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Changes in pediatric trauma during COVID-19 stay-at-home epoch at a tertiary pediatric hospital



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ABSTRACT

Background: Trauma is the leading cause of morbidity and mortality in the pediatric population. However, during the societal disruptions secondary to the coronavirus (COVID-19) stay-at-home regulations, there have been reported changes to the pattern and severity of pediatric trauma. We review our two-institution experience.

Methods: Pediatric trauma emergency department (ED) encounters from the National Trauma Registry for a large, tertiary, metropolitan level 1 pediatric trauma center and pediatric burn admission at the regional burn center were extracted for children less than 19 years from March 15th thru May 15th during the years 2015–2020. The primary outcome was the difference in encounters during the COVID-19 (2020) epoch versus the pre-COVID-19 epoch (2015–2019).

Results: There were 392 pediatric trauma encounters during the COVID-19 epoch as compared to 451, 475, 520, 460, 432 (mean 467.6) during the pre-COVID-19 epoch. Overall trauma admissions and ED trauma encounters were significantly lower ($p < 0.001$) during COVID-19. Burn injury admissions ($p < 0.001$) and penetrating trauma encounters ($p = 0.002$) increased during the COVID-19 epoch while blunt trauma encounters decreased ($p < 0.001$). Trauma occurred among more white ($p = 0.01$) and privately insured ($p < 0.001$) children, but no difference in suspected abuse, injury severity, mortality, age, or gender were detected. Sub-analysis showed significant decreases in motor vehicle crashes ($p < 0.001$), pedestrians struck by automobile ($p < 0.001$), all-terrain vehicle (ATV)/motorcross/bicycle/skateboard involved injuries ($p = 0.02$), falls ($p < 0.001$), and sports related injuries ($p < 0.001$). Fewer injuries occurring in the playground or home play equipment such as trampolines neared significance ($p = 0.05$). Interpersonal violence (assault, NAT, self-harm) was lower during the COVID-19 era ($p = 0.04$). For burn admissions, there was a significant increase in flame burns ($p < 0.001$).

Conclusions: Stay-at-home regulations alter societal patterns, leading to decreased overall and blunt traumas. However, the proportion of penetrating and burn injuries increased. Owing to increased stressors and time spent at home, healthcare professionals should keep a high suspicion for abuse and neglect.

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Level of Evidence:

Level III Treatment study: retrospective comparative study

1. Introduction

Trauma is the leading cause of morbidity and mortality among children [1]. Stay-at-home regulations during the SARS-CoV-2

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novel coronavirus (COVID-19) pandemic caused massive changes in travel, social interactions, and scholastic/athletic/extracurricular activities. International reports have shown changes in overall volume as well as type and severity of traumas. In New Zealand, quarantine was associated with 48% reduction in pediatric trauma [2]. In the United Kingdom, increased abusive head trauma cases were noted during quarantine [3].

In the United States, how stay-at-home regulations affect pediatric trauma occurrence is still being investigated, with increased attention toward non-accidental trauma (NAT) and burn injuries. As COVID-19 disease burden continues to fluctuate, communities

may be faced with a return to physical distancing, stay-at-home regulations, and further virtual classrooms leading to alterations in risk of trauma. A heightened awareness for injuries sustained in the home, including NAT, is imperative to pediatric trauma evaluation.

We performed an observational case-control study to test the hypothesis that stay-at-home regulations were associated with changes in pediatric trauma encounters at a large, level 1 pediatric trauma center and the regional burn center serving a major metropolitan area.

2. Methods

After Institutional Review Board approval (STU-2020-0532), pediatric trauma emergency department (ED) encounters and hospital admissions from the data collection for the institutional trauma registry for Children's Medical Center Dallas (a large, quaternary, metropolitan level 1 pediatric trauma center) and pediatric burn admission for Parkland Hospital (regional burn center) were extracted for children less than 19 years from March 15th thru May 15th during the years 2015–2020. During this period in 2020, Dallas county was in a "shelter-in-place" ordinance and regional school systems within the Dallas-Fort Worth metropolitan area and north Texas transitioned to a virtual education system for the remainder of the 2019–2020 school year. All school-sanctioned extracurricular activities, including athletics, were cancelled.

The primary outcome was the difference in overall emergency department trauma encounters and trauma admissions at the Children's Hospital, and burn center admissions at Parkland Hospital during the COVID-19 (2020) epoch versus the pre-COVID-19 epoch (2015–2019). Encounters include all patients seen and evaluated for a trauma mechanism, including those who were not admitted. Trauma subtype, race/ethnicity, insurance status, suspicion for abuse, mortality and injury severity variables were extracted. The burn registry data only includes burns that required admission to Parkland Hospital, and does not capture burn evaluations in the Parkland ED that were not admitted.

A nonparametric bootstrap with 10,000 samples defined confidence intervals for the distribution of means for all pediatric trauma encounters and each trauma sub-type (blunt, penetrating, burn) for the pre-COVID-19 epoch. Pearson Chi Square defined statistical differences in the distribution of categorical variables between the pre-COVID-19 epoch and COVID-19 epoch. Wilcoxon rank-sum defined statistical differences between median values for non-parametric, continuous variables.

3. Results

There were 392 pediatric trauma encounters during the COVID-19 epoch as compared to 451, 475, 520, 460, 432 during the pre-COVID-19 epoch. During the COVID-19 epoch, overall trauma encounters were significantly lower ($p < 0.001$) than the bootstrap mean of encounters (460, 95%CI 424–496) from pre-COVID-19 epochs. However, burn injury admissions (79 vs 64, 95%CI 60–69, $p < 0.001$) and penetrating trauma encounters (43 vs 34, 95%CI 28–40, $p = 0.002$) increased during the COVID-19 epoch while blunt trauma encounters decreased (270 vs 359, 95%CI 324–394, $p < 0.001$) (Fig. 1).

Trauma occurred among more white ($p = 0.01$) and privately insured ($p < 0.001$) children during the COVID-19 epoch (Table 1). No difference in suspected abuse, injury severity, mortality, age, or gender were detected.

When further classified for subtypes under mechanism, there were significant differences: During the COVID-19 epoch, there were fewer encounters and admissions for motor vehicle crashes (MVC) ($p < 0.001$), pedestrians struck by automobile ($p < 0.001$,

all-terrain vehicle (ATV)/motorcross/bicycle/skateboard involved injuries ($p = 0.02$), falls ($p < 0.001$), and sports related injuries ($p < 0.001$). Injuries occurring in the playground or home play equipment such as trampolines neared significance ($P = 0.05$). We grouped interpersonal violence (assault, NAT, self-harm) and this was lower during the COVID-19 era ($p = 0.04$). For burn admissions, there was a significant increase in flame burns ($p < 0.001$) (Table 2).

4. Discussion

The societal changes necessitated by COVID-19 impact pediatric mental health, child neglect, and the occurrence of pediatric traumatic injuries [4,5]. Consistent with previous reports, we identified decreased overall trauma encounters during stay-at-home regulations which was attributable to decreased blunt injuries [6,7]. This included decreases in pediatric orthopedic injuries during the pandemic and likely reflect reduced motor vehicle travel, lack of extracurricular activities, and changes in childcare/observation [6–8].

However, there appears to be a trend across literature from the United States showing an increase in penetrating injuries during stay-at-home regulations. Our data are aligned with these previous findings. In Philadelphia, there was an increase in gun-related trauma during March 2020, despite overall decrease in trauma encounters in the ED [9,10]. Although their study did not show an increase in overall trauma, penetrating trauma, or NAT among pediatric trauma centers, they highlight the overall increased rates of interpersonal violence that was observed in other major cities in the United States.

Burn visits to regional burn centers published by other groups were also similar to our experience. Burn injuries admitted to our regional burn center increased during the COVID-19 epoch, contrasting with previous trends of decreasing pediatric burn admissions at Parkland Hospital from 1974 to 2010 [11]. Sethuraman et al. highlight the increased proportion of burn visits and severity during the stay-at-home period in the metro Detroit area, with a significant increase in proportion of house fire related burns [12]. Although they had a 66.6% reduction in overall ED visits and a 35% reduction in overall burn visits, they note an increase in house fire proportion, burn alerts, total body surface area (TBSA) burned, proportion of children with >5% TBSA, and intensive care unit admissions. They speculate that this increase may be owing to potential loss of social connections and family support, stress of working from home while managing virtual school, lack of structured childcare environments, and reduced supervision of children. In North Carolina, there was a 9% increase in pediatric admissions to their burn center during the stay-at-home order, with a 28% increase in admissions for school age children compared to a similar time period in 2019 [13]. They note this is similar to the admissions seen during summertime months when children are not attending school. Variance in childcare or parental monitoring at home along with greater exposure to burn risk in the home environment may explain the increase in burn injuries. Our data indicate further public education on burn prevention are warranted.

Finally, although we did not observe an increase in NAT during the stay-at-home epoch, our data may lack power to detect smaller differences in the proportion of NAT. Suspicion for abuse and neglect, as well as interpersonal violence, must be high during times of family stress. We are fortunate to have a pediatric forensic team dedicated to determining NAT in our trauma patients, but they must be consulted by the emergency department or the trauma team to begin the investigation. It is likely that NAT is under-detected and underreported. In a single-center retrospective review, Kovler et al. noted an increase in physical child abuse increase to 13% of all trauma patients, compared to 4 and 3% in the previous years [14]. Similarly, suspected abusive head

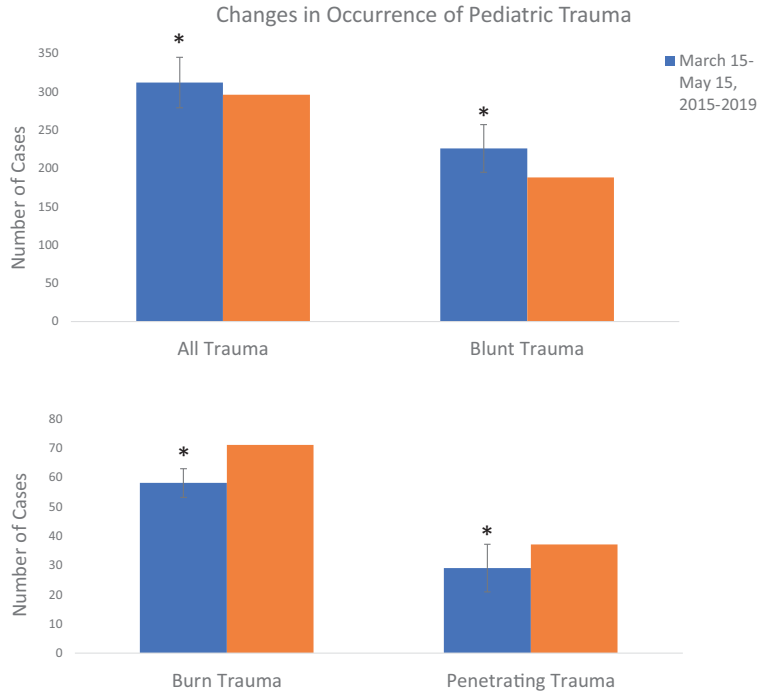


Fig. 1. Changes in occurrence of pediatric trauma.

**p* < 0.001
 ^*p* = 0.002.

Table 1

Characteristics of pediatric trauma encounters from March 15–May15 stratified by pre-Covid-19 Epoch (2015–2019) and Covid-19 Epoch (2020).

Characteristic	2015–2019 (N = 2338)	2020 (N = 392)	P
AGE	6.2 (3, 11) ^a	6 (2, 11) ^a	0.69
Sex			
Male	1423 (60.9)	234 (59.7)	0.66
Female	915 (39.1)	158 (40.3)	
Trauma Subgroups			
Blunt	1853 (79.3)	270 (68.9)	<0.001
Penetrating	168 (7.2)	43 (11.0)	
Burn ^b	317 (13.6)	79 (20.2)	
Latino ethnicity			
Yes	905 (38.7)	142 (36.2)	0.25
No	1380 (59.0)	245 (62.5)	
Unknown	53 (2.3)	5 (1.3)	
Race			
White	1438 (61.5)	270 (68.9)	<0.001
African-American	432 (18.5)	77 (19.6)	
Unknown	468 (20.0)	45 (11.5)	
Health Insurance Status			
Private	706 (30.2)	149 (38.0)	<0.001
Public	1295 (55.4)	218 (55.6)	
Uninsured	334 (14.3)	24 (6.1)	
Other/Unknown	3 (0.1)	1 (0.3)	
Case investigated for abuse			
Yes	89 (3.8)	12 (3.1)	0.71
No	2248 (96.2)	380 (96.9)	
Unknown	1 (0.04)	0	
Mortality			
Yes	17 (0.7)	2 (0.5)	0.63
No	2321 (99.3)	390 (99.5)	
Injury Severity Scale	4 (2, 6) ^{b,c}	4 (1, 9) ^{b,c}	0.95

^a Median values with interquartile ranges reported.

^b Burn injury encounters only available for admitted patients.

^c Burn injury encounters do not include injury severity scale values, median values with interquartile ranges reported. All other parentheses values designate percentages.

Table 2

Subgroup analysis of pediatric trauma types from March 15–May 15 stratified by Pre-Covid-19 Epoch (2015–2019) and Covid-19 Epoch (2020).

Mechanism	2015–2019*	2020	p value
BLUNT			
Motor vehicle crash	53.2 (39.3–67.1)	27	<0.001
Pedestrian vs automobile	50 (42.0–58.0)	14	<0.001
ATV, bicycle, skateboard	23.8 (15.7–32.0)	73	0.02
Fall	52.2 (42.7–61.7)	36	<0.001
Sports	40.2 (33.0–47.4)	8	<0.001
Playground/home	111 (81.5–140.5)	81	0.05
Workplace	4 (0–2.86)	1	0.80
Furniture/crush	13.8 (8.44–19.2)	13	0.78
Assault/NAT/Self-Harm	20.6 (16.1–25.1)	17	0.04
PENETRATING			
Stab/laceration	14.4 (7.2–21.6)	18	0.21
GSW/pellet gun	6.6 (3.5–9.7)	7	0.81
Animal bite	17.6 (9.1–26.1)	18	0.93
BURN			
Scald	38.2 (29.5–46.9)	44	0.54
Flame	22.4 (16.3–28.5)	32	<0.001
Electric/Chemical/SJS	2.4 (1.1–3.7)	3	0.37

*Mean values with 95% confidence intervals in parenthesis.

ATV = all terrain vehicle; NAT = non-accidental trauma; GSW = gunshot wound; SJS = Stevens-Johnson Syndrome.

trauma increased from a mean of 0.67 cases per month to 10 cases per month during COVID-19 quarantine measures at Great Ormond Street Hospital for Children [3]. Other reports confirm an increase in domestic abuse and family violence in countries which enforced social distancing regulations [15,16]. In enforcing social distancing to reduce transmission, the unintended side effects of parental stress, unemployment, decreased child care and supervision, and virtual learning may increase the risk of abuse. Additionally, for many children, school is the most common means for children to engage with reporting bodies; by going virtual, signs of abuse may not be identified. In turn, physicians and other healthcare professionals may be the only contact for abused or neglected children.

A greater number of encounters occurred among white, privately insured children. Although our institutions are a level 1 pediatric trauma center and regional burn center in a large metropolitan area, it is possible that our data does not encompass the true nature of trauma patterns during the pandemic. Children from differing socioeconomic or racial groups may be less likely to present to large hospital systems owing to disproportionate impact of COVID-19 among minorities [17–30]. Our literature review has found that there is deeply rooted skepticism, especially within the Black and immigrant communities, toward the medical establishment. Furthermore, the COVID-19 pandemic has highlighted disproportionate burdens on low socioeconomic groups, who are at highest risk of exposure and lowest ability to isolate owing to limited living situations, and those in the Black community who have been reported to have worse outcomes. It is certainly possible that as families lost employment, and likely their insurance coverage, that the added burdens of having to pay for an emergency room visit may have led families to not seek medical care. This could result in detected, rather than actual, differences in occurrence of traumatic injury.

Although our analysis was conducted at the sole pediatric level 1 trauma center and regional burn center in a major metropolitan area, akin to previous reports it is limited in generalizability. Differing state regulations during the stay-at-home time period and differing regional pediatric activities diminish the generalizability of our data. The covariables we analyzed are limited to those available in the respective registries, including the fact that the burn center data only captures admission. It is likely that the burn numbers are higher if our registry also included burns presenting to the

emergency room that did not require inpatient admission. A review of a national database may offer a more comprehensive assessment of alterations in pediatric trauma during stay-at-home regulations.

Despite limitations, our analysis aligns with previous retrospective reports describing alterations in traumatic injuries during stay-at-home precautions in the United States. During these periods of social, educational, and societal disruptions, it will become imperative for healthcare professionals to be prepared for proportional increases in penetrating trauma and burn related injuries. These data may inform health policy guidelines and resources expenditures as quarantine policies evolve with the ongoing public safety measures implemented to curb COVID-19.

Contributors statement

Drs. Sanford and Zagory conceptualized and designed the study, drafted the initial manuscript, and reviewed and revised the final manuscript.

Mr. Blackwell carried out initial analysis and reviewed and revised the final manuscript.

Drs. Szmuk and Ryan coordinated and supervised data collection, and critically reviewed the manuscript for intellectual content.

Dr. Ambardekar conceptualized the study, supervised data collection, and critically appraised and edited the final manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Declaration of Competing Interest

The authors have no conflicts of interest to disclose.

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