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.

The Effects of Lockdown During the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Pandemic on Neurotrauma-Related Hospital Admissions

Javier M. Figueroa, James Boddu, Michael Kader, Katherine Berry, Vignessh Kumar, Veronica Ayala, Steven Vanni, Jonathan Jagid

BACKGROUND: **The response to the global severe acute respiratory syndrome coronavirus 2 pandemic culminated in mandatory isolation throughout the world, with nationwide confinement orders issued to decrease viral spread. These drastic measures were successful in "flattening the curve" and maintaining the previous rate of coronavirus disease 2019 infections and deaths. To date, the effects of the coronavirus disease 2019 pandemic on neurotrauma has not been reported.**

METHODS: **We retrospectively analyzed hospital admissions from Ryder Trauma Center at Jackson Memorial Hospital, during the months of March and April from 2016 to 2020. Specifically, we identified all patients who had cranial neurotrauma consisting of traumatic brain injury and/or skull fractures, as well as spinal neurotrauma consisting of vertebral fractures and/or spinal cord injury. We then performed chart review to determine mechanism of injury and if emergent surgical intervention was required.**

RESULTS: **Compared with previous years, we saw a significant decline in the number of neurotraumas during the pandemic, with a 62% decline after the lockdown began. The number of emergent neurotrauma surgical cases also significantly decreased by 84% in the month of April. Interestingly, although the number of vehicular traumas decreased by 77%, there was a significant 100% increase in the number of gunshot wounds.**

CONCLUSIONS: **Population seclusion had a direct effect on the frequency of neurotrauma, whereas the change in relative proportion of certain mechanisms may be associated with the psychosocial effects of social distancing and quarantine.**

INTRODUCTION

As of June 1, 2020, the global incidence of coronavirus disease 2019 (COVID-19) was 6.05 million confirmed cases, with 371,000 related deaths. The United States had a major proportion of infections, with 1.7 million confirmed cases and 102,000 related deaths.[1] Specific to our institution, Miami-Dade county had 18,139 confirmed cases with 702 associated deaths. The first case of COVID-19 in Miami-Dade county was confirmed on March 12, 2020, nearly 50 days after the initial case in the United States and 8 days after the initial case in Florida.[2] A subsequent statewide closing of restaurants and bars on March 17, 2020, was then implemented to decrease viral spread. However, after a significant increase in infection rate over the next few weeks, the Governor of Florida issued an executive "stay-at-home" order on April 1, 2020.[3] Although the rate of viral spread improved, we also saw a decrease in both the number of accidents causing traumatic injuries and the number of emergent surgical procedures, secondary to a decline in both foot and automobile traffic.[4]

METHODS

After obtaining approval for this retrospective study from the University of Miami institutional review board, we queried the registry at Ryder Trauma Center to obtain a list of patients from 2016 to 2020 who sustained neurotrauma during the time frame of March 1 to April 30, 2020. Neurotrauma was defined as patients with traumatic brain injury, skull fractures, spinal cord injury, and

Key words
- Admissions
- COVID-19
- Lockdown
- Neurotrauma
- Pandemic

Abbreviations and Acronyms
COVID-19: Coronavirus disease 2019
GSW: Gunshot wound
PHBC: Pedestrian hit by car

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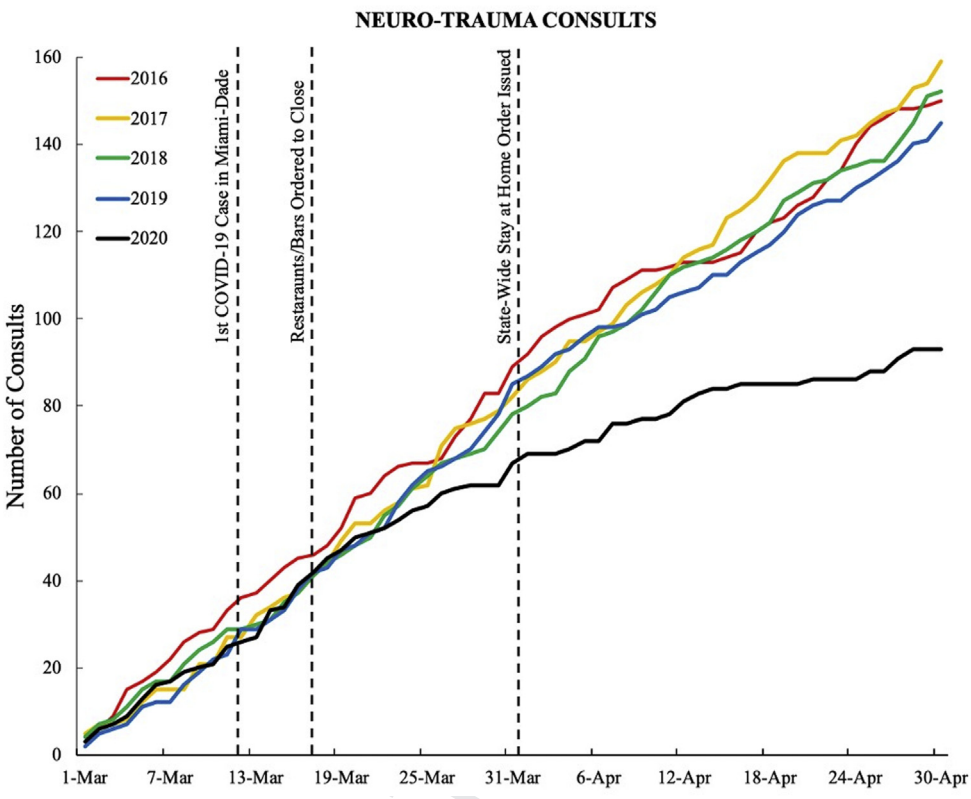

Figure 1. Neurotrauma consults. The average number of neurotrauma consults between 2016 and 2019 was 151.5, with 83.5 in March and 68 in April. There were 67 neurotrauma consults in March 2020, which was significantly lower than the previous-year average ($P = 0.036$, Poisson analysis). There were 26 neurotrauma consults in April 2020, which was significantly lower than the previous-year average ($P = 0.0001$, Poisson analysis). COVID-19, coronavirus disease 2019.

vertebral fractures. Chart review was then performed to obtain variables such as age, sex, mechanism of injury, type of injury, and need for emergent surgery. Mechanisms of injury included assaults, bicycle accidents, ground-level falls (sitting, standing), falls from height (ladder, roof, multiple stories), gunshot wounds (GSWs), motorcycle collisions, motor vehicle collisions, pedestrian hit by car (PHBC), and other (boating, jet-ski, diving). Emergent surgery included procedures such as craniotomy, craniectomy, elevation of depressed skull fracture, skull-base repair for leakage of cerebrospinal fluid, laminectomy for spinal decompression, and instrumented fusions for spinal instability. Data sources included hospital charts and imaging studies.

Data from the previous years 2016–2019 were used to establish baselines for statistical analysis. The absolute number of neurotrauma consults, surgeries, and mechanisms of injury in 2020 were compared with previous monthly averages and analyzed by Poisson regression analysis. The relative differences in proportion of mechanisms of injury in 2020 were compared before monthly averages by χ^2 proportion analysis. All statistical analysis was accomplished on GraphPad Prism 8 scientific software (GraphPad Software, San Diego, California, USA).

RESULTS

Overall, we found a significant difference in the average number of monthly neurotrauma consults from 2016 to 2019, with 83.5 ± 4.7 in March and 68.0 ± 8.8 in April ($P = 0.048$, Student t test). However, in March 2020 we saw a 20% decrease in total neurotrauma consults, which was significantly lower ($P = 0.036$, Poisson analysis) than previous years (Figure 1). This declining trend continued in April 2020, with the number of neurotrauma consults decreasing significantly by 62% ($P = 0.0001$, Poisson analysis), after a statewide "stay-at-home" order was issued on April 1, 2020 (Figure 1). Further analysis demonstrated that the number of operative cases for neurotrauma also decreased significantly by 84% ($P = 0.0004$, Poisson analysis) in April 2020 (Figure 2).

We then evaluated the mechanisms of injury for monthly neurotrauma consults and found no significant difference from 2016 to 2020. However, with only 28% of consults in 2020 coming in April, results may have been masked by normal proportions in March. When assessed individually, we found several differences in mechanisms of injury between March and April 2020 (Figure 3). Although absolute numbers of nearly all mechanisms of injury

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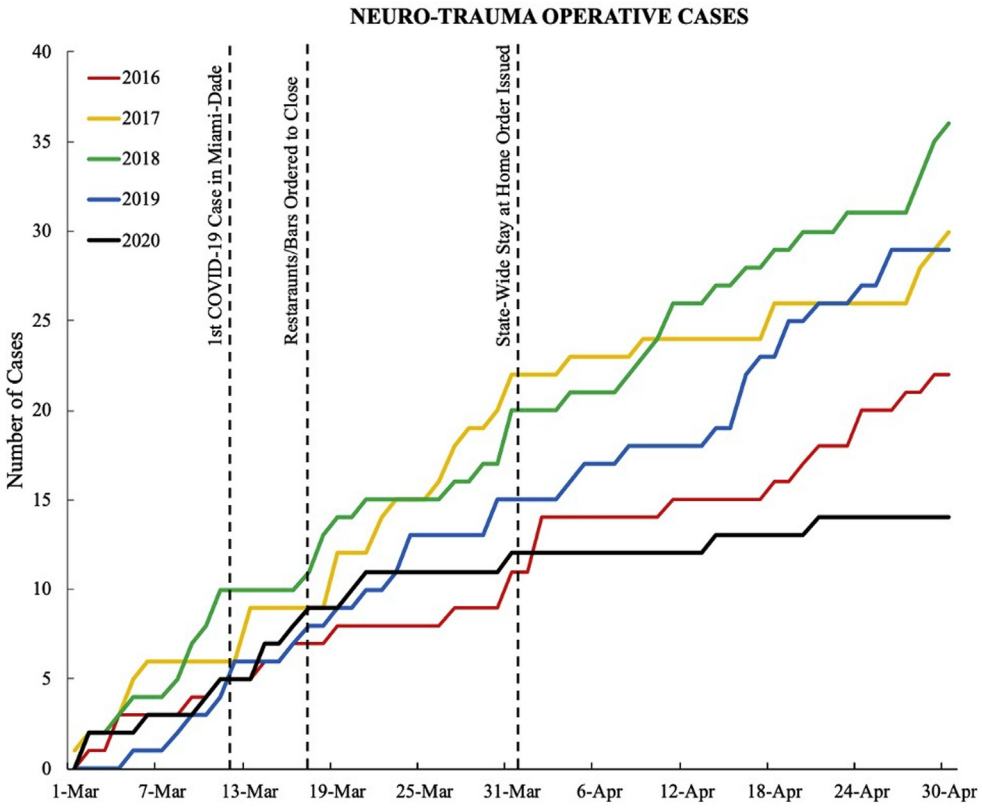

Figure 2. Neurotrauma operative cases. The average number of neurotrauma operative cases between 2016 and 2019 was 29.25, with 17.0 in March and 12.25 in April. There were 12 neurotrauma surgeries in March 2020, which was not significantly lower than the previous year average ($P = 0.135$, Poisson analysis). There were 2 neurotrauma surgeries in April 2020, which was significantly lower than the previous year average ($P = 0.0004$, Poisson analysis). COVID-19, coronavirus disease 2019.

declined compared with previous-year averages, the relative proportion of each mechanism did not. As expected, the proportion of motorcycle collisions, motor vehicle collisions, and bicycle accidents decreased by 4%, 10%, and 3% respectively. In addition, the proportion of ground-level falls resulting in neurotrauma decreased by 6%, whereas the proportion of falls from height increased by 6%. There was also a nonsignificant 2% increase in the proportion of assaults. Surprisingly, there was a 6% increase in the proportion of PHBC and a 12% significant increase ($P = 0.034$, χ^2 proportion analysis) in the proportion of GSWs. There were no traumatic injuries caused by "other" mechanisms during the pandemic.

DISCUSSION

In the United States, traumatic unintentional injuries are the leading cause of death in people younger than 45 years old and the third-leading cause of death among all age groups combined.[5] An estimated 1.7 million people sustain traumatic brain injury annually, with approximately 52,000 deaths.[6] In addition, although not typically life-threatening, an estimated 18,000 people sustain spinal cord injury annually.[7] Importantly, the effects of the severe acute respiratory syndrome coronavirus 2 pandemic on the incidence of neurotrauma has yet to be reported. While several hospitals found a decreasing trend in general trauma admissions from February to April 2020, none of these studies thoroughly evaluated the effects on emergent operative cases or changes in mechanisms of injury.[8-18]

Here. we found that the average number of neurotrauma consults differed significantly between March and April, likely secondary to South Florida being a destination for spring break, causing an influx of vacationers during that time frame. During the pandemic, however, travel restrictions in combination with less foot and vehicle traffic led to a decrease in all mechanisms of injury, except for GSW. Upon further investigation, we found that the relative proportion of mechanisms of injury also changed after the lockdown in April 2020. With fewer citizens commuting on the streets, the proportion of vehicular trauma decreased, as expected. Decreases in these types of traumas have been reported across the country, however, not in correlation

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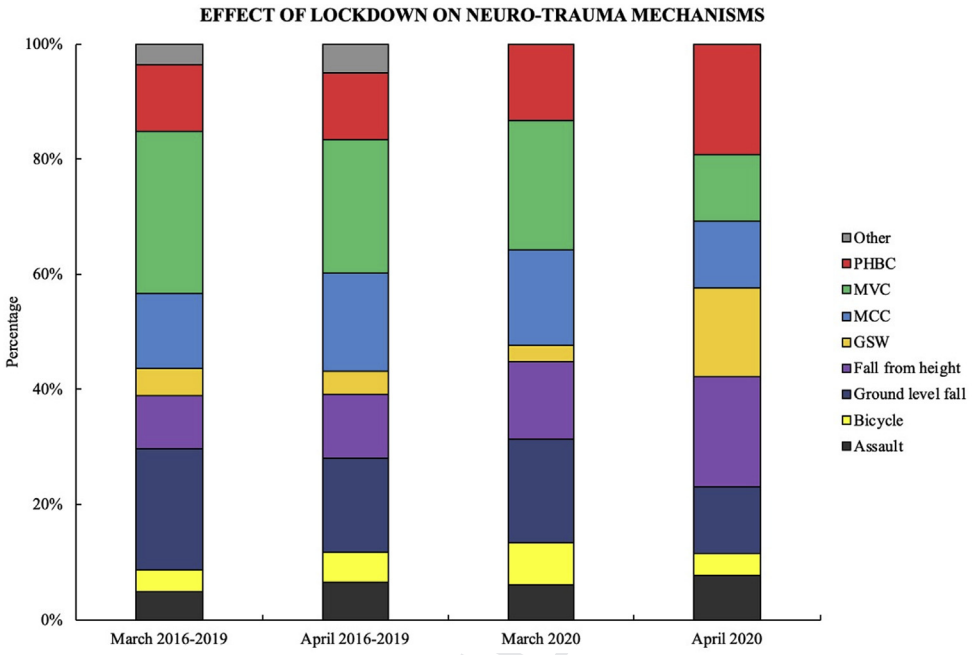

Figure 3. Effect of lockdown on neurotrauma mechanisms. When comparing the relative proportions of mechanisms of injury between April 2020 and previous years, there were decreases in motor vehicle collisions (MVCs), motorcycle collisions (MCCs), bicycle accidents, and ground-level falls, and other (boating, jet-ski, diving) and increases in pedestrian hit by car (PHBC), falls from height (ladders, roof, multiple stories), assaults, and gunshot wounds (GSWs). Only GSWs had a significant proportional increase from 3% to 15% ($P = 0.034$, χ^2 proportion analysis).

with specific events such as initiation of lockdown protocols.[8,9,12,13] The proportion of ground-level falls also decreased; however, this may have been secondary to patients unwilling to take the risk of going to the emergency department after minor accidents for concern of contracting the virus.[18] Importantly, some businesses were deemed "essential" and allowed to continue operating, of which some construction companies took advantage.[1] This may explain the increase in the proportion of falls from height, in addition to people doing home repairs while "stay-at-home" orders were in place. With respect to increases in the proportions of assaults and GSWs during the pandemic, they may be secondary to the psychosocial effects of mandatory isolation.[19,20] Family and friends were forced to be in close proximity to one another, which had the potential to ignite conflicts and violence leading to assault.[21] Finally, with prolonged confinement comes an increase in the risk of suicide, which may explain the increase in presumed self-inflicted PHBC and GSW.[22]

Although are results are compelling, there are several limitations that could be affecting the results of this study. For instance, ambulances may have avoided our hospital, which had a high COVID-19 census, and primary care physicians may have treated minor traumas rather than referring patients to the emergency department. These confounding variables are difficult to address during the pandemic and must be taken into account when referencing this observational study.

CONCLUSIONS

The severe acute respiratory syndrome coronavirus 2 pandemic significantly impacted the incidence of neurotraumas and associated emergent neurosurgical interventions, as lockdown orders and apprehension of infection decreased the likelihood of certain mechanisms of injury such as vehicular trauma. Conversely, the psychosocial impact of sheltering at home increased the likelihood of interpersonal and self-inflicted trauma. These observations will be helpful if another wave of the epidemic arises.

CRediT AUTHORSHIP CONTRIBUTION STATEMENT

Javier M. Figueroa: Conceptualization, Investigation, Formal analysis, Writing - review & editing. **James Boddu:** Investigation, Formal analysis, Writing - review & editing. **Michael Kader:** Formal analysis, Writing - review & editing. **Katherine Berry:** Formal analysis, Writing - review & editing. **Vignessh Kumar:** Writing - review & editing. **Veronica Ayala:** Writing - review & editing. **Steven Vanni:** Conceptualization, Writing - review & editing. **Jonathan Jagid:** Conceptualization, Writing - review & editing.

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