Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Frequency of Firearm Injuries to Head and Neck Increased During Covid-19 Pandemic

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Purpose: During coronavirus disease-19 (COVID-19) pandemic, hospitals faced challenges which were different than previous years. The purpose this study was to report frequency of firearm injuries (FI) to head and neck during the COVID-19 pandemic.

Materials and Methods: This cross-sectional study reviewed patients in the Trauma Registry at Grady Memorial Hospital (GMH) in Atlanta, GA. Patients were included if they sustained FI to head and neck, were listed in TR, and were treated at GMH. Patients were stratified according to date of injury into *1)* before COVID-19 pandemic, (BC19) or *2)* during initial 5 months of COVID-19 pandemic, (C19). Variables were patient demographics, illegal substance use, etiology, place of injury, distressed communities index, location of injury, Glasgow Coma scale on arrival, cardiopulmonary resuscitation in Emergency Department (ED), shock on admission, disposition from ED, length of stay, days on mechanical ventilation and discharge status. Descriptive, univariate, and bivariate analysis were completed. Chi square test was used for categorical variables. Statistical significance was $P < .05$.

Results: There were 215 patients who met inclusion criteria. There were 96 patients (78 males) with a mean age of 31.5 years old during BC19. There were 119 patients (101 males) with a mean age 32.7 years old during C19. There was a 10.4% increase in FI to head and neck during COVID-19. Our data showed that alcohol use was associated with FI during C19 ($P \leq .0001$). FI to base of skull occurred 34.5% more often during C19 ($P = .002$). Cranial injuries occurred 26% more often during BC19 ($P = .03$). During BC19, 85.4% of the patients arrived alive to GMH, but only 16% arrived alive during C19 ($P \leq .0001$).

Conclusions: There were more FI to head and neck during COVID-10 pandemic than during the previous time period.

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The coronavirus disease-19 (COVID-19) was declared a global pandemic in March 2020 by the World Health Organization.[1] Almost immediately, local and national governments mandated to "stay at home" for the majority of the population. Rates of unemployment increased.[2] This new social situation introduced

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anxiety, depression, distress, and fear.[3] Concurrently, the Federal Bureau of Investigation (FBI) reported that significantly more firearms were sold in March 2020 than in previous months[4] resulting in an increase in access to firearms. This increase in access coupled with stress, anxiety, and mental illnesses, lead to an increase in firearm injuries (FI).[5]

COVID-19 added to an already existing problem of mortality from firearms which ranks among the leading causes of death in the United States (US).[6] Firearm-related injuries and/or deaths result in over $48 billion in medical expenses.[7]

Data on the impact of COVID-19 on FI is sparse. Specifically, there is a paucity of literature regarding the incidence of FI to head and neck during the COVID-19 pandemic nationally or regionally. The purpose of this study was to measure changes in the frequency of FI injuries during the pandemic. We hypothesized that frequency of FI to head and neck increased during the pandemic. The specific aims were to compare the frequency, demographics, and injury severity before and during the initial months of the pandemic.

Materials and Methods

STUDY DESIGN AND SAMPLE

This retrospective cohort study (Institutional Review Board #00000432) reviewed patients in the Trauma Registry (TR) at Grady Memorial Hospital (GMH) in Atlanta, GA. Study included patients who: *1)* sustained FI to head and neck, *2)* were included in TR as per American College of Surgeons guidelines,[8] and *3)* were treated at GMH. Patients were stratified according to date of injury indicated 2 groups: *1)* March 13 to August 13, 2019 (ie, before COVID-19 pandemic, [BC19]) or *2)* March 13 to August 13, 2020 (ie, during initial 5 months of COVID-19 pandemic, [C19]). March 13 was chosen because COVID-19 was announced as a national emergency on that date. This method of stratification was previously described by our group.[9]

VARIABLES

The primary predictor variable was time: before and during COVID-19 pandemic. The primary outcome variable was FI to head and neck. The research team collected patient-related variables: *1)* demographics (age, gender, race, insurance status [none/self-pay, commercial, government-subsidized]), *2)* substance use (alcohol and/or illicit drug/s), *3)* etiology (assault or self-inflicted), *4)* place of injury (home, public building, street, unknown location), and *5)* patient's distressed communities index (DCI). Variables regarding distribution of FI were: *1)* isolated soft tissue (face), boney (cranial bones [ie, frontal, parietal, orbit], base of skull [ie, occipital, sphenoid, temporal, maxilla, zygomaticomaxillary complex, nose/naso-orbito-ethmoid, mandible]), intraoral injuries, and/or neck, and *2)* other locations of injuries (lower and/or upper limb, abdomen, chest, pelvic). Severity of injury was described using the following variables: *1)* Glasgow Coma scale (1-15) on arrival to GMH, *2)* cardiopulmonary resuscitation in the Emergency Department (ED), *3)* diagnosis of shock on admission (ie, systolic blood pressure <90 mm Hg[10]), *4)* disposition from ED (intensive care unit [ICU], floor/step down unit, operating room, morgue), *5)* ICU length of stay (LOS), *6)* total days on mechanical ventilation (MV), *7)* hospital LOS, and *8)* discharge status (alive, expired).

DISTRESSED COMMUNITIES INDEX

The DCI was previously used to evaluate the impact of a community's socioeconomic status and the effect of health disparities on surgical procedure outcome.[10,11] It was developed by the Economic Innovation Group.[12] DCI exists for all zoning improvement plans (zip codes) in the United States (US) in which more than 500 people reside (ie, 99% of US population). DCI is a composite score based on the following metrics: *1)* no high school degree, *2)* housing vacancy rate, *3)* adults not working, *4)* poverty rate, *5)* median income ratio, *6)* change in employment, and *7)* change in business establishments.[10-12] Metrics are then averaged and converted to percentiles. DCI ranges between 0 (ie, no distress) to 100 (ie, severe distress).[10,13] DCI over 80 indicates distress; DCI below 20 indicates prosperity.[14] The research team used DCI to describe the sample's well-being or distress.

DATA ANALYSIS

Data was de-identified and recorded in a standardized collection form. Data was analyzed using IBM SPSS Statistical software for Windows (version 26; IBM; Armonk, NY). Descriptive statistics were performed. Univariate and bivariate analysis were calculated. Chi-square test was used for categorical variables. Statistical significance was $P < .05$.

Results

During the study period, 948 patients sustained FI. Of them, 215 patients had FI to head and neck and met inclusion criteria. There were 96 patients (78 males) with a mean age of 31.5 years old (range, 7 to 82) who sustained FI before the pandemic (ie, BC19 group). There were 119 patients (101 males) with an average age of 32.7 years old (range, 14 to 82) during the first 5 months of pandemic (ie, C19 group). Our

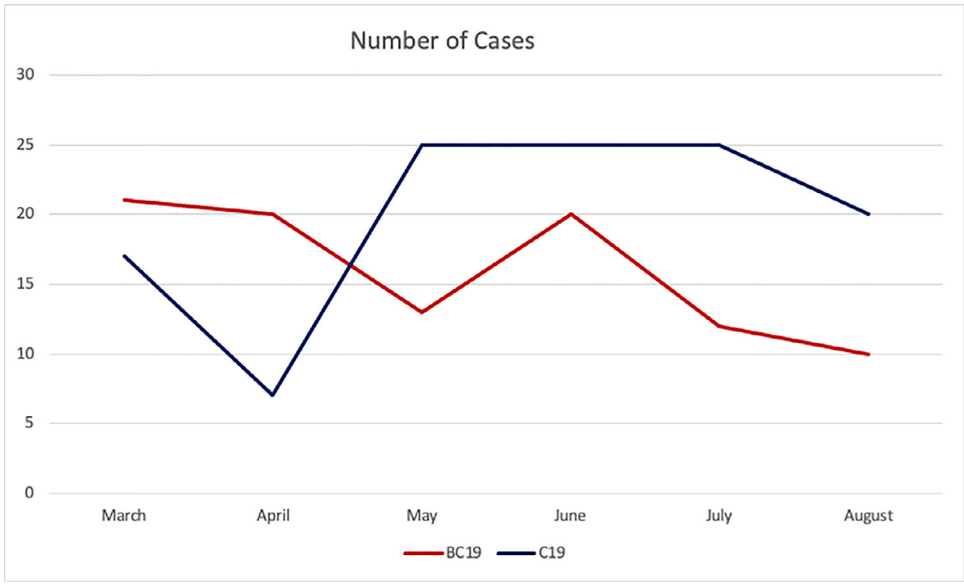

FIGURE 1. Incidence of firearm injuries to head and neck per month before COVID-19 (BC19) and during COVID-19 (C19).

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data showed an initial decrease in number of FI to head and neck cases during March and April. During the rest of study period, there was an increase in the number of cases. Overall, there was a 10.4% increase in the incidence of FI to the head and neck during the first 5 months of the COVID-19 pandemic (Fig 1).

The majority of patients in both groups were Black (BC19: n = 80, 83.3%; C19: n = 96, 80.7%) and/or uninsured/self-pay (BC19: n = 57, 59.4%; C19: n = 83, 69.7%). The most common etiology of FI in both groups was assault (BC19: n = 81, 84.4%; C19: n = 102, 85.7%). Most FI occurred at the victim's home (BC19: n = 40, 41.7%; C19: n = 37, 31.1%).

Substance use was alcohol (BC19: n = 31, 32.3%; C19: n = 5, 4.2%) and/or illicit drugs (BC19: n = 13, 13.5%; C19: n = 96, 80.7%). Alcohol use had a statistically significant difference between the 2 cohorts ($P \leq .0001$). There was no statistical difference in demographics, etiology, and place of injury between the 2 cohorts (Table 1).

During BC19, DCI was 71 (range, 3.7 to 98). During C19, DCI was 64.6 (range, 3.7 to 99.7) (Table 1). The mean DCI during the pandemic was 6.4% lower than before the pandemic. This value did not have statistical significance, but there was a trend towards significance ($P = .07$).

Table 2 summarizes the distribution of FI. During BC19, the most common FI was isolated soft tissue injuries to the face (n = 26, 27%), followed by cranial bones injuries (n = 25, 26%). During C19, the most common FI was isolated soft tissue injuries to face (n = 37, 37.1%), followed by base of skull injuries (n = 41, 34.5%). Our data showed that there were statistically more base of skull injuries during C19 ($P = .001$). In contrast, there were more cranial bone injuries during BC19 ($P = .03$) (Table 2). Most common extracranial locations were upper limb (BC19: n = 27, 28.1%; C19: n = 31, 26.1%), chest (BC19: n = 27, 28.1%; C19: n = 21, 17.6 %), and lower limbs (BC19: n = 19, 19.8%; C19: n = 20, 16.8%).

Table 3 consists of details regarding severity of FI. Regarding the specific variables which were investigated to summarize the severity of FI (ie, Glasgow Coma scale, cardiopulmonary resuscitation in ED, shock on admission, disposition form ED, ICU/hospital LOS, days on MV, discharge status), our data showed that there was no statistical difference in severity of FI between the 2 cohorts (Table 3).

Discussion

The purpose of this study was to measure changes in the frequency of FI injuries during the pandemic. Our hypothesis was that the incidence of FI to head and neck increased during the pandemic. The specific aims were to compare the frequency, demographics, and injury severity before and during the initial 5 months of the pandemic. To our knowledge, this is the first descriptive analysis of FI to head and neck during the COVID-19 pandemic.

Our data showed a transient decrease in FI injuries to head and neck during first 2 months of C19. This initial decrease in FI cases parallels the declaration of COVID-19 outbreak as a pandemic.[1] Gradually, the number of cases reached a 10.4% increase and surpassed the period BC19. During the same period, the Federal Bureau of Investigation (FBI) reports indicated an increase in purchases of firearms. As the pandemic

Table 1. DEMOGRAPHIC DATA

Variables	Before COVID-19 (BC19) n, (%) 96	COVID-19 (C19) n, (%) 119	*P* Value
Age, mean (yr), (range)	31.5 (7-82)	32.7 (14-82)	.55
Gender			.48
Male	78 (81.3)	101 (84.9)	
Female	18 (18.8)	18 (15.1)	
Racial distribution			.79
Black	80 (83.3)	96 (80.7)	
White	10 (10.4)	16 (13.4)	
Other	6 (6.3)	7 (5.9)	
Insurance status			.13
Uninsured/self-pay	57 (59.4)	83 (69.7)	
Commercial	15 (15.6)	19 (16)	
Government subsidized	24 (25)	17 (14.3)	
Substance Abuse			
Alcohol	31 (32.3)	5 (4.2)	<.0001*
Illegal substance	13 (13.5)	19 (16)	.58
Etiology			.49
Assault	81 (84.4)	102 (85.7)	
Self-inflicted	15 (15.6)	15 (12.6)	
Place of injury			.4
Home	40 (41.7)	37 (31.1)	
Public Building	11 (11.5)	13 (10.9)	
Street	22 (22.9)	32 (26.9)	
Unknown location	23 (24)	37 (31.1)	
DCI, mean, (range), %	71 (3.7-98)	64.6 (3.7-99.7)	.07

Abbreviation: DCI, Distressed communities index.
* Statistical significance ($P \leq .05$).

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Table 2. DISTRIBUTION OF FIREARM INJURIES TO HEAD AND NECK

	Before COVID-19 (BC19)n (%)	COVID-19 (C19) n (%)	*P* Value
Isolated soft tissue injuries			
Face	26 (27)	37 (37.1)	.3
Boney injuries			
Maxilla	5 (5.2)	6 (5)	>.99
Mandible	12 (12.5)	14 (11.8)	.87
ZMC	0	2 (1.7)	.5
Nose/NOE	3 (3.1)	1 (0.8)	.33
Orbit	6 (6.3)	13 (10.9)	.24
Base of skull	14 (14.6)	41 (34.5)	.001*
Cranial	25(26)	17(14.3)	.03*
Intraoral injuries	1(1)	2 (1.7)	>.99
Neck	21 (21.9)	24 (20.2)	.76
Other location/s			
Upper limb	27 (28.1)	31 (26.1)	.73
Chest	27 (28.1)	21 (17.6)	.07
Lower limb	19 (19.8)	20 (16.8)	.57
Pelvic	8 (8.3)	16 (13.4)	.24
Abdomen	9 (9.4)	14 (11.8)	.57

Abbreviations: NOE, naso-orbito-ethmoid; ZMC, zygomaticomaxillary complex.
* Statistical significance ($P \leq .05$).

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Table 3. SEVERITY OF FIREARM INJURIES

	Before COVID-19 (BC19)n (%)	COVID-19 (C19)n (%)	*P* Value
GCS mean, (range)	10.6 (3-15)	10.6 (3-15)	>.99
CPR in ED	2 (2.1)	5 (4.2)	.47
Shock on admission*	22 (22.9)	24 (20.2)	.65
Disposition from ED			.75
OR	35 (36.5)	40 (33.6)	.66
ICU	18 (18.8)	31 (26.1)	.21
Morgue	19 (19.8)	24 (20.2)	.95
Floor/Step down	17 (17.7)	17 (14.3)	.49
Home	7 (7.3)	7 (5.9)	.68
ICU LOS mean (days), (range)	9.4 (1-71)	6.9 (1-36)	.25
Days on MV mean, (range)	7.8 (1-70)	4.9 (0-29)	.22
Hospital LOS mean (days), (range)	11.4 (1-136)	7.9 (1-48)	.16
Discharge Status			.84
Alive	69 (71.9)	87 (73.1)	
Expired	27 (28.1)	32 (26.9)	

Abbreviations: CPR, cardiopulmonary resuscitation; ED, emergency department; GCS, Glasgow Coma scale; ICU, intensive care unit; LOS, length of stay; MV, mechanical ventilator; SBP, systolic blood pressure; SD, standard deviation.

* Shock on admission is defined as SBP <90 mm Hg.[8]

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progressed, the number of FI to head and neck increased. An increase in stress, depression, and anxiety secondary to COVID-induced lifestyle,[3] high unemployment rates,[15,16] and easier access to firearms created an ideal setting for this increase in FI. Specifically, the US government issued shelter-in-place orders in order to decrease transmission of COVID-19 and potentially overwhelming health care systems.[17,18] Organizations and institutions encouraged their employees to work remotely, [19,20] but schools and childcare facilities closed.[21] Therefore, people worked from home and provided childcare concomitantly, which increased stress levels.[22] Restaurants, gyms, and various entertainment venues closed[23,24]; people did not have an outlet to relieve stress and anxiety.[25] Physical contact with family and friends was limited[26]; individuals who used social interactions and physical touch to restore calmness were not able to do so because of the risk of transmission.[26] As a result, the COVID-19 pandemic created levels of stress, anxiety, and social isolation that communities have never experienced.[27] Furthermore, despite a higher rate of burnout, an outlet for stress did not exist.[28]

Concomitantly, the pandemic introduced a sudden economic recession with progressing economic hardship and an increase in unemployment.[29] Specifically, by May 2020, 20 million Americans lost their jobs and became unemployed.[30] This unemployment created unrest and fear; citizens felt a need for self − preservation,[31,32] which occasionally manifested as purchasing firearms. The FBI reported that over 700,000 additional firearms were sold than in previous months.[4,33] This amount represents over 120,000 firearms per day in March 2020.[4]

Social isolation, anxiety, fear of contagion, uncertainty, chronic stress, and economic difficulties have been shown to lead to the development or exacerbation of psychiatric disorders (ie, depression, anxiety, substance use).[3] A positive correlation between access to firearms, stress, anxiety, mental illnesses, and FI was previously discussed.[5] A recent study reported a positive correlation between unemployment and the increase in firearm violence.[31,32] Our finding is consistent with these reports which showed an increase in total FI during the COVID-19 pandemic.[16,31,32,34] Similar to our results, studies stated that access to firearms, burnout from the new lifestyle, an increase in stress, depression, and anxiety lead to additional FI.[3,30]

The DCI during the COVID-19 pandemic decreased by 6.4%. This decrease indicates that the overall distress is decreased in this cohort. Our data showed that the decrease is trending toward significance, which indicates that a larger sample size would potentially show a statistical significance. Overall, there is no consensus regarding the decrease in community distress during C19. This is the subject of an ongoing investigation at our institution.

Our data showed an increase in base of skull FI. The study team separated FI into specific locations such as base of skull, facial bone, and intraoral sites. This separation was important because assault typically causes

base of skull injuries[35] but self-inflected injuries cause orbital/ocular injuries.[35] A FI to base of skull is typically fatal since the damage extends locally to cause significant brain damage.[35] However, in our cohort, patients who sustained FI to base of skull did not present with similar devastating injuries.

Although there was an increase in incidence of FI to head and neck, LOS (in hospital and in ICU) and days on MV were shorter during the COVID-19 pandemic. The authors contribute this finding to the unprecedented bed demands during the pandemic.[36] It is possible that inpatient teams made intentional efforts to hasten discharges in anticipation of need for beds for patients with COVID. Hospitals were required to adjust resources to keep ICU units available for the expected increase in COVID-19 admissions.[13]

Finally, a hidden consequence of the COVID-19 pandemic is its impact on trauma quality initiatives (ie, updating TR).[37] There was a large increase in the need for direct patient care during the initial stages of the pandemic. Therefore, some staff who were assigned to TR were deployed from their routine roles of abstracting charts to direct patient care.[37] In our study, this likely decreased the speed by which data was available in TR.

This study had a few limitations. First, this study relied on a large data set (ie, institutional TR) which had some missing and incomplete information. In addition, it is possible that our data underestimates the true incidence of FI to the head and neck because this TR only included hospitalized patients. Patients who sustained minor injuries from FI were likely not admitted to hospital and thus were not included. Lastly, our data only represents the initial 5 months of the pandemic. As the pandemic continues, epidemiology of FI may change.

In conclusion, FI increased during the COVID-19 pandemic in comparison to its historic cohort.

Our data showed that FIs to head and neck continued to be a public health concern during the COVID-19 pandemic.

Press Release

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