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# Injury-Related Pediatric Emergency Department Visits in the First Year of COVID-19

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abstract

**OBJECTIVES:** To describe the epidemiology of pediatric injury-related visits to children's hospital emergency departments (EDs) in the United States during early and later periods of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic.

**METHODS:** We conducted a cross-sectional study using the Pediatric Health Information System, an administrative database to identify injury-related ED visits at 41 United States children's hospitals during the SARS-CoV-2 pandemic period (March 15, 2020 to March 14, 2021) and a 3 year comparator period (March 15–March 14, 2017–2020). For these 2 periods, we compared patient characteristics, injury type and severity, primary discharge diagnoses, and disposition, stratified by early (March 15, 2020 to June 30, 2020), middle (July 1, 2020 to October 31, 2020), and late (November 1, 2020 to March 14, 2021) pandemic periods.

**RESULTS:** Overall, ED injury-related visits decreased by 26.6% during the first year of the SARS-CoV-2 pandemic, with the largest decline observed in minor injuries. ED injury-related visits resulting in serious–critical injuries increased across the pandemic (15.9% early, 4.9% middle, 20.6% late). Injury patterns with the sharpest relative declines included superficial injuries (41.7% early) and sprains/strains (62.4% early). Mechanisms of injury with the greatest relative increases included (1) firearms (22.9% early; 42.8% middle; 37% late), (2) pedal cyclists (60.4%; 24.9%; 32.2%), (3) other transportation (20.8%; 25.3%; 17.9%), and (4) suffocation/asphyxiation (21.4%; 20.2%; 28.4%) and injuries because of suicide intent (–16.2%, 19.9%, 21.8%).

**CONCLUSIONS:** Pediatric injury-related ED visits declined in general. However, there was a relative increase in injuries with the highest severity, which warrants further investigation.

Full article can be found online at [www.pediatrics.org/cgi/doi/10.1542/peds.2021-054545](http://www.pediatrics.org/cgi/doi/10.1542/peds.2021-054545)

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**WHAT'S KNOWN ON THE SUBJECT:** Pediatric injury-related emergency department visits declined during the severe acute respiratory syndrome coronavirus 2 pandemic; however, it is unclear how visits varied by injury type and severity.

**WHAT THIS STUDY ADDS:** Pediatric injury-related emergency department visits declined rapidly, but injury severity increased after mitigation efforts to curb severe acute respiratory syndrome coronavirus 2 disease burden.

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The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic was declared on March 11, 2020, by the World Health Organization and led to sweeping public health efforts in the United States to curb disease transmission,<sup>1</sup> including wide-reaching, stay-at-home orders for school children and nonessential workforce personnel. These measures, and concordance therewith, varied by region and over time, leading to substantial and temporally-varied burden on children and adolescents attributable to disruptions in school, child care, and extracurricular activities.<sup>2,3</sup>

The SARS-CoV-2 pandemic stressors have been previously described as risk factors for pediatric trauma.<sup>4-6</sup> Navigating the changes in employment and lifestyle because of social distancing created a paradigm shift in family dynamics for both children and caregivers. Some caregivers navigated the economic stress of abrupt job loss that necessitated leaving home to seek new forms of employment. Others adjusted to new “work-from-home” environments that may have afforded young children more supervision. The disruption of school and child care is particularly impactful for children with preexisting psychosocial stressors from living in unstructured environments.<sup>7</sup> However, the impact of the SARS-CoV-2 social distancing measures on injuries in children is not well described within the literature.

Current literature evaluating pediatric trauma-related emergency department (ED) visits during the SARS-CoV-2 pandemic in the United States is limited to single-center studies or adult populations.<sup>8-10</sup> As the SARS-CoV-2 pandemic continues to influence public health recommendations for social distancing, an improved understanding of pediatric injury

mechanisms, patterns, and severity is needed. The main aim of this study is to describe the epidemiology of pediatric injury-related visits to children’s hospital EDs in the United States during the early and later periods of the SARS-CoV-2 pandemic.

## METHODS

We conducted a cross-sectional study using data from the Pediatric Health Information System (PHIS), which includes 49 tertiary care children’s hospitals in the United States. The PHIS database contains *International Classification of Diseases, 10th Revision, Clinical Modification* (ICD-10-CM) diagnosis and procedure codes, billed services, and hospital charges. Data integrity is jointly monitored by participating institutions and the Children’s Hospital Association.<sup>11</sup> We included all ED visits for children aged 0 to 17 years during the first year of the SARS-CoV-2 pandemic (March 15, 2020 to March 14, 2021) and a 3 year comparator period (March 15–March 14, 2017–2020) for 41 hospitals with complete administrative and billing data for the study periods. Encounters for children born at the hospital, those who left without being seen by an ED provider, and those who left against medical advice were also excluded. The Nationwide Children’s Hospital institutional review board deemed that this study did not qualify as human subject research.

We divided the first year of the pandemic into periods on the basis of widely experienced changes in social distancing, and defined the early pandemic period as the first Sunday (March 15, 2020) after the national emergency declaration on March 13, 2020 to June 30, 2020.<sup>12</sup> The middle (July 1, 2020 to October 31, 2020) and late (November 1, 2020 to March 14, 2021) pandemic periods were selected specifically to account for trauma seasonality,

because trauma visits typically occur with the highest incidence between April and late October, and to reflect the return to in-person or hybrid models for school attendance for many children in the late period.<sup>13</sup> ED visit numbers for the 3 year comparator period were averaged across the same calendar dates as the pandemic period to consider yearly variation in ED volume and case mix.

Injury encounter identification was performed using external causes of injury codes (specifically, V, X, W, and Y codes in ICD-10-CM coding). The sample was restricted to encounters with external cause of injury codes, categorized using the ICD-10-CM groupings in the Centers for Disease Control and Prevention’s external cause of injury matrix, for primary injury mechanisms of bites/stings, cut/pierce, drowning, environmental, fall, fire/burns, firearm, foreign body, motor vehicle collisions, neglect/abuse, overexertion, pedal cyclist, pedestrian, poisoning, sports-related injury, struck by/against, suffocation/asphyxiation, and transportation included.<sup>14</sup>

## Patient Demographics and Clinical Characteristics

Demographic characteristics for each ED visit included age (<1, 1–4, 5–9, 10–14, and 15–17 years), sex, race and ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Asian American or other), payer (government, private, or other), distance from the hospital (calculated as the number of miles between the centroids of the patient’s and hospital’s zip codes), geographic region (Midwest, Northeast, South, West), rurality (metropolitan, micropolitan, small town, rural), and median zip code income.<sup>15</sup> Race and ethnicity data were preserved in the analyses as a social construct because of their

association with differences in ED care-seeking behavior and in injury rates.<sup>16-18</sup> The exposure of interest was documented race and ethnicity. In the PHIS, race and ethnicity are included as 2 distinct variables, which were collapsed into a single variable.<sup>19</sup> Hospitals submit race and ethnicity data to the PHIS for each visit according to hospital-specific practices, which include parent/guardian self-report at the time of arrival or hospital registration assignment. Zip code-level social determinants of health were measured using the Child Opportunity Index 2.0, which includes 29 indicators across 3 domains of neighborhood characteristics that impact children's healthy development: education, health and environment, and social and economic opportunities.<sup>20</sup> Child opportunity categories are created by ranking all US zip codes by overall score and dividing them into equally sized quintiles by population: very low, low, moderate, high, and very high.

Measures to evaluate injury type and severity included reported intentionality, injury severity score (ISS), and ED disposition.<sup>21</sup> We categorized injury severity by ISS as follows: minimal, (0), mild, (1 to 8), moderate, (9 to 15), and serious-critical ( $\geq 16$ ).<sup>22</sup> Finally, we categorized ED injury visits by both injury patterns (superficial, open wound, sprains/strain, fracture, and dislocation) and injury regions (head, neck, face, thorax, abdomen, pelvis, upper and lower extremity, and other). We examined primary discharge diagnoses, ED management, and disposition for each visit.<sup>23</sup>

### Statistical Analyses

Patient demographic and clinical characteristics were summarized as frequencies for categorical variables and median with interquartile

ranges for numerical variables. To calculate percentage change between 2019 (comparator) and 2020, the number of clinical encounters in a given 2019 interval was subtracted from the number of encounters during the corresponding 2020 interval and then divided by the number of encounters in the 2019 interval, which we adapted to our multiple-year comparison periods. Percentage changes in absolute visits were calculated by season in total and by subgroups. Percentage change by ISS in total was also stratified by race/ethnicity, Child Opportunity Index (COI), median zip code income, and rurality. Because of the large sample size, formal statistical comparisons were not made, but an a priori absolute difference of 5% among groups was considered clinically significant.<sup>24</sup> SAS 9.4 (SAS Institute, Inc, Cary, NC) was used for all analyses.

## RESULTS

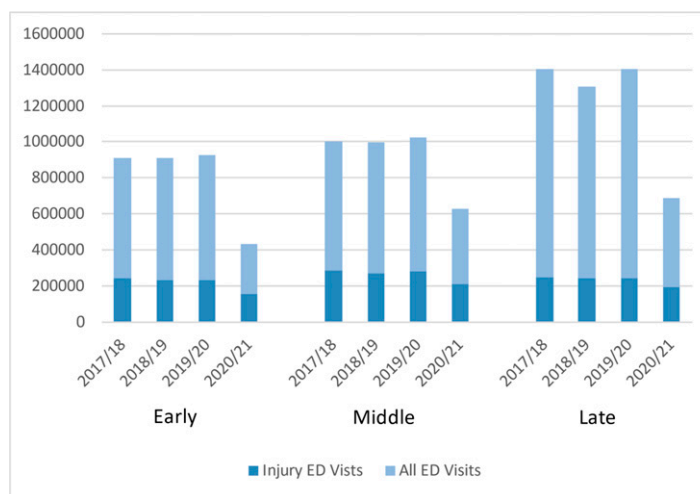
### Characteristics of the Study Sample

Between the pandemic study period and the 3 comparator years, we identified 2 846 991 total pediatric injury visits (Fig 1). Compared with

the 3 previous years, demographic characteristics of the injured children presenting to the ED differed during each of the pandemic periods (Table 1). ED injury-related ED visits demonstrated a sharp decline during the early pandemic period (34.4%), followed by modest declines in volume during the middle (24.4%) and late (21.2%) pandemic periods. There were sharper declines among school-aged children and adolescents compared with younger children, and among non-Hispanic Black, Hispanic, and Asian American patients compared with non-Hispanic White patients. The decline in injury-related ED visits was greatest for metropolitan communities and those in closer proximity to children's hospitals. Among both COI quintiles and median household income quartiles, the number of visits declined most in the very-low opportunity and the lowest-income groups, with a graded exposure-response relationship through the remaining COI and income groups.

### Injury Intent and Severity

By injury intent, ED visits decreased during each pandemic period except



**FIGURE 1**

Changes in pediatric ED visits for injury during year 1 of coronavirus disease 2019 and comparator years.

**TABLE 1** Cohort Characteristics

	Time Period					
	Early (March 15–June 31, 2020)		Middle (July 1–October 31, 2020)		Late (November 31, 2020–March 14, 2021)	
	Prepandemic Mean Volume	Pandemic % Change	Prepandemic Mean Volume	Pandemic % Change	Prepandemic Mean Volume	Pandemic % Change
<i>N</i>	235 964	−34.4	280 835	−24.2	245 243	−21.2
Age, <i>y</i> , <i>n</i> (%)						
<1	12 530 (5.3)	−25.5	15 262 (5.4)	−18.2	14 416 (5.9)	−6.9
1–4	73 799 (31.3)	−24.1	88 288 (31.4)	−18.5	75 970 (31.0)	−9.0
5–9	64 053 (27.1)	−36.7	72 524 (25.8)	−26.0	58 586 (23.9)	−22.6
10–14	59 159 (25.1)	−45.2	70 833 (25.2)	−31.4	64 190 (26.2)	−35.4
≥15	26 423 (11.2)	−37.6	33 928 (12.1)	−22.9	32 081 (13.1)	−25.8
Sex, <i>n</i> (%)						
Male	131 341 (55.7)	−35.3	160 179 (57.1)	−25.3	135 348 (55.2)	−22.5
Female	104 521 (44.3)	−33.3	120 519 (42.9)	−22.7	109 777 (44.8)	−19.6
Race and/or ethnicity, <i>n</i> (%)						
Non-Hispanic White	102 214 (43.3)	−27.1	121 431 (43.2)	−18.7	105 012 (42.8)	−16.3
Non-Hispanic African-American	53 951 (22.9)	−42.7	65 394 (23.3)	−29.6	54 613 (22.3)	−27.3
Hispanic	55 853 (23.7)	−39.6	65 236 (23.2)	−30.1	60 650 (24.7)	−25.5
Asian American	5640 (2.4)	−36.3	6740 (2.4)	−23.7	5966 (2.4)	−18.7
Other	18 306 (7.8)	−34.5	22 034 (7.8)	−21.3	19 002 (7.7)	−18.3
Payer, <i>n</i> (%)						
Government	128 069 (55.1)	−37.3	151 430 (54.9)	−24.6	132 616 (54.8)	−22.1
Private	90 080 (38.8)	−29.4	107 468 (38.9)	−20.7	94 393 (39.0)	−18.5
Other	14 283 (6.1)	−29.3	17 140 (6.2)	−26.8	14 982 (6.2)	−18.9
Distance from hospital, <i>n</i> (%)						
<5 miles	56 837 (24.1)	−43.5	67 201 (24.0)	−32.4	58 288 (23.9)	−31.7
5–10 miles	63 204 (26.8)	−39.6	74 538 (26.6)	−28.0	65 455 (26.8)	−26.3
>10–20 miles	62 036 (26.3)	−32.4	73 430 (26.2)	−22.6	64 934 (26.6)	−17.3
>20 miles	53 521 (22.7)	−20.9	64 926 (23.2)	−12.7	55 456 (22.7)	−7.8
Region, <i>n</i> (%)						
Midwest	79 080 (33.5)	−38.1	95 804 (34.1)	−25.9	75 670 (30.9)	−25.3
Northeast	23 149 (9.8)	−35.9	27 389 (9.8)	−20.4	23 313 (9.5)	−22.6
South	83 695 (35.5)	−30.7	96 187 (34.3)	−21.2	90 901 (37.1)	−16.7
West	50 040 (21.2)	−34.1	61 455 (21.9)	−27.9	55 359 (22.6)	−22.5
Rurality, <i>n</i> (%)						
Metropolitan	218 779 (94.4)	−35.5	259 920 (94.4)	−25.0	226 905 (94.6)	−21.9
Micropolitan	7 189 (3.1)	−18.2	8 501 (3.1)	−10.5	7 255 (3.0)	−6.2
Small town	3 803 (1.6)	−18.5	4 572 (1.7)	−11.7	3 772 (1.6)	−13.6
Rural	1 972 (0.9)	−18.3	2 337 (0.8)	−7.0	1 956 (0.8)	−6.6
COI, <i>n</i> (%)						
Very-low opportunity	64 428 (27.4)	−41.9	76 044 (27.2)	−30.5	65 148 (26.7)	−28.9
Low opportunity	42 248 (17.9)	−35.9	50 340 (18.0)	−26.0	44 380 (18.2)	−22.2
Moderate opportunity	39 278 (16.7)	−33.5	46 795 (16.7)	−23.5	40 690 (16.7)	−18.7
High opportunity	38 069 (16.2)	−29.2	45 322 (16.2)	−20.6	39 969 (16.4)	−15.2
Very-high opportunity	51 542 (21.9)	−28.2	61 550 (22.0)	−17.5	53 918 (22.1)	−16.2
Median zip code income quartile, <i>n</i> (%)						
First, ≤27 270	28 524 (12.3)	−43.4	33 631 (12.2)	−32.4	28 690 (12.0)	−31.5
Second, 27 271–35 910	48 433 (20.9)	−38.2	57 177 (20.8)	−27.5	49 481 (20.6)	−24.5
Third, 35 911–47 341	66 897 (28.9)	−34.2	79 428 (28.9)	−24.3	69 447 (29.0)	−20.6
Fourth, >47 341	87 862 (37.9)	−29.9	105 048 (38.2)	−19.8	92 234 (38.5)	−16.5

Characteristics within this grouping are not mutually exclusive. An encounter may have multiple or none, so percentages will not add up to 100%. *N* = patient encounter.

for suicide intent, which increased during the middle (19.9%) and late (21.8%) pandemic periods (Table 2). By injury severity, ED injury-related visits showed an increase in serious–critical injuries that began in the early period (15.9%) and

continued throughout the pandemic (4.9% middle; 20.6% late). Consistent with the observed increase in children with severe injury, injury-related visits resulting in discharge from the ED declined during all pandemic periods (−36.9% early;

−26.9% middle, −24.3% late), whereas visits resulting in hospital admission (−13%; −1.5%; 3%) or ICU admission (−10.3%; 1.7%; 4.1%) trended upward through the study period. A marked increase in deceased patients who arrived in the

**TABLE 2** Injury Type and Severity

	Time Period					
	Early (March 15–June 31)		Middle (July 1–October 31)		Late (November 31–March 14)	
	Prepandemic Mean Volume	Pandemic % Change	Prepandemic Mean Volume	Pandemic % Change	Prepandemic Mean Volume	Pandemic % Change
All injury, <i>n</i> (%)						
Unintentional	53 135 (22.5)	−25.1	62 215 (22.2)	−17.6	56 725 (23.1)	−19.4
Suicide	1499 (0.6)	−16.2	1580 (0.6)	19.9	2012 (0.8)	21.8
Homicide	3493 (1.5)	−47.4	3770 (1.3)	−34.2	4084 (1.7)	−39.5
Undetermined	684 (0.3)	−46.5	731 (0.3)	−15.8	654 (0.3)	−26.2
Legal intervention or war	30 (0.0)	−16.7	30 (0.0)	−22.5	34 (0.0)	−13.9
ISS score, <i>n</i> (%)						
Undetermined	14 950 (6.3)	−39.4	18 415 (6.6)	−26.5	17 031 (6.9)	−26.2
0	67 431 (28.6)	−40.3	84 333 (30.0)	−29.1	70 070 (28.6)	−22.5
Minor (1–8)	148 554 (63.0)	−32.1	172 272 (61.3)	−22.2	153 293 (62.5)	−20.9
Moderate (9–15)	4645 (2.0)	−12.3	5293 (1.9)	−3.8	4432 (1.8)	0.9
Serious–critical (>16)	384 (0.2)	15.9	522 (0.2)	4.9	416 (0.2)	20.6
ED disposition, <i>n</i> (%)						
Discharged	210 703 (89.3)	−36.9	251 486 (89.5)	−26.9	217 070 (88.5)	−24.3
Hospital admission	19 004 (8.1)	−13.0	22 273 (7.9)	−1.5	20 886 (8.5)	3.0
ICU admission	3075 (1.3)	−10.3	3595 (1.3)	1.7	3695 (1.5)	4.1
Deceased	47 (0.0)	37.1	55 (0.0)	43.6	57 (0.0)	14.0
Transfer	3135 (1.3)	−23.0	3425 (1.2)	−4.0	3536 (1.4)	−2.3

Characteristics within this grouping are not mutually exclusive. An encounter may have multiple or none, so percentages will not add up to 100%. *N* = patient encounter.

ED was observed in the early (37.1%), middle (43.6%), and late (14%) pandemic periods.

### ED Injury-Related Visits by Type and Mechanism

Compared with baseline, during all 3 pandemic periods, the number of visits by mechanism category declined with the following exceptions: there were increases in injury-related ED visits because of firearms (22.9% early; 42.8% middle; 37% late), pedal cyclist (60.4%; 24.9%; 32.2%), other transportation (20.8%; 25.3%; 17.9%), and suffocation/asphyxiation (21.4%; 20.2%; 28.4%). The number of visits because of cutting/piercing increased in the late pandemic period only (7.2%) (Table 3). Although declines in ED visits for all patterns of injury were observed, the sharpest declines were for superficial injuries (early −41.7%) and sprains/strains (early −62.4%) (Table 4). Table 5 describes the distribution of severe and nonsevere injuries by intent and mechanism. Most severe injuries were

unintentional (61%), and the leading mechanisms for severe injury observed in children remained motor vehicle crash–occupant (31.4%), sports-related injury (15.8%), fall (12.7%), and transportation–other (10.2%). The distribution of severe injuries before the SARS-CoV-2 pandemic and during the SARS-CoV-2 pandemic remained largely unchanged.

Exploratory analyses evaluated the relationship between injury severity and COI, race, ethnicity, household income, and rurality (Fig 2). ED visits for minimal, mild, and moderate severity injuries decreased across all COI, race, ethnicity, income, and urbanicity groups. Declines were greatest among children with very-low COI, living in zip codes associated with the lowest-income quartile and/or in metropolitan areas, and those who were Black or Hispanic. Serious–critical injuries, however, increased across all COI, race, ethnicity, income, and urbanicity groups during the pandemic. The greatest increases in serious–critical

injuries were observed among children with high or very-high COI, those living in zip codes associated with the highest 3 income quartiles and/or rural areas, and those who were Black or Asian American.

### DISCUSSION

Overall pediatric injury-related ED encounters at US children’s hospitals decreased substantially during the pandemic; however, relative injury severity increased. This study continues to expand the knowledge of the impact of the pandemic on pediatric injury events and, to our knowledge, is 1 of the earliest to evaluate national trends in pediatric injury-related ED encounters at children’s hospitals during the first year of the SARS-CoV-2 pandemic. In addition to the previously known decline in pediatric ED visits during the SARS-CoV-2 pandemic, this study found an increase in severity of injuries including deaths, which continued to increase as the pandemic progressed. The overall distribution of injuries before the SARS-CoV-2 pandemic and during



**TABLE 3** External Mechanisms of Injury

	Time Period					
	Early (March 15–June 31)		Middle (July 1–October 31)		Late (November 31–March 14)	
	Prepandemic Mean Volume, <i>n</i> (%)	Pandemic % Change	Prepandemic Mean Volume, <i>n</i> (%)	Pandemic % Change	Prepandemic Mean Volume, <i>n</i> (%)	Pandemic % Change
Bites/stings	12 590 (5.3)	−39.0	18 494 (6.6)	−38.6	7 120 (2.9)	−9.8
Cut/pierce	7 336 (3.1)	−10.1	8 623 (3.1)	−1.2	7 367 (3.0)	7.2
Drowning	351 (0.1)	−43.8	395 (0.1)	−28.9	94 (0.0)	−16.0
Environmental	376 (0.2)	−47.0	506 (0.2)	−39.0	416 (0.2)	−14.9
Fall	73 584 (31.2)	−37.0	85 318 (30.4)	−28.0	78 511 (32.0)	−23.6
Fire or burns	3 533 (1.5)	−12.3	4 520 (1.6)	−12.0	4 158 (1.7)	−4.6
Firearm	467 (0.2)	22.9	541 (0.2)	42.8	566 (0.2)	37.0
Foreign body	9 333 (4.0)	−15.5	11 086 (3.9)	−6.0	11 017 (4.5)	−0.9
MVC–occupant	8 524 (3.6)	−24.7	9 749 (3.5)	−8.8	9 108 (3.7)	−18.6
Neglect/abuse	4 712 (2.0)	−20.6	5 462 (1.9)	1.0	5 755 (2.3)	−1.6
Overexertion	8 563 (3.6)	−47.7	10 277 (3.7)	−31.5	9 825 (4.0)	−29.9
Pedal cyclist	4 090 (1.7)	60.4	4 858 (1.7)	24.9	1 885 (0.8)	32.2
Pedestrian	1 004 (0.4)	−40.3	1 127 (0.4)	−32.7	1 038 (0.4)	−50.3
Poisoning	13 338 (5.7)	−24.4	16 296 (5.8)	−7.5	16 678 (6.8)	−4.9
Sports-related injury	46 688 (19.8)	−43.1	57 466 (20.5)	−33.4	48 410 (19.7)	−33.4
Struck by/against	36 939 (15.7)	−51.4	43 489 (15.5)	−38.9	39 137 (16.0)	−36.2
Suffocation/asphyxiation	112 (0.0)	21.4	124 (0.0)	20.2	146 (0.1)	28.4
Transportation–other	2 268 (1.0)	20.8	2 665 (0.9)	25.3	1 835 (0.7)	17.9
Unknown/unspecified	221 (0.1)	−45.2	224 (0.1)	−33.8	265 (0.1)	−42.6

MVC, motor vehicle crash.

Characteristics within this grouping are not mutually exclusive. An encounter may have multiple or none, so percentages will not add up to 100%. *N* = patient encounter.

the SARS-CoV-2 pandemic were similar, but there was an increase in injury mechanisms that are disproportionately severe. For example, injuries with the associated mechanisms for firearm, pedal cyclist, and suffocation/asphyxiation increased, and injuries associated with suicide intent were increased throughout the pandemic period, which are injuries that are more likely to be severe. Nearly all of the suffocation/asphyxiation injuries were also designated also as intentional self-harm (data not shown). The degree of decline in overall ED injury-related visits and the severity of injury events during the first year of the pandemic appeared to be related to child opportunity; lower opportunity related to greater decreases in overall injury-related ED visits and higher opportunity related to greater increases in severity of injury events.

Although it is unclear at this time why the conditions of the SARS-CoV-2 pandemic were associated with

increases in pediatric injury severity, previous studies have demonstrated severe pediatric traumatic injuries occur at higher rates during the spring, summer, afternoons, evenings, and weekends.<sup>25,26</sup> Without the inherent structure of school and extracurricular activities, children may have been at increased risk for severe injury while engaging in unsupervised play/activity. Although a single center found an association with reduced pediatric trauma visits with reduced school days during the pandemic, there is a need to also consider the impact of risk-taking behaviors relative to school closures.<sup>27</sup> Other literature supports the association of risky behaviors with unsupervised, out of school time, which likely increased during the SARS-CoV-2 pandemic.<sup>28</sup> Understanding the changes in patterns and mechanisms of pediatric injuries relative to changes in family and school structure during the pandemic could help guide the development of injury prevention strategies, treatment, and management.

Serious–critical injuries increased in all categories of child opportunity, race and ethnicity, median zip income, and urbanicity. Children from rural areas and Black, Hispanic, and Asian American children had larger increases in ED visits for severe injury. Increased risk-taking behavior among rural youth and decreased adherence to injury prevention practices in rural areas are well documented in the literature and may account for the observed increases in ED visits for severe injury.<sup>29,30</sup> In addition, there is greater access and use of motorized equipment, along with dangerous roads with high speeds in rural areas, thus increasing the risk for severe injuries.<sup>31</sup> In the setting of the SARS-CoV-2 pandemic, the already high and rising suicide rates among children living in rural area and Asian American and Black children may have been exacerbated.<sup>32–34</sup> The dramatic change in family and school structure during the SARS-CoV-2 pandemic may have compounded

**TABLE 4** Patterns and Regions of Injury

	Time Period					
	Early (March 15–June 31)		Middle (July 1–October 31)		Late (November 31–March 14)	
	Prepandemic Mean Volume	Pandemic % Change	Prepandemic Mean Volume	Pandemic % Change	Prepandemic Mean Volume	Pandemic % Change
<b>Patterns, n (%)</b>						
Superficial	49 021 (20.8)	−41.7	60 293 (21.5)	−34.1	42 916 (17.5)	−29.8
Open wounds	45 446 (19.3)	−13.7	52 340 (18.6)	−8.1	47 449 (19.3)	−4.9
Sprains/strains, n (%)	11 420 (4.8)	−62.4	12 923 (4.6)	−47.8	12 490 (5.1)	−52.8
Fracture	41 046 (17.4)	−26.6	47 800 (17.0)	−15.9	37 310 (15.2)	−11.9
Dislocation	5869 (2.5)	−20.6	7098 (2.5)	−13.6	6731 (2.7)	−9.0
<b>Regions, n (%)</b>						
Head	55 343 (23.5)	−33.2	65 355 (23.3)	−26.4	59 567 (24.3)	−22.6
Neck	3768 (1.6)	−46.1	4769 (1.7)	−37.3	3818 (1.6)	−33.5
Face	25 292 (10.7)	−25.8	28 765 (10.2)	−16.0	27 373 (11.2)	−14.0
Thorax	4525 (1.9)	−32.0	5591 (2.0)	−25.8	4173 (1.7)	−22.7
Abdomen/pelvis, n (%)	8349 (3.5)	−31.8	10 135 (3.6)	−24.8	7654 (3.1)	−23.0
Abdomen	2718 (1.2)	−15.1	3190 (1.1)	−4.0	2509 (1.0)	−8.1
Pelvis	7092 (3.0)	−32.7	8660 (3.1)	−26.1	6461 (2.6)	−24.3
Upper extremity, n (%)	66 596 (28.2)	−34.5	79 185 (28.2)	−24.1	62 231 (25.4)	−20.4
Spine, n (%)	1565 (0.7)	−9.2	2024 (0.7)	−9.6	1769 (0.7)	−1.3
Lower extremity, n (%)	46 914 (19.9)	−37.8	57 986 (20.6)	−29.1	44 004 (17.9)	−29.3
Other, n (%)	1738 (0.7)	−37.2	1983 (0.7)	−22.0	1531 (0.6)	−25.1

Characteristics within this grouping are not mutually exclusive. An encounter may have multiple or none, so percentages will not add up to 100%. *N* = patient encounter.

existing differences in injury trends among children living in rural areas and for Black, Hispanic, and Asian American children. Our study found relatively large decreases in ED injury visits for children in the lower socioeconomic status and Black, Hispanic, and Asian American children. Consistent with previous literature, 1 explanation for these decreases may be lower ED utilization from historically marginalized groups during the pandemic amid social distancing measures in place.<sup>35,36</sup> Additionally, it may be that Black, Hispanic, and Asian American children, especially in urban environments, had greater decreases in their injury rates because of closer supervision by parents who remained home during the pandemic because of joblessness or transitions to a new work-from-home status.<sup>37,38</sup>

A previous, single-center, pandemic-related report also showed an increase in penetrating trauma during the pandemic period, which was offset by a decline in motor vehicle-related injuries, so that the

absolute number of severe injuries remained constant.<sup>10</sup> Consistent with previous studies, we redemonstrate an increase in pediatric firearm-related injuries during the SARS-CoV-2 pandemic.<sup>39,40</sup> The SARS-CoV-2 pandemic brought about record sales of new firearms.<sup>41</sup> Together with the demonstrated increase in pediatric suicide intent, these sales spark significant concern because of the added psychological and financial stressors of the SARS-CoV-2 pandemic, which are known risk factors for suicide attempts and death.<sup>42,43</sup> Social distancing as a mitigation effort to reduce the virus transmission has been implicated as a new psychological stressor impacting pediatric suicide attempts and deaths during the SARS-CoV-2 pandemic.<sup>44</sup> The increase in both injuries with suicide intent and firearm injuries underscores the importance of mental health assessments, social supports and resources, and firearm harm reduction strategies during pandemics and their aftermath.<sup>42,45</sup>

Pedal cycling and other ride-on apparatuses (eg, scooters) offered means of transportation and leisure time activity for children during SARS-CoV-2 stay-at-home orders amid school closures and cancellations of regular sporting activities. Consistent with another pediatric study, there was an increase in pediatric pedal cyclist and other transportation injuries throughout all pandemic periods.<sup>46</sup> The increase in pediatric bicycle-related injuries could also be attributed to increased bicycle sales and use of bicycle share programs during the same time period.<sup>47</sup> Although our results showed an increase in moderate to severe–critical injury visits in all opportunity groups, it was larger in the high and very-high opportunity groups that may have greater access to these means of transportation under pandemic conditions.<sup>47</sup>

Limitations include retrospective design and reduced generalizability to community hospitals and rural settings. Without access to the



**TABLE 5** Distribution of Severe Injury by Intent, Mechanism and Presence of Pandemic

Characteristic <sup>a</sup>	All Cases		Severe Injury	
	Nonsevere Injury N = 2 841 531	Severe <sup>b</sup> Injury N = 5460	Prepandemic N = 3966	Pandemic N = 1494
Intentionality, n (%)				
Unintentional	649 659 (22.9)	3333 (61.0)	2385 (60.1)	948 (63.5)
Suicide	20 850 (0.7)	26 (0.5)	16 (0.4)	10 (0.7)
Homicide	40 638 (1.4)	191 (3.5)	148 (3.7)	43 (2.9)
Undetermined	7620 (0.3)	53 (1.0)	39 (1.0)	14 (0.9)
Legal intervention or war	357 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Mechanism, n (%)				
Bites/stings	139 988 (4.9)	75 (1.4)	56 (1.4)	19 (1.3)
Cut/pierce	92 960 (3.3)	24 (0.4)	16 (0.4)	8 (0.5)
Drowning	3061 (0.1)	15 (0.3)	12 (0.3)	3 (0.2)
Environmental	4728 (0.2)	28 (0.5)	20 (0.5)	8 (0.5)
Fall	879 284 (30.9)	694 (12.7)	547 (13.8)	147 (9.8)
Fire or burns	47 352 (1.7)	326 (6.0)	224 (5.6)	102 (6.8)
Firearm	6697 (0.2)	147 (2.7)	87 (2.2)	60 (4.0)
Foreign body	123 425 (4.3)	106 (1.9)	83 (2.1)	23 (1.5)
MVC—occupant	103 158 (3.6)	1714 (31.4)	1199 (30.2)	515 (34.5)
Neglect/abuse	62 299 (2.2)	413 (7.6)	322 (8.1)	91 (6.1)
Overexertion	104 385 (3.7)	13 (0.2)	10 (0.3)	3 (0.2)
Pedal cyclist	47 288 (1.7)	329 (6.0)	220 (5.5)	109 (7.3)
Pedestrian	10 985 (0.4)	396 (7.3)	326 (8.2)	70 (4.7)
Poisoning	179 813 (6.3)	151 (2.8)	115 (2.9)	36 (2.4)
Sports-related injury	553 890 (19.5)	863 (15.8)	640 (16.1)	223 (14.9)
Struck by/against	427 839 (15.1)	311 (5.7)	234 (5.9)	77 (5.2)
Suffocation/asphyxiation	1602 (0.1)	15 (0.3)	14 (0.4)	1 (0.1)
Transportation—other	27 993 (1.0)	555 (10.2)	399 (10.1)	156 (10.4)
Unknown/unspecified	2512 (0.1)	36 (0.7)	34 (0.9)	2 (0.1)

MVC, motor vehicle crash.

<sup>a</sup> Characteristics within this grouping are not mutually exclusive. An encounter may have multiple or none, so percentages will not add up to 100%.<sup>b</sup> Severe injury is categorized as having an ISS score of 15 or greater.

medical records in our database, we were unable to ascertain the circumstances that surrounded the injuries. Although we recognize database limitations, we chose PHIS given its large national sample, inclusion of inpatient and ED encounters, and up-to-date data. Although we reported intent on the basis of ICD-10 coding, we refrained from inferences because of known discordance between codes and injury description.<sup>48,49</sup> We recognize that decreased ED visits for minor injuries does not necessarily negate their existence but may be attributable to avoidance of SARS-CoV-2 exposure and other nonclinical factors. Different injury trends may continue to emerge as

extended timelines and additional data sets are used.

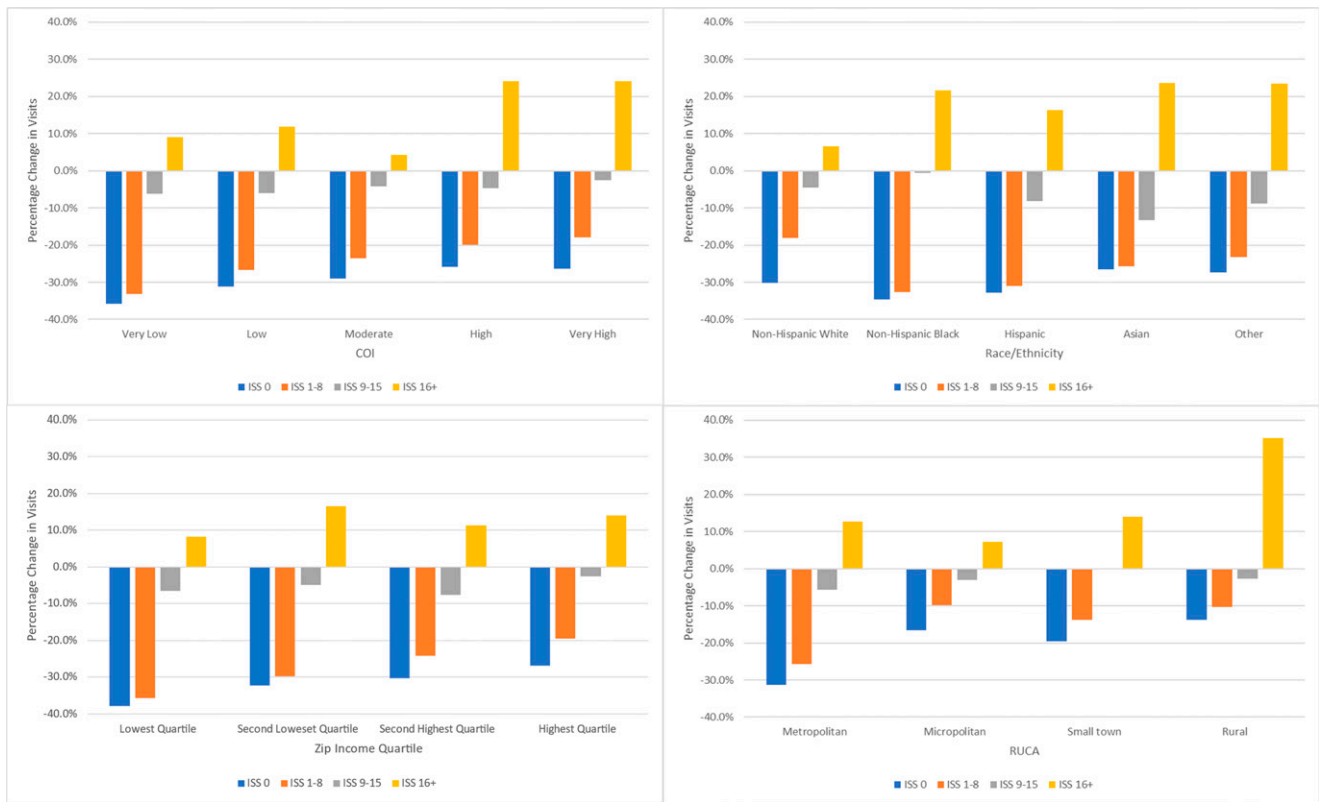
### CONCLUSIONS

Pediatric EDs in the United States saw a dramatic decline in injury-related visits during the SARS-CoV-2 pandemic. Although visits declined across a broad range of injury types, the proportional increase in injury severity, increases in pedal cyclist, firearm, and suffocation/asphyxiation injuries, as well as injuries because of suicide intent, are concerning. As public health officials continue to urge preparation for ongoing waves of the SARS-CoV-2 pandemic, as well as future pandemics, it is of critical importance to prioritize research

and develop strategies that promote injury prevention.

### ABBREVIATIONS

COI: Child Opportunity Index  
 ED: emergency department  
 ICD-10-CM: International Classification of Diseases, 10<sup>th</sup> Revision, Clinical Modification  
 ISS: injury severity score  
 PHIS: Pediatric Health Information System  
 SARS-CoV-2: severe acute respiratory syndrome coronavirus 2



**FIGURE 2** Percentage change of pediatric ED visits by injury severity score, COI, race and ethnicity, median zip code income, and rurality.

Deidentified individual participant data will not be made available.

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