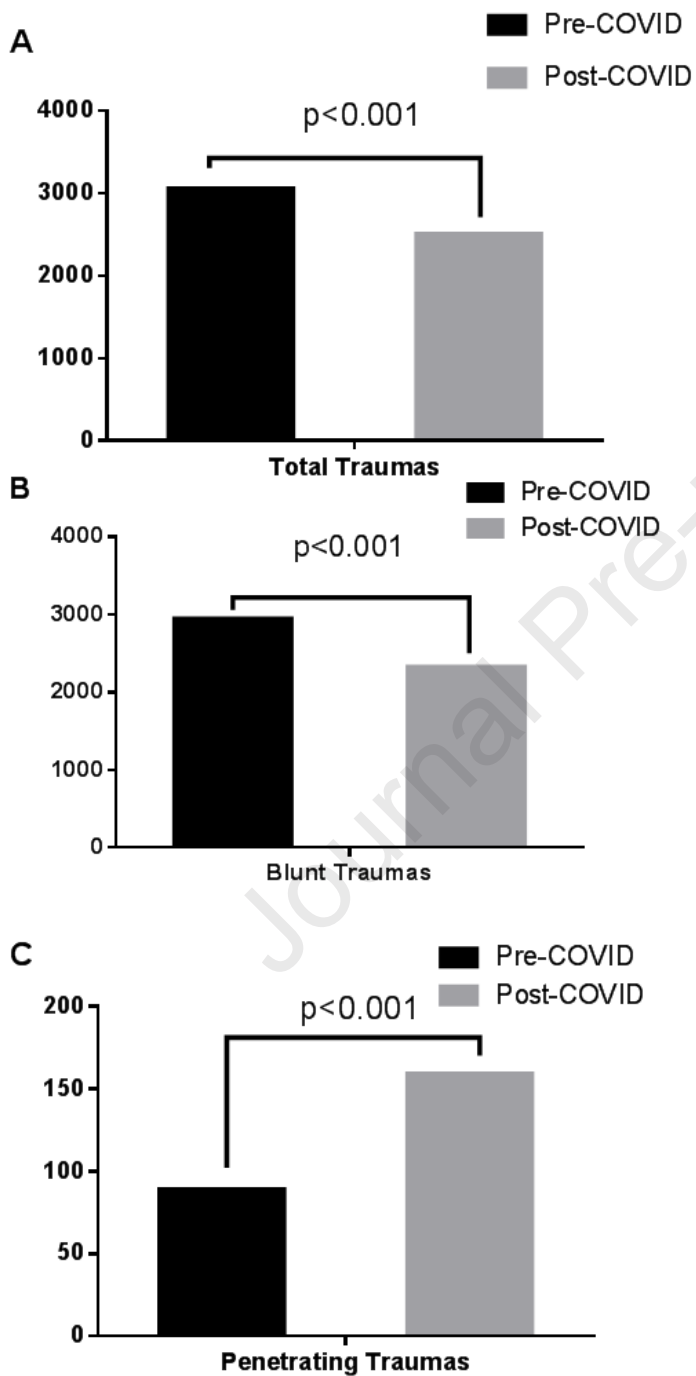


Figure 1. A, Total number of traumas, B, Blunt traumas, C, Penetrating traumas.

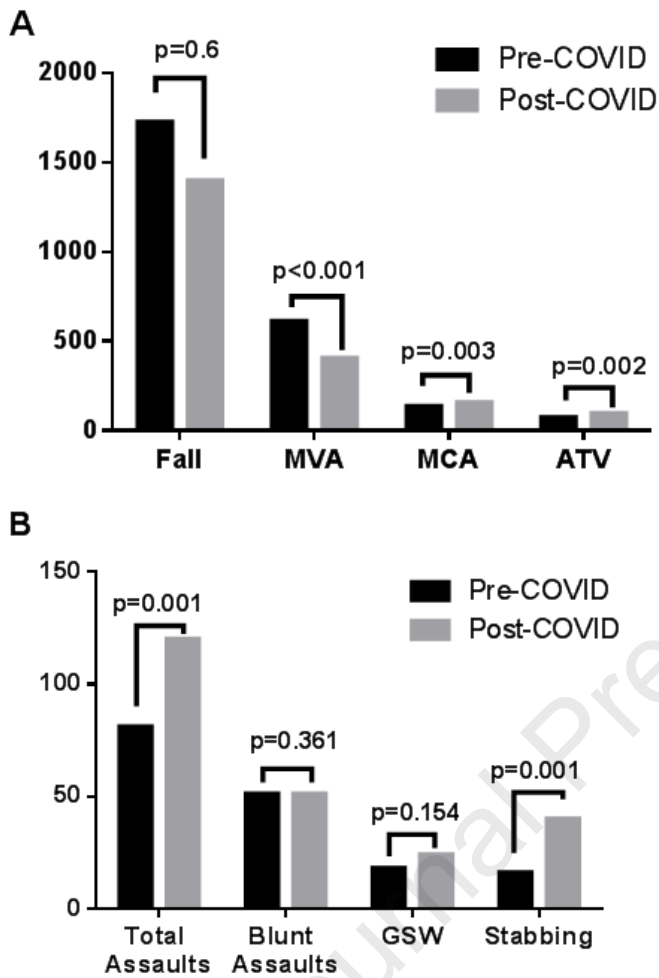


Figure 2. A, blunt mechanism of injury. B, Total assaults, including assaults involving blunt traumas (e.g. punching), or penetrating traumas (e.g. GSW and stabbing). MVA: Motor Vehicle Accident, MCA: Motorcycle Accident, ATV: All-terrain Vehicle, GSW: Gunshot Wound.

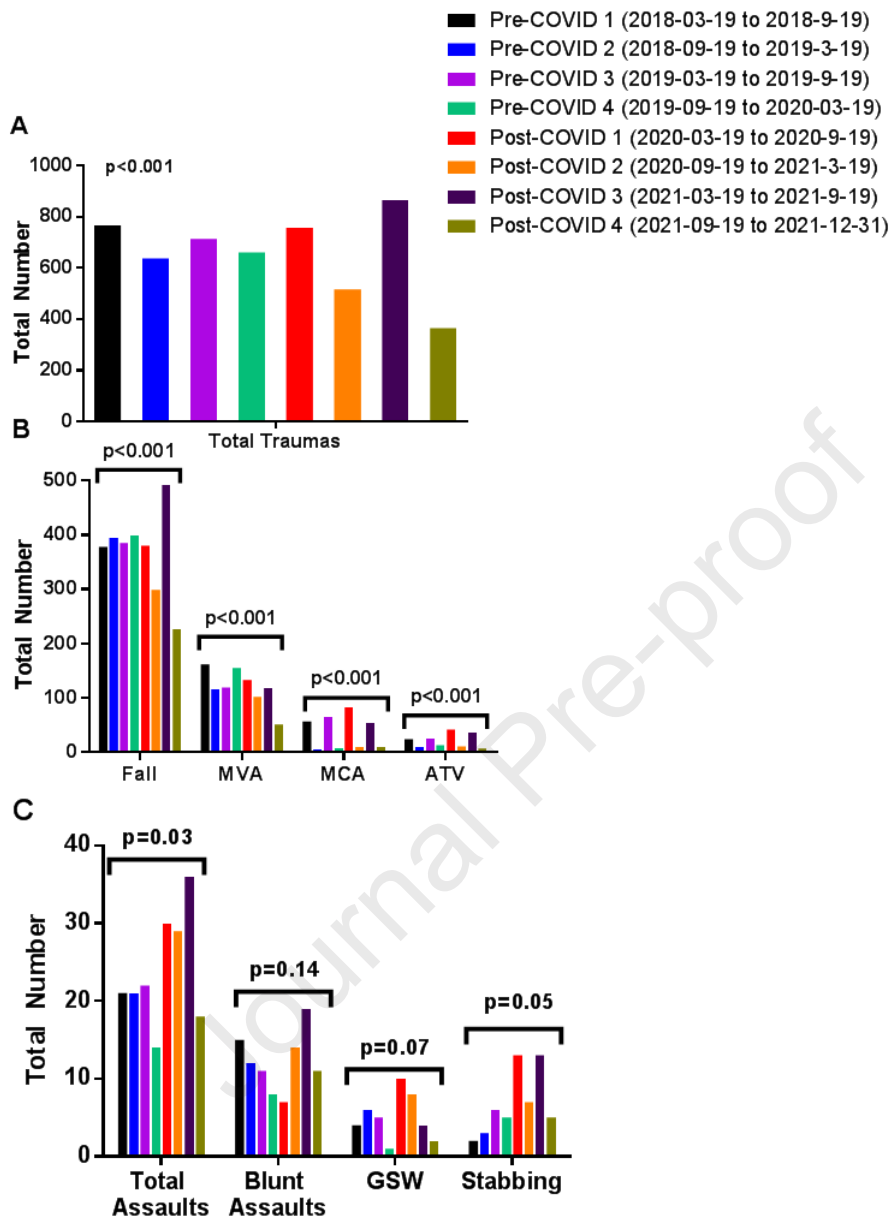


Figure 3. A, total trauma numbers across the different phases of the pandemic and the control era. B, blunt mechanism of injury. C, Total assaults, including assaults involving blunt traumas (e.g. punching), or penetrating traumas (e.g. GSW and stabbing). MVA: Motor Vehicle Accident, MCA: Motorcycle Accident, ATV: All-terrain Vehicle, GSW: Gunshot Wound.