Pediatric Injury Trends in Rhode Island During the COVID-19 Pandemic

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ABSTRACT

BACKGROUND: Pediatric Emergency Department (PED) visits nationally decreased while the proportion of injury-related PED visits increased during the COVID-19 pandemic. Little is known about the trends in Rhode Island (RI).

METHODS: This is a planned sub-analysis of RI data from a retrospective study of pediatric injury-related visits to 40 PEDs for children <18 years old from January 2019–December 2020. We calculated frequencies and compared patient demographics, injury types, severity, and mechanisms for 3/17/2019–12/31/2019 (pre-COVID-19) versus 3/15/2020–12/31/2020 (study period).

RESULTS: Despite a 31.4% decrease in total injury-related PED visits from 2019 to 2020, the proportion of injury-related PED visits increased by 8.1% (p<0.001) in 2020. The mean age of patients decreased from 8.3 (SD 5.4) to 7.7 (SD 5.4) years old (p<0.0001), with a higher proportion of female (p=0.0018), privately insured (p=0.0274), and non-Hispanic White children (p<0.001) in 2020. There was a higher proportion of trauma activations, admissions, and injuries caused by intentional self-harm (all p<0.0001).

CONCLUSIONS: In RI, the total number of injury-related PED visits decreased while the proportion of injury-related PED visits increased during the COVID-19 pandemic, similar to national trends. There were significant demographic, mechanism, and intent shifts among injured patients, highlighting epidemiologic changes during the pandemic and identifying high-risk groups that would benefit from targeted education and interventions.

KEYWORDS: Pediatrics, Trauma, Injury, COVID-19

INTRODUCTION

Injuries are the leading cause of death and nonfatal emergency department (ED) visits among children <18 years old.[1] In 2020, there were over 12,000 deaths and 4.1 million ED visits attributable to injuries within this age demographic in the United States.[1] The risk of injury among children is multifactorial, including social, economic, and environmental factors, among several others.[2] The COVID-19 pandemic, caused by the international spread of a novel coronavirus known as SARS-CoV-2, represents an example of one such environmental factor. At the beginning of the COVID-19 pandemic in March 2020, to curb the spread of the SARS-CoV-2 virus by encouraging social distancing, states began to close schools, daycares, and nonessential businesses, and cancel extracurricular activities and sports. With these closures, children spent most of the time at home, and parents and caregivers were often tasked with working from home while simultaneously caring for children and managing education at home.[3]

Rhode Island declared a state of emergency in response to the COVID-19 pandemic on March 9, 2020.[4] By March 22, 2020, in-person dining, public recreation and entertainment venues, gyms, and barbershops were all shut down.[4] Over the next several days, schools were required to transition to remote learning and out-of-state travelers were required to quarantine, and on March 28, 2020, a stay-at-home order was issued and all non-essential businesses were closed.[4]

While pediatric ED (PED) visits decreased significantly in the first few months after the pandemic began, conflicting hypotheses about the impact of lockdowns and school and childcare closures on pediatric traumatic injuries arose; while studies ubiquitously reported an overall decrease in all-cause PED visits, data differed about whether the proportion of ED visits related to injuries increased or decreased within studied populations.[5-9] Several single and multi-center studies have subsequently described changes in pediatric injury patterns due to the pandemic, including automobile-related injuries, burns, non-accidental trauma, and bicycle and motorbike injuries.[10-17]

A recent 40-site multi-center cross-sectional study describing pediatric injury patterns across the United States demonstrated an increase in the proportion of PED visits due to injuries in 2020 compared to the same time period in 2019 despite an overall decrease in PED visits, a younger median age of injured children, and changes in injury mechanisms.[17]

To date, no data has been reported about the impact of the pandemic on pediatric injury patterns in the state. By performing a planned sub-analysis of the above-described 40-center study, we aimed to describe PED injury patterns at the only pediatric Level 1 trauma center in RI during the 2020 COVID-19 pandemic compared to the prior year.

METHODS

Study Design and Population

This was a planned secondary analysis of RI data from a cross-sectional study of children less than 18 years old presenting with an injury to one of 40 PEDs in the United States and Canada between January 1, 2019 and December 31, 2020.[17] A multidisciplinary coalition of pediatric physicians and surgeons and injury prevention experts, the Injury Free Coalition for Kids, supported the primary study. Hanson et al previously described the study design and methods.[17] Pediatric ED visits with at least one International Classification of Disease – 10th revision (ICD-10) code for bodily injury (S00 – T78) were used to identify patients for inclusion. The first three ICD-10 codes for mechanism and intent of injury (V00-X58 = unintentional, X71-X83 = intentional self-harm, X92-Y09 = assault, Y21-Y33 = undetermined Intent, Y35-Y38 = legal intervention) were also collected, when documented. The nature, mechanism, and injury extent were classified by the Centers for Disease Control and Prevention (CDC) National Center for Health Statistics Injury Diagnosis Matrices and External Cause-of-Injury (E-Code) Matrices.[18,19] This sub-analysis included all PED visits at the RI study site. Visits for the same injury within seven days of the primary visit and injuries occurring secondary to complications of surgical and/or medical care (ICD-10 codes T80-88 or Y65.8) were excluded. De-identified data was abstracted from the institutional electronic health record and uploaded data into a secure REDCap database at Cincinnati Children's Hospital Medical Center, the study's data coordinating center.[20] The institutional review board at the study site approved this study. The methods pertinent to this secondary analysis are described here.

Measures

For each injury-related PED visit, demographic data were obtained from the medical record. Discrete variables included age, sex, race, ethnicity, primary language, insurance payor, triage emergency severity index (ESI), if the visit was associated with a trauma activation, intent and mechanism of injury, PED disposition, admission unit (when applicable), PED and hospital length of stay, and final hospital disposition (alive/deceased). Sex, race, ethnicity, and language were reported by the patient, parent, or guardian, or were assigned by registration staff at the time of PED check-in. Injury mechanism, intent, nature, and associated activity were derived from ICD10 codes, when documented. Using a previously described validated tool, injury severity scores (ISS) were calculated for each PED visit based on mapped abbreviated injury scale (AIS) scores and were grouped according into categories ranging from mild injury to very severe injury.[21-23]

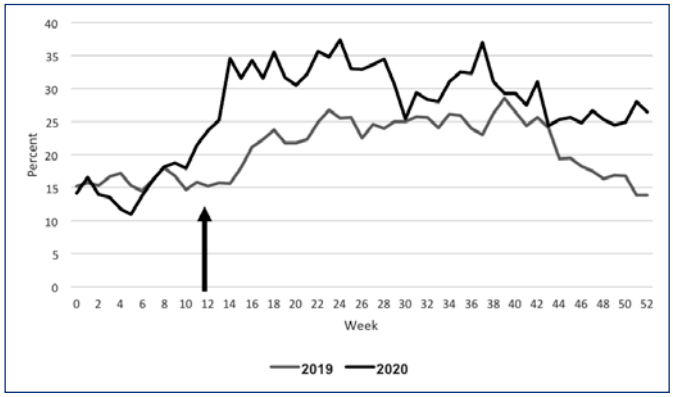
Data Analysis

Data analysis was performed at Cincinnati Children's Hospital Medical Center and the State University of New York Upstate Medical University. PED visits starting on March 17, 2019 and ending on December 31, 2019 were included and compared to visits starting on March 15, 2020 and ending on December 31, 2020; this allowed comparison between pre-COVID-19 pandemic PED visits and visits that occurred after the national public health emergency declaration for the COVID-19 pandemic, issued on March 15, 2020. Descriptive statistical analyses were performed, and results were reported as frequencies and proportions, with median and interquartile ranges calculated. Chi-square tests and Wilcoxon rank sum tests were performed for comparative analyses, when appropriate. All statistical analyses were conducted using SAS® (version 9.4, SAS Institute, Inc.).

RESULTS

From March through December 2019, there were 9,581 reported PED visits attributable to traumatic injuries compared to 6,575 injury visits during the same timeframe in 2020, representing a 31.4% decrease in injury-related PED visits during the study period. Despite this significant decrease in total injury-related PED, the proportion of all PED visits that were injury-related increased by 8.1% (p<0.001) in 2020 (**Figure 1**).

Figure 1. Pediatric ED Injury-Related Visits as a Percentage of all ED Visits, January 1, 2019–December 31, 2020*



*Arrow denotes the first full week of COVID in 2020. This figure represents all visits from January 1, 2019 through December 31, 2020, with an N of 56,585 ED visits in 2019 and 35,472 in 2020.

PATIENT DEMOGRAPHICS

The mean age of patients presenting with injuries was 7.7 (SD 5.4) in 2020 compared to 8.3 (SD 5.4) years in 2019 (p<0.0001). There was a 4.8% increase in the proportion of children <5 years old and a 4.7% decrease in the proportion of children ages 5–17 (p<0.0001) in 2020. During the COVID-19 pandemic, there was an increase in the proportion of

injury-related PED visits among children who were female (41.9% in 2019 versus 44.4% in 2020, p=0.0018), White (54.7% versus 58.9%, p<0.0001)), non-Hispanic (66.8% versus 71.1%, p<0.0001), privately insured (75.1% versus 76.4%, p=0.0274), and English speaking (86.9% to 88.9%, p=0.0014) (**Table 1**).

Table 1. Demographic Characteristics of Study Population Before and During COVID (N=16,156)

Characteristic	Pre-COVID (2019) Mean (SD), Median (IQR)	During COVID (2020) Mean (SD), Median (IQR)	P-value
Age (years)	8.3 (5.4), 7.6 (3.2–13.1)	7.7 (5.4), 6.4 (2.8–12.6)	<0.0001
	Pre-COVID (N=9,581) N (%)	**During COVID (N=6,575) N (%)**	
Age Category (years)			<0.0001
<1	469 (4.9)	398 (6.1)	
1 to 4	3,060 (31.9)	2,334 (35.5)	
5 to 9	2,263 (23.6)	1,562 (23.8)	
10 to 14	2,287 (23.9)	1,355 (20.6)	
15 to 18	1,502 (15.7)	926 (14.1)	
Sex			0.0018
Male	5,568 (58.1)	3,658 (55.6)	
Female	4,013 (41.9)	2,917 (44.4)	
Non-Binary & Unknown	NA	NA	
Race			<0.0001
White	5,238 (54.7)	3,871 (58.9)	
Black	1,115 (11.6)	671 (10.2)	
American Indian/Alaska Native	23 (0.2)	15 (0.2)	
Asian	130 (1.4)	85 (1.3)	
Other/unknown	3,075 (32.1)	1,933 (29.4)	
Ethnicity			<0.0001
Hispanic	3,111 (32.5)	1,845 (28.1)	
Non-Hispanic	6,396 (66.8)	4,672 (71.1)	
Unknown	74 (0.8)	58 (0.9)	
Insurance Type			0.0274
Public	1,812 (18.9)	1,201 (18.3)	
Private	7,198 (75.1)	5,024 (76.4)	
Military	92 (1.0)	83 (1.3)	
Self	258 (2.7)	145 (2.2)	
Other/unknown	221 (2.4)	122 (1.8)	
Primary Language			0.0014
English	8.329 (86.9)	5,847 (88.9)	
Spanish	1,099 (11.5)	635 (9.7)	
Other	146 (1.5)	91 (1.4)	
Unknown	7 (0.1)	2 (0.0)	

PED ACUITY AND INJURY SEVERITY

In 2020, there was an increase in the proportion of visits associated with trauma activations (+2.5% p<0.0001). The proportion of high acuity ESI visits (ESI 1 and 2) remained unchanged across both years, with a 1.7% decrease in moderate acuity visits (ESI 3) and a 1.5% increase in the proportion of low acuity visits (ESI 4 and 5) (p<0.001) (**Table 2**). ED length of stay was noted to be longer for visits occurring in 2020 (3.6 hours) compared to 2019 (3.4 hours) (p=0.0001).

Table 2. Injury Characteristics Before and During COVID (N=16,156)

Characteristic	Pre-COVID (N=9,581) N (%)	During COVID (N=6,575) N (%)	P-value
Triage ESI Code			<0.0001
1	9 (0.1)	6 (0.1)	
2	2,072 (21.6)	1,411 (21.5)	
3	4,619 (48.2)	3,059 (46.5)	
4	2,733 (28.5)	2,008 (30.5)	
5	139 (1.5)	66 (1.0)	
Unknown	9 (0.1)	25 (0.4)	
Trauma Activation			<0.0001
Yes	115 (1.2)	241 (3.7)	
No	9,466 (98.8)	6,334 (96.3)	
Injury Severity Score Categories*			0.1665
0	2,065 (21.7)	1,338 (20.5)	
1–8 (mild)	7,327 (77.0)	5,075 (77.8)	
9–15 (moderate)	121 (1.3)	105 (1.6)	
16–24 (severe)	3 (0.0)	3 (0.1)	
≥25 (very severe)	3 (0.0)	3 (0.1)	
Intent*			<0.0001
Unintentional	7,885 (95.9)	5,307 (95.6)	
Intentional self-harm	144 (1.8)	159 (2.9)	
Assault	177 (2.2)	76 (1.4)	
Undetermined Intent	10 (0.1)	6 (0.1)	
Legal Intervention	3 (0.0)	1 (0.0)	
ED Disposition			<0.0001
Admit	641 (6.7)	561 (8.5)	
Discharge	8,877 (92.7)	5,934 (90.3)	
Transferred	39 (0.4)	64 (1.0)	
Left	12 (0.1)	9 (0.1)	
Died	0 (0.0)	1 (0.0)	
Unknown	12 (0.1)	6 (0.1)	
Admitting Unit*			0.3277
ICU	67 (10.5)	68 (12.1)	
OR	69 (10.8)	73 (13.0)	
Ward	504 (78.6)	420 (74.9)	
Unknown	1 (0.2)	0. (0.0)	
Final Encounter Status			0.3757
Lived	9,578 (99.9)	6,571 (99.9)	
Died	3 (0.0)	4 (0.1)	
Unknown	NA	NA	

Abbreviations: ESI – emergency severity index; ED – emergency department; ICU – intensive care unit; OR – operating room.

*Injury severity score categories are among N=16,043 classifiable injury severity scores; Intent is among N=13,768 with classifiable external cause codes; admitting unit is among N=1,202 admitted.

Despite an increase in the proportion of trauma activations in 2020, injury severity categories (mild, moderate, severe, and very severe) were not statistically different during the pandemic compared to the year prior (p=0.1665) (**Table 2**). There were proportionate increases in hospital admissions and transfers (primarily to psychiatric inpatient units) during the pandemic (p<0.0001) (**Table 2**). Hospital length of stay among admitted patients was also noted to be longer in 2020 (83.0 hours, SD 166.8) than 2019 (59.3 hours, SD 83.6) (p=0.0064). There were no statistically significant differences in PED disposition to the wards versus intensive care unit (ICU) or operating room (OR); however, the raw number and proportion of admissions to the ICU and OR did increase in 2020. Of note, while there was also no significant difference in the proportion of patients who died (p=0.3757), there were four deaths in the PED for injuries in 2020 with three deaths 2019, despite a decrease in over 3,000 visits for injuries in 2020.

INJURY MECHANISM AND INTENT

Among the 13,774 visits in 2019 and 2020 with classifiable mechanism codes, falls represented the most common mechanism of injury in both 2019 and 2020, comprising 41% of all injury-related visits during both years. The mechanisms with the largest increases in the proportion of total visits in 2020 were pedal cyclists (bicycle) (+2.2%) and cut/pierce injuries (+2.8%), while the largest decrease was seen in injuries caused by children being struck by or against something (-5.8%).

There were significant differences in injury intent, when classified, with a 1.1% increase in the proportion of self-inflicted injuries and a 0.8% decrease in assaults (p<0.001) (**Table 2**). Among the 16,156 visits for which the nature of the injury was classified, open wounds decreased by 11.4% (N=2,397 versus 2,123 in 2019 vs 2020) and poisonings increased by 7.4% (N=249 versus 269 in 2019 vs 2020).

DISCUSSION

The COVID-19 lockdown resulted in the closure of schools, playgrounds, and many workplaces, and coincided with dramatic changes in children's lives. Not only was most schooling relocated to the child's home, but other activities such as sports, clubs, and afterschool jobs were shut down. Previous publications have demonstrated that these changes impacted injury-related PED visits with reported total-visit decreases of 26–40% but increases in the proportion of PED visits for injuries.[10,17,24] In line with these national publications, we saw a 31.4% decrease in the total number of pediatric injury-related visits at a RI pediatric Level 1 trauma center from March 2020 to December 2020 compared to the same timeframe from 2019, but a statistically significant increase in the proportion of all injury-related PED visits.

Our data show significant demographic shifts, including an increase in PED injury-related visits among children who were female, White, non-Hispanic, privately insured, and English speaking, as well as a lower mean age of patients. These observations are consistent with previously described literature which has showed a younger mean age, more females and White non-Hispanic children, and a reduction in overall ED utilization among publicly insured and less resourced individuals during the pandemic.[16,24] While this dataset cannot elucidate the reasons for these findings, the cause is likely multifactorial. Less-resourced populations may have been more likely to delay seeking medical care or avoid the hospital altogether.[25,26] Additionally, ability to access medical care may have been disproportionately limited in this population due to increased childcare responsibilities caused by the closing of schools and daycares.[27]

Although there was no significant change in the ISS categories between 2019 and 2020, injury-related visits during 2020 resulted in a statistically significantly higher proportion of trauma activations, admissions, and longer PED and hospital lengths of stay. These other surrogates of severity suggest that injuries seen in the hospital during the pandemic may have been more severe than pre-pandemic. Similar patterns have been documented in previous studies.[16,23] These findings may be related to an overall decrease in presentation to PEDs for minor injuries due to avoidance of medical facilities, and/or simultaneously, due to an increase in higher-severity injuries.

There were several observed changes to mechanisms of injury contributing to PED visits when comparing 2019 to 2020. Mechanisms attributable to sports and recreational activities, such as injuries caused by being struck by/against something or by overexertion, markedly decreased during the pandemic. This change corresponds with an overall decrease in organized sport participation because of COVID-19 shut-downs.[28,29] Conversely, our institution saw an increase in injuries due to pedal cycling and cuts/piercings as well as an increase in poisonings. The former is likely driven by an increase in purchase of personal-use recreational equipment that has been well-described in the lay press and previous publications.[24,30-32] The latter are likely, at least in part, due to the 1.1% increase in intentional self-harm observed in our site-specific population, potentially from a higher prevalence of psychosocial stressors and social isolation. While PED visits across RI that were attributable to a mental health condition decreased by 26% from 2019 to 2020, the number of hospital admissions for mental health conditions remained steady (1,841 to 1,825); this indicates a higher severity of these conditions after the onset of the pandemic.[33,34] Additionally, and/or alternatively, more unsupervised time at home could have led to increased opportunities to sustain unintentional lacerations or have exposure to unsecured medications and/or cleaning products due to inadequate supervision or unsafe play environments. During

our study period, there was a notable decrease in problem-related pediatric clinic visits observed nationally compared to 2019.[35] Combined with an increase in opportunity for injuries as discussed above, decreased availability of urgent and primary care appointments may have also contributed to the observed proportionate increase in PED visits for injuries.

This study has several limitations. Data were collected retrospectively through the electronic medical record. Some variables, such as demographic data, injury mechanism, nature and activity, were not consistently documented. The population was identified by ICD-10 codes, and inaccurate ICD-10 coding may have led to misclassification of injury type and severity. Additionally, these data are from a single, pediatric Level 1 trauma center and may not be representative of all patients who presented to RI community hospitals or to trauma centers outside of RI. Children who presented to the ED in other facilities may have variations in demographics, injury mechanisms, or injury severity that were not captured in this study.

CONCLUSION

These state-specific results highlight epidemiologic pediatric injury changes during the COVID-19 pandemic. Despite an overall decline in PED visits, the proportion of injury-related PED visits increased during the COVID-19 pandemic in our single-center cohort, with a higher proportion of admissions and a longer mean hospital length of stay. Injury mechanisms relating to organized sports declined substantially in frequency while mechanisms related to single-person activities (cycling), cuts/piercings, and poisonings were noted to increase.

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