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*Research Article*

# Injury Patterns and Demographics in Child and Adolescent Assault Victims Presenting to US Emergency Departments

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*Objective*. To correlate injury patterns with patient demographics in child and adolescent assault victims. *Methods*. The National Electronic Injury Surveillance System-All Injury Program data for the years 2005 through 2015 was used. Injuries due to assault were identified and analyzed with SUDAAN 11.0.01™ software to account for the weighted, stratified nature of the data. *Results*. There were an estimated 4,407,009 ED visits for assault in patients ≤ 19 years of age. With increasing age, the percentage of females decreased. Sexual assaults were more common in females (87.4%), and robbery/burglary was more common in males (79.8%). When the perpetrator was a spouse/partner, the assault victim was most commonly female (88.8%), and when a stranger, the assault victim was most commonly male (71.5%). With increasing age, the percentage of sexual assaults decreased while the reason for the assault being unknown increased. The assault occurred in the home in 59.6% of those ≤ 4 years of age, decreasing to 18.7% in those 15 to 19 years of age. The anatomic location was the head/neck in 32.8% of those ≤ 4 years of age, increasing to 60.6% in those 15-19 years old. Those ≤ 4 years old had the highest hospital admission rate (8.3%). The main diagnoses were concussion (3.0%), contusion/abrasion (33.3%), fracture (11.5%), laceration (11.5%), internal organ injury (11.5%), puncture (2.8%), and strain/sprain (20.7%). The number of assaults from 2005 to 2015 decreased for all age groups except for those ≤ 4 years old. *Conclusions*. These data provide a comprehensive overview of child and adolescent assault victims presenting to the ED in the USA and can be used as background data for further study. The decreasing numbers of assaults over the 11 years of the study are encouraging, and challenges still exist in decreasing the number for those ≤ 4 years old.

## 1. Introduction

Violence and assault are significant public health issues [1]. Although they have been studied in the general population, there are few overall studies of assault in children and adolescents that correlate injury patterns with the demographics of age and gender. Most studies in children and adolescents only address particular anatomic areas (e.g., craniofacial) or singular mechanisms of injury (firearm injuries, sexual assault, and nonaccidental trauma). Barmparas et al. [2] studied children admitted to a trauma center for assault using the National Trauma Data Bank; however, such results are skewed to more serious injuries as these children were seen at a major trauma center. Mollen et al. [3] reviewed youth violence patients presenting to three hospitals in the Philadelphia area, but the study was limited by age (8 to 24 years), as well as urban location. The purpose of this study was to analyze all child/adolescent assault patients in the USA presenting to emergency departments (ED) and correlate the injury patterns with patient demographics by age and gender. Such information will be very useful to all health care providers involved in caring for injured children and adolescents. Understanding injury patterns with their associated demographics will be helpful information for such a health care provider by giving clues to the potential for assault when not immediately divulged by the patient.

## 2. Materials and Methods

Children and adolescents were defined as individuals ≤ 19 years of age. The National Electronic Injury Surveillance System- (NEISS-) All Injury Program (AIP) data was used for

this study. The NEISS is a stratified, weighted dataset managed by the US Consumer Product Safety Commission (USCPSC) which collects injury data from ~100 hospitals in the United States and its territories having an emergency department (ED). It was initially designed for injuries due to consumer products. However, not all injuries are from consumer products; thus, the USCPSC selected ~65 of these hospitals (actual numbers vary slightly from year to year) to obtain data for all nonfatal injuries, regardless of the association with consumer products. This has been designated the All Injury Program (AIP). This data is in the public domain and housed by the Inter-University Consortium for Political and Social Research (ICPSR). It can be accessed at https://www.icpsr.umich.edu/icpsrweb/ICPSR/search/studies?q=all+injury+program. Use of this publicly available deidentified data was considered exempt by our local Institutional Review Board.

The database includes date of ED visit, gender/race/age of the injured patient, diagnosis, disposition from the ED, incident locale, body part injured, perpetrator and type of assault, reason for assault, causative agent/event of the injury, and hospital size (strata). Detailed descriptions of these variables are given in the appendix. The NEISS-AIP data for the years 2005 through 2015 was used. These years were chosen because 2015 was the last available year at the time the study began in mid-2019, and data before 2005 was coded differently for many variables, making it difficult to combine the years before 2005 with those afterwards. Injuries due to assault were identified using the code INTENT=1 (assault). Race was classified as White, Black, Amerindian (Hispanic and Native American), and Asian [4]. NEISS does not code for Polynesian and Indo-Mediterranean peoples.

*2.1. Statistical Analysis.* Statistical analyses were performed with SUDAAN 11.0.01™ software (RTI International, Research Triangle Park, North Carolina, 2013) which accounts for the weighted, stratified nature of the data. The estimated number of injuries/ED visits is calculated, along with 95% confidence intervals (CIs) of the estimate. When the actual number of patients ($n$) is <20, the estimated number ($N$) becomes unstable and should be interpreted with caution; thus, we report both the $n$ and $N$. The annual incidence of ED visits for assault was calculated using the US Census Bureau data. Analyses between groups of continuous data were performed with the $t$-test (2 groups) or ANOVA (3 or more groups). Differences between groups of categorical data were analyzed by the $\chi^2$ test. A $p < 0.05$ was considered to be statistically significant.

## 3. Results

There were a total of 5,702,369 ED visits in the NEISS-AIP database from 2005 through 2015, for an estimated 337,627,315 patients. Of these estimated 337,627,315 patients, there were an estimated 18,116,132 (14,855,602–22,013,301) due to assault (5.4%). Of these assault patients, an estimated 4,407,009 (4,139,536–4,686,643) were in those ≤ 19 years of age (24.3% of all assault patients).

The average age of these 4,407,009 patients was 14.5 years. Age group distribution was 286,883 (228,316–359,410) (6.5%) (≤4 years), 322,164 (282,865–366,449) (7.3%) (5 to 9 years), 995,807 (922,941–1,072,512) (22.6%) (10 to 14 years), and 2,794,290 (92,693,157–2,892,438) (63.5%) (15 to 19 years old). There were 2,653,938 (60.2%) males and 1,752,659 females (39.8%). Racial composition was known in 3,506,513 patients: White in 1,517,881 (993,044–2089,531) (43.3%), Black in 1,264,225 (974,460–1,586,346) (36.1%), Amerindian in 692,581 (351,002–1,236,046) (19.8%), and Asian in 31,826 (16,831–59,961) (0.9%). Disposition from the ED was known in 4,329,619 patients: 4,110,966 (3,997,537–4,187,175) (94.9%) were treated and released and 281,653 (142,444–332,082) (5.1%) were admitted to the hospital.

*3.1. Analyses by Gender.* There were differences by gender for all demographic variables (Table 1). With increasing age, the percentage of female patients decreased. Sexual assaults occurred most commonly in females (87.4%), and robbery/-burglary most commonly in males (79.8%) (Figure 1(a)) When the perpetrator was a spouse/partner, the assault victim was most commonly female (88.8%); when it was a stranger, the assault victim was most commonly male (71.5%) (Figure 1(b)). When the assault occurred at home, the victim was female in 55.9%, and when on the street, the victim was male in 71.0%. When the injury involved the lower trunk, 70.5% of the victims were female, and when the upper extremity, only 32.8% were female. When the victim was admitted to the hospital, 78.8% were male.

*3.2. Analyses by Age Groups.* The NEISS data is divided into different age groups; for this study, the groups were ≤4 years, 5 to 9 years, 10 to 14 years, and 15 to 19 years old. With increasing age (Table 2), the percentage of sexual assaults decreased while the reason for the assault being unknown increased (Figure 2(a)). Similarly, the perpetrator being a parent decreased with increasing age (Figure 2(b)) while the identity being unknown increased. The home was the incident locale in 59.6% of those ≤ 4 years of age which decreased to 18.7% in those 15 to 19 years of age. Injuries involving the head/neck increased from 32.8% in those ≤ 4 years of age to 60.6% in those 15 to 19 years of age, while lower trunk injuries decreased from 38.9% in those ≤ 4 years to 8.1% in those 15 to 19 years old. While the vast majority of patients in all four groups were discharged from the ED, those ≤ 4 years old had the highest hospital admission rate (8.3%).

*3.3. Analyses by Diagnosis.* There were seven major diagnoses (Table 3) that accounted for 99.6% of all the injuries. These were concussions ($N$ = 129,580—3.0%), contusion/abrasion ($N$ = 1,459,483—33.3%), fracture ($N$ = 504,522—11.5%), laceration ($N$ = 758,519—17.3%), internal organ injury ($N$ = 505,545—11.5%), puncture ($N$ = 122,679—2.8%), and strain/sprain ($N$ = 906,855—20.7%). The punctures and lacerations (penetrating trauma) comprised 20.1% of the assaults with blunt trauma comprising the remaining 79.9%. The common penetrating trauma was overwhelmingly in the 15- to 19-year-old age group (76.6% of the

Table 1: General demographics and demographics by gender.

| | All | | | | | Male | | | | | Female | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *n* | *N* | U95% | L95% | % | *n* | *N* | U95% | L95% | % | *n* | *N* | U95% | L95% | % | % female | *p* value |
| Average age ± 1 SD (years) | | | 14.5 ± 5.1 | | | | | 14.8 ± 4.8 | | | | | 14.0 ± 5.4 | | | | $<10^{-4}$ |
| Age group (years) | | | | | | | | | | | | | | | | | |
| ≤4 | 10,017 | 286,857 | 359,382 | 228,298 | 6.5 | 4,176 | 119,739 | 146,910 | 97,411 | 4.5 | 5,841 | 167,118 | 210,389 | 132,084 | 9.5 | 58.3 | $<10^{-4}$ |
| 5 to 9 | 9,748 | 322,079 | 366,420 | 282,843 | 7.3 | 5,287 | 183,605 | 212,821 | 158,027 | 6.9 | 4,461 | 138,475 | 157,135 | 121,749 | 7.9 | 43.0 | |
| 10 to 14 | 25,031 | 995,786 | 1,072,429 | 922,869 | 22.6 | 14,658 | 604,745 | 651,433 | 560,375 | 22.8 | 10,373 | 391,041 | 426,733 | 357,538 | 22.3 | 39.3 | |
| 15 to 19 | 57,749 | 2,794,082 | 2,892,214 | 2,692,948 | 63.5 | 35,430 | 1,738,937 | 1,798,125 | 1,677,950 | 65.7 | 22,319 | 1,055,145 | 1,099,767 | 1,009,550 | 60.2 | 37.8 | |
| Race | | | | | | | | | | | | | | | | | |
| White | 27,090 | 1,517,881 | 2,089,390 | 992,977 | 43.3 | 15,349 | 903,556 | 1,260,861 | 579,068 | 42.7 | 11,741 | 614,325 | 830,312 | 412,866 | 44.3 | 40.5 | 0.015 |
| Black | 40,032 | 1,264,082 | 1,592,551 | 974,043 | 36.1 | 23,349 | 751,445 | 955,018 | 570,173 | 35.5 | 16,683 | 512,636 | 635,124 | 401,204 | 36.9 | 40.6 | |
| Amerindian | 12,877 | 692,488 | 1,235,612 | 350,978 | 19.7 | 7,853 | 440,438 | 779,645 | 224,087 | 20.8 | 5,024 | 252,050 | 455,485 | 127,025 | 18.2 | 36.4 | |
| Asian | 699 | 31,826 | 59,957 | 16,830 | 0.9 | 471 | 22,587 | 42,784 | 11,861 | 1.1 | 228 | 9,239 | 17,492 | 4,859 | 0.7 | 29.0 | |
| Reason | | | | | | | | | | | | | | | | | |
| Altercation | 27,268 | 1,244,983 | 1,331,674 | 1,161,579 | 28.3 | 17,564 | 814,419 | 878,188 | 753,188 | 30.7 | 9,704 | 430,565 | 484,961 | 380,327 | 24.6 | 34.6 | $<10^{-4}$ |
| Robbery/burglary | 1,253 | 53,672 | 73,150 | 39,219 | 1.2 | 1,024 | 42,806 | 56,529 | 32,378 | 1.6 | 229 | 10,865 | 17,702 | 6,660 | 0.6 | 20.2 | |
| Sexual assault | 14,810 | 453,496 | 583,433 | 349,884 | 10.3 | 2,275 | 57,234 | 77,760 | 41,932 | 2.2 | 12,535 | 396,262 | 488,116 | 317,407 | 22.6 | 87.4 | |
| Other specified | 2,677 | 87,088 | 103,114 | 73,590 | 2.0 | 1,607 | 53,934 | 66,348 | 43,790 | 2.0 | 1,070 | 33,154 | 37,857 | 28,919 | 1.9 | 38.1 | |
| Unknown | 56,551 | 2,558,422 | 2,685,821 | 2,428,916 | 58.1 | 37,117 | 1,678,462 | 1,747,618 | 1,607,225 | 63.2 | 19,434 | 879,960 | 936,972 | 822,873 | 50.2 | 34.4 | |
| Perpetrator | | | | | | | | | | | | | | | | | |
| Spouse/partner | 3,190 | 168,516 | 189,043 | 150,265 | 3.8 | 358 | 18,912 | 22,824 | 15,658 | 0.7 | 2,832 | 149,604 | 164,575 | 135,831 | 8.5 | 88.8 | $<10^{-4}$ |
| Parent | 8,245 | 293,505 | 333,579 | 257,786 | 6.7 | 3,672 | 132,079 | 151,540 | 114,916 | 5.0 | 4,573 | 161,426 | 179,823 | 144,770 | 9.2 | 55.0 | |
| Other relative | 8,660 | 319,136 | 350,324 | 290,835 | 7.2 | 3,878 | 151,728 | 168,790 | 136,412 | 5.7 | 4,782 | 167,408 | 182,101 | 153,883 | 9.6 | 52.5 | |
| Friend/acquaintance | 22,655 | 942,928 | 1,001,619 | 886,607 | 21.4 | 12,854 | 568,282 | 611,202 | 527,603 | 21.4 | 9,801 | 374,646 | 394,173 | 355,790 | 21.4 | 39.7 | |
| Multiple | 15,281 | 642,918 | 763,663 | 538,486 | 14.6 | 9,346 | 409,989 | 490,713 | 340,500 | 15.4 | 5,935 | 232,930 | 273,415 | 197,700 | 13.3 | 36.2 | |
| Stranger | 2,883 | 113,461 | 140,570 | 91,657 | 2.6 | 2,023 | 81,162 | 99,788 | 65,818 | 3.1 | 860 | 32,298 | 41,012 | 25,414 | 1.8 | 28.5 | |
| Other specified | 2,303 | 110,746 | 120,741 | 101,792 | 2.5 | 1,780 | 86,635 | 96,073 | 78,026 | 3.3 | 523 | 24,111 | 26,816 | 21,733 | 1.4 | 21.8 | |
| Unknown | 39,072 | 1,801,229 | 1,911,582 | 1,693,015 | 40.9 | 25,616 | 1,198,517 | 1,272,563 | 1,125,270 | 45.2 | 13,456 | 602,712 | 644,803 | 561,902 | 34.4 | 33.5 | |
| Incident locale | | | | | | | | | | | | | | | | | |
| Unknown | 36,784 | 1,620,207 | 1,930,530 | 1,332,996 | 36.8 | 22,069 | 993,134 | 1,195,334 | 806,266 | 37.4 | 14,715 | 627,073 | 739,096 | 523,344 | 35.8 | 38.7 | $<10^{-4}$ |
| Home | 26,586 | 1,019,068 | 1,204,764 | 854,439 | 23.1 | 11,136 | 449,374 | 540,076 | 371,286 | 16.9 | 15,450 | 569,694 | 659,701 | 486,538 | 32.5 | 55.9 | |
| School/sports | 19,195 | 862,116 | 943,893 | 786,137 | 19.6 | 12,680 | 585,871 | 641,457 | 533,707 | 22.1 | 6,515 | 276,246 | 309,520 | 245,898 | 15.8 | 32.0 | |
| Street | 9,485 | 440,176 | 621,330 | 307,580 | 10.0 | 6,814 | 312,618 | 438,165 | 219,481 | 11.8 | 2,671 | 127,558 | 186,483 | 86,231 | 7.3 | 29.0 | |
| Other property | 10,708 | 464,533 | 581,671 | 368,832 | 10.5 | 7,045 | 312,590 | 399,683 | 242,570 | 11.8 | 3,663 | 151,943 | 185,607 | 123,913 | 8.7 | 32.7 | |
| Anatomic location | | | | | | | | | | | | | | | | | |
| Unknown | 2,572 | 87,316 | 137,045 | 55,523 | 2.0 | 781 | 25,706 | 39,278 | 16,720 | 1.0 | 1,791 | 61,610 | 100,953 | 37,156 | 3.5 | 70.6 | $<10^{-4}$ |

Table 1: Continued.

| | All | | | | | Male | | | | | Female | | | | | % | $p$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $n$ | $N$ | U95% | L95% | % | $n$ | $N$ | U95% | L95% | % | $n$ | $N$ | U95% | L95% | % | female | value |
| Head/neck | 54,620 | 2,489,646 | 2,583,147 | 2,395,426 | 56.5 | 35,868 | 1,654,719 | 1,690,028 | 1,614,125 | 62.3 | 18,752 | 834,927 | 899,289 | 770,995 | 47.6 | 33.5 | |
| Upper trunk | 6,976 | 308,217 | 331,817 | 285,988 | 7.0 | 4,521 | 199,149 | 218,950 | 180,999 | 7.5 | 2,455 | 109,068 | 117,954 | 100,778 | 6.2 | 35.4 | |
| Lower trunk | 15,961 | 520,630 | 642,923 | 419,067 | 11.8 | 4,411 | 153,453 | 178,079 | 131,901 | 5.8 | 11,550 | 367,177 | 459,722 | 289,013 | 20.9 | 70.5 | |
| Upper extremity | 15,442 | 700,595 | 743,834 | 659,227 | 15.9 | 10,316 | 471,143 | 643,845 | 598,728 | 17.8 | 5,126 | 229,451 | 255,012 | 206,113 | 13.1 | 32.8 | |
| Lower extremity | 7,197 | 300,192 | 341,511 | 263,515 | 6.8 | 3,851 | 149,766 | 172,241 | 130,043 | 5.6 | 3,346 | 150,426 | 179,472 | 125,666 | 8.6 | 50.1 | |
| Disposition from ED | | | | | | | | | | | | | | | | | |
| Release | 94,251 | 4,110,626 | 4,186,797 | 3,997,177 | 95.0 | 53,657 | 2,441,560 | 2,498,849 | 2,358,485 | 93.4 | 40,594 | 1,669,065 | 1,687,753 | 1,638,350 | 97.3 | 40.6 | $<10^{-4}$ |
| Admit | 6,712 | 218,603 | 332,052 | 142,432 | 5.0 | 5,211 | 172,298 | 255,374 | 115,010 | 6.6 | 1,501 | 46,305 | 77,020 | 27,617 | 2.7 | 21.2 | |
| Hospital size | | | | | | | | | | | | | | | | | |
| Small | 6,408 | 779,276 | 1,096,361 | 538,927 | 17.7 | 3,647 | 443,477 | 634,291 | 301,487 | 16.7 | 2,761 | 335,799 | 464,104 | 236,434 | 19.2 | 43.1 | 0.012 |
| Medium | 6,966 | 887,698 | 1,234,288 | 619,568 | 20.1 | 4,260 | 539,925 | 756,106 | 373,409 | 20.3 | 2,706 | 347,773 | 486,363 | 241,166 | 19.8 | 39.2 | |
| Large | 17,353 | 1,535,598 | 2,189,197 | 990,162 | 34.8 | 10,910 | 965,666 | 1,386,151 | 611,201 | 36.4 | 6,443 | 569,932 | 804,646 | 376,471 | 32.5 | 37.1 | |
| Very large | 41,098 | 937,644 | 1,302,590 | 653,498 | 21.3 | 24,827 | 566,153 | 802,816 | 384,821 | 21.3 | 16,271 | 371,490 | 504,766 | 265,878 | 21.2 | 39.6 | |
| Children's | 30,943 | 266,381 | 479,878 | 144,536 | 6.0 | 16,104 | 138,716 | 253,982 | 74,045 | 5.2 | 14,839 | 127,665 | 227,495 | 69,581 | 7.3 | 47.9 | |

$n$ = actual number of ED visits; $N$ = estimated number of ED visits; L95% = lower 95% confidence interval of the estimate; U95% = upper 95% confidence interval of the estimate. Those categories comprising less than 1% of the variables as described in the appendix are excluded; thus, the percentage sum will not add up to 100.

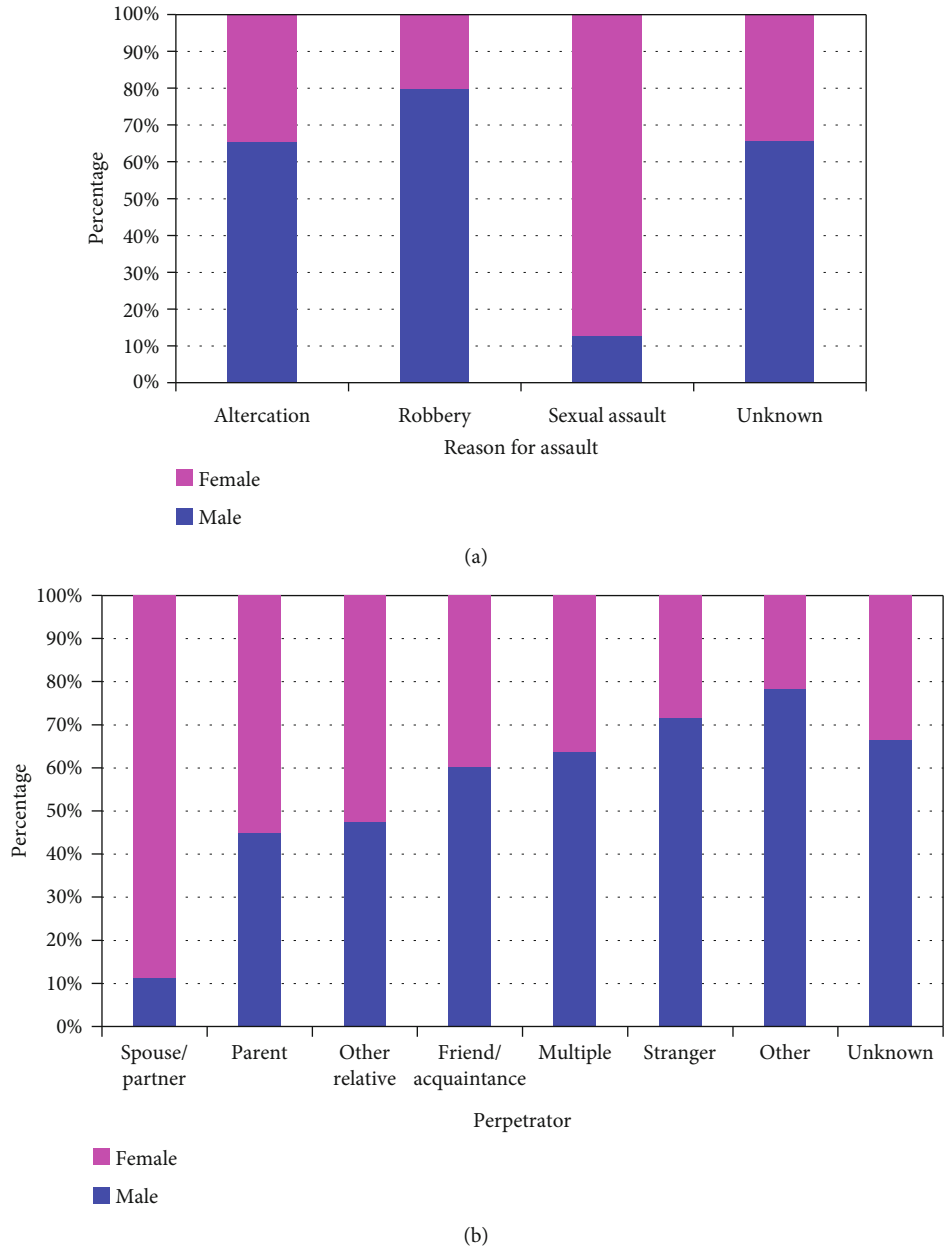



Figure 1: Differences by gender in child and adolescent assault victims. (a) By reason for assault ($p < 10^{-4}$). (b) By perpetrator of assault ($p < 10^{-4}$).

lacerations and 79.1% of the punctures were in those 15 to 19 years old). These diagnoses differed markedly by age group (Figure 3(a)) and gender (Figure 3(b)). Strain/sprains were most common in females, and fractures in males.

*3.4. Changes Over Time.* There was a gradual decrease in the number of assaults from 2005 to 2015 for all age groups except for those < 4 years old (Figure 4).

## 4. Discussion

While there are some similar studies, none have focused on all injured patients who present to the emergency department across a whole country. Most focus on a certain city or county [3, 5, 6], only patients admitted to the hospital [2], or a certain type/cause of injury [7–12]. This study is more expansive, studying all assault victims in children and adolescents, not just those admitted to the hospital or having a particular type of injury, involving a particular anatomic area or encompassing a particular geographic location. In this study, only 5.0% of the patients were admitted to the hospital.

*4.1. Literature Comparison.* The study most similar to the present one is that of Barmparas et al. [2]. However, they used the National Trauma Data Bank, only studying patients admitted to the hospital. They found a slightly higher median

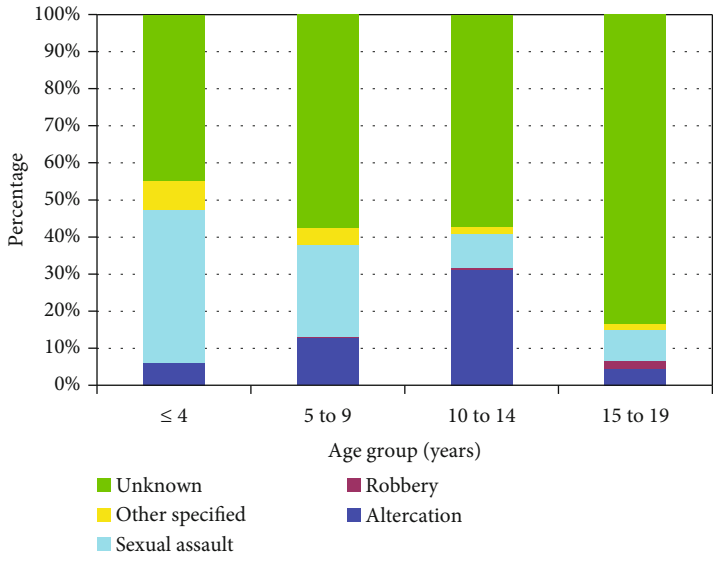
Table 2: Demographics by age group.

| | ≤4 years | | | | | 5 to 9 years | | | | | 10 to 14 years | | | | | 15 to 19 years | | | | | $p$ value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $n$ | $N$ | L95% | U95% | % | $n$ | $N$ | L95% | U95% | % | $n$ | $N$ | L95% | U95% | % | $n$ | $N$ | L95% | U95% | % | |
| Sex | | | | | | | | | | | | | | | | | | | | | |
| Male | 4,176 | 119,739 | 111,042 | 128,627 | 41.7 | 5,287 | 183,605 | 170,316 | 196,598 | 57.0 | 14,658 | 604,775 | 592,393 | 616,889 | 60.7 | 35,430 | 1,738,937 | 1,681,758 | 1,794,918 | 62.2 | $<10^{-4}$ |
| Female | 5,841 | 167,118 | 158,230 | 175,815 | 58.3 | 4,461 | 138,475 | 125,482 | 151,764 | 43.0 | 10,373 | 391,041 | 378,897 | 403,393 | 39.3 | 22,319 | 1,055,145 | 999,164 | 1,112,324 | 37.8 | |
| Race | | | | | | | | | | | | | | | | | | | | | |
| White | 3,652 | 120,734 | 85,764 | 153,782 | 54.6 | 2,725 | 106,686 | 61,341 | 158,418 | 41.5 | 5,943 | 320,890 | 196,764 | 463,823 | 39.8 | 14,749 | 968,890 | 647,627 | 1,316,096 | 43.7 | $<10^{-4}$ |
| Black | 2,790 | 58,623 | 39,541 | 82,732 | 26.5 | 3,735 | 90,703 | 64,761 | 120,523 | 35.3 | 10,987 | 315,873 | 241,475 | 397,159 | 39.1 | 22,432 | 796,637 | 616,366 | 996,827 | 35.9 | |
| Amerindian | 1,184 | 40,819 | 23,123 | 67,443 | 18.4 | 1,270 | 56,185 | 28,640 | 98,799 | 21.9 | 3,187 | 164,481 | 78,689 | 304,750 | 20.4 | 7,220 | 430,248 | 217,945 | 769,792 | 19.4 | |
| Asian | 58 | 1,093 | 553 | 2,146 | 0.5 | 88 | 3,515 | 1,800 | 6,787 | 0.0 | 154 | 5,627 | 3,067 | 10,976 | 0.7 | 398 | 21,369 | 10,864 | 41,904 | 1.0 | |
| Reason | | | | | | | | | | | | | | | | | | | | | |
| Altercation | 533 | 17,315 | 13,024 | 22,893 | 6.0 | 1,187 | 41,309 | 36,694 | 46,424 | 12.8 | 7,681 | 308,946 | 281,813 | 336,583 | 31.0 | 17,853 | 87,678 | 819,286 | 936,367 | 3.1 | $<10^{-4}$ |
| Robbery/burglary | 12 | 338 | 172 | 631 | 0.1 | 18 | 616 | 226 | 1,675 | 0.2 | 198 | 7,055 | 4,182 | 11,950 | 0.7 | 1,016 | 45,392 | 33,811 | 60,916 | 1.6 | |
| Sexual assault | 4,441 | 117,669 | 99,061 | 137,216 | 41.0 | 3,240 | 80,435 | 61,598 | 102,770 | 25.0 | 3,143 | 89,755 | 69,607 | 115,016 | 9.0 | 3,986 | 165,624 | 125,743 | 216,837 | 5.9 | |
| Other specified | 957 | 23,181 | 19,910 | 26,967 | 8.1 | 490 | 14,286 | 11,888 | 17,139 | 4.4 | 578 | 20,045 | 16,530 | 24,198 | 2.0 | 651 | 29,555 | 22,913 | 38,282 | 1.1 | |
| Unknown | 4,075 | 128,333 | 111,970 | 145,105 | 44.7 | 4,812 | 185,502 | 166,752 | 203,608 | 57.6 | 13,395 | 568,737 | 537,337 | 599,575 | 57.1 | 34,078 | 1,669,333 | 1,590,230 | 1,746,711 | 59.7 | |
| Perpetrator | | | | | | | | | | | | | | | | | | | | | |
| Spouse/partner | 17 | 809 | 430 | 1,549 | 0.3 | 6 | 68 | 32 | 161 | 0.0 | 157 | 5,368 | 3,983 | 7,170 | 0.5 | 3,007 | 162,203 | 144,465 | 181,908 | 5.8 | $<10^{-4}$ |
| Parent | 2,933 | 86,586 | 80,872 | 92,520 | 30.2 | 1,616 | 53,295 | 43,589 | 64,658 | 16.5 | 1,829 | 66,290 | 57,956 | 75,681 | 6.7 | 1,867 | 87,334 | 76,005 | 100,315 | 3.1 | |
| Other relative | 1,905 | 49,724 | 44,696 | 55,168 | 17.3 | 2,115 | 63,766 | 58,054 | 69,877 | 19.8 | 2,046 | 81,267 | 72,395 | 91,116 | 8.2 | 2,595 | 124,378 | 112,330 | 137,758 | 4.5 | |
| Unrelated caregiver | 302 | 7,818 | 6,197 | 9,869 | 2.7 | 73 | 2,302 | 1,546 | 3,447 | 0.7 | 44 | 20 | 996 | 2,490 | 0.0 | 35 | 1,468 | 838 | 2,235 | 0.1 | |
| Friend/acquaintance | 1,955 | 53,864 | 49,946 | 58,008 | 18.8 | 3,504 | 119,545 | 105,799 | 133,956 | 37.1 | 8,756 | 360,802 | 344,250 | 377,809 | 36.2 | 8,436 | 408,563 | 354,037 | 470,000 | 14.6 | |
| Multiple | 629 | 15,486 | 13,168 | 18,188 | 5.4 | 737 | 22,615 | 20,361 | 25,097 | 7.0 | 4,080 | 150,827 | 120,791 | 186,714 | 15.1 | 9,823 | 453,753 | 381,141 | 537,342 | 16.2 | |
| Stranger | 43 | 1,234 | 832 | 1,807 | 0.4 | 55 | 2,064 | 1,450 | 2,932 | 0.6 | 415 | 12,433 | 10,058 | 15,335 | 1.2 | 2,352 | 97,008 | 77,402 | 121,552 | 3.5 | |
| Other specified | 37 | 1,649 | 1,148 | 2,381 | 0.6 | 95 | 3,297 | 2,513 | 4,317 | 1.0 | 728 | 30,247 | 26,688 | 34,256 | 3.0 | 1,423 | 75,552 | 68,181 | 83,549 | 2.7 | |
| Unknown | 2,179 | 69,713 | 63,258 | 76,598 | 24.3 | 1,546 | 55,083 | 49,001 | 61,727 | 17.1 | 6,969 | 286,770 | 259,607 | 315,571 | 28.8 | 28,199 | 1,383,384 | 1,316,949 | 1,449,957 | 49.5 | |
| Incident locale | | | | | | | | | | | | | | | | | | | | | |
| Unknown | 2,542 | 84,218 | 69,254 | 100,925 | 29.4 | 2,218 | 74,272 | 58,054 | 93,428 | 23.1 | 7,268 | 270,454 | 220,273 | 327,222 | 27.2 | 24,653 | 1,187,179 | 955,647 | 1,431,235 | 42.5 | $<10^{-4}$ |
| Home | 6,445 | 170,958 | 155,749 | 182,687 | 59.6 | 4,411 | 131,254 | 109,987 | 153,640 | 40.7 | 5,358 | 193,660 | 161,022 | 231,027 | 19.4 | 10,356 | 522,617 | 426,688 | 634,304 | 18.7 | |
| School/sports | 671 | 19,845 | 15,262 | 25,676 | 6.9 | 2,546 | 95,004 | 70,747 | 123,518 | 29.5 | 8,579 | 377,087 | 347,935 | 407,185 | 37.9 | 7,399 | 370,264 | 314,916 | 433,394 | 13.3 | |
| Street | 112 | 3,725 | 2,238 | 6,168 | 1.3 | 260 | 9,457 | 7,216 | 12,339 | 2.9 | 1,690 | 77,337 | 51,882 | 113,721 | 7.8 | 7,366 | 348,235 | 243,383 | 489,560 | 12.5 | |
| Other property | 248 | 8,107 | 6,053 | 10,844 | 2.8 | 313 | 12,168 | 8,698 | 16,978 | 3.8 | 2,134 | 77,150 | 60,645 | 97,689 | 7.7 | 7,974 | 365,657 | 289,488 | 458,264 | 13.1 | |
| Anatomic location | | | | | | | | | | | | | | | | | | | | | |
| Head/neck | 3,043 | 93,972 | 78,950 | 110,364 | 32.8 | 3,607 | 131,804 | 115,013 | 149,259 | 40.9 | 13,852 | 567,114 | 542,914 | 591,908 | 57.0 | 34,026 | 1,693,398 | 1,643,043 | 1,742,799 | 60.6 | $<10^{-4}$ |
| Upper trunk | 458 | 13,063 | 10,902 | 15,635 | 4.6 | 588 | 21,683 | 19,491 | 24,130 | 6.7 | 1,501 | 65,076 | 59,748 | 70,901 | 6.5 | 4,382 | 206,583 | 189,173 | 225,220 | 7.4 | |
| Lower trunk | 4,317 | 111,495 | 91,430 | 132,970 | 38.9 | 3,251 | 84,128 | 66,398 | 104,639 | 26.1 | 3,213 | 98,207 | 78,967 | 121,488 | 9.9 | 5,136 | 225,432 | 184,144 | 274,958 | 8.1 | |
| Upper extremity | 586 | 16,650 | 13,971 | 19,795 | 5.8 | 1,036 | 37,670 | 33,956 | 41,752 | 11.7 | 4,438 | 184,055 | 172,673 | 195,975 | 18.5 | 9,374 | 461,971 | 432,556 | 492,913 | 16.5 | |
| Lower extremity | 17,168 | 33,846 | 27,971 | 40,766 | 11.8 | 816 | 33,390 | 27,674 | 40,142 | 10.4 | 1,501 | 64,013 | 56,064 | 72,993 | 6.4 | 3,811 | 168,324 | 145,583 | 194,483 | 6.0 | |
| Disposition from ED | | | | | | | | | | | | | | | | | | | | | |
| Release | 8,736 | 259,819 | 244,976 | 269,225 | 91.7 | 9,409 | 312,693 | 306,250 | 315,844 | 98.1 | 23,984 | 963,933 | 945,877 | 973,868 | 97.8 | 52,093 | 2,573,306 | 2,493,535 | 2,627,796 | 94.1 | 0.0005 |
| Admit | 1,142 | 23,456 | 14,050 | 38,299 | 8.3 | 207 | 6,019 | 2,868 | 12,462 | 1.9 | 780 | 21,665 | 11,729 | 39,720 | 2.2 | 4,408 | 161,133 | 106,643 | 240,904 | 5.9 | |
| Hospital size | | | | | | | | | | | | | | | | | | | | | |
| Small | 534 | 65,216 | 44,610 | 91,745 | 22.7 | 535 | 65,156 | 41,205 | 98,196 | 20.2 | 1,495 | 181,770 | 120,493 | 264,686 | 18.3 | 3,843 | 467,014 | 325,814 | 653,305 | 16.7 | $<10^{-4}$ |

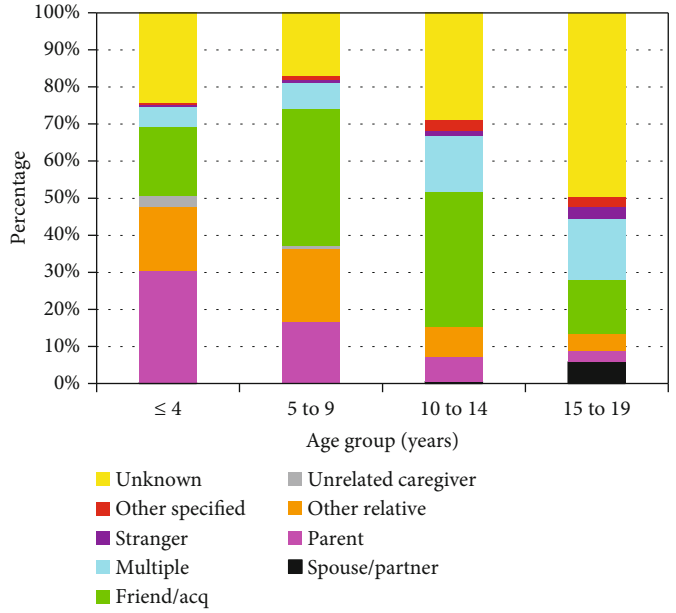
Table 2: Continued.

| | ≤4 years | | | | | 5 to 9 years | | | | | 10 to 14 years | | | | | 15 to 19 years | | | | | $p$ value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $n$ | $N$ | L95% | U95% | % | $n$ | $N$ | L95% | U95% | % | $n$ | $N$ | L95% | U95% | % | $n$ | $N$ | L95% | U95% | % | |
| Medium | 237 | 31,526 | 19,795 | 48,942 | 11.0 | 336 | 43,526 | 27,030 | 67,816 | 13.5 | 1,504 | 193,179 | 125,372 | 285,597 | 19.4 | 4,889 | 619,468 | 440,380 | 844,993 | 22.2 | |
| Large | 1,022 | 90,183 | 57,836 | 130,331 | 31.4 | 1,272 | 111,658 | 60,148 | 177,416 | 34.7 | 3,856 | 340,230 | 195,875 | 285,597 | 34.2 | 11,165 | 990,152 | 655,261 | 1,385,409 | 35.4 | |
| Very large | 2,039 | 46,684 | 27,684 | 74,963 | 16.3 | 2,557 | 58,396 | 34,021 | 94,491 | 18.1 | 8,722 | 199,260 | 121,488 | 521,604 | 20.0 | 27,610 | 629,400 | 455,469 | 845,832 | 22.5 | |
| Children's | 6,188 | 53,274 | 27,311 | 94,930 | 18.6 | 5,049 | 43,428 | 22,713 | 78,093 | 13.5 | 9,455 | 81,368 | 43,517 | 309,198 | 8.2 | 10,245 | 88,255 | 47,503 | 162,069 | 3.2 | |

$n$ = actual number of ED visits; $N$ = estimated number of ED visits; L95% = lower 95% confidence interval of the estimate; U95% = upper 95% confidence interval of the estimate. Those categories comprising less than 1% of the variables as described in the appendix are excluded; thus, the percentage sum will not add up to 100.




(a)




(b)

Figure 2: Differences by gender in child and adolescent assault victims. (a) By reason for assault ($p < 10^{-4}$). (b) By perpetrator of assault ($p < 10^{-4}$).

age (16 years vs. 15 years). Both studies noted that most of the assault victims were adolescents. They noted that with increasing age, a greater proportion of their patients were Black and fewer were White. While this trend was also seen in our data until age 15 years, in those aged 15 to 19, there was an increase in the proportion of White patients (Table 2). Amerindian and Asian races demonstrated a consistent proportion across all four age groups. Barmparas et al. [2] found that younger children were more likely to sustain a head injury, while we found that they were more likely to have lower trunk injury. This difference is likely due to the fact that they only studied those admitted to the hospital. In this study, all other age groups were more likely to have a head injury, especially concussions in those 15 to 19 years of age. Additionally, the present study used different classifications for reason of injury. When known, a sexual assault was the most common reason for the assault, except for those 10 to 14 years of age, who were most likely to be injured in an altercation. This also likely explains the fact that most of the injuries in the group ≤ 4 years old involved the lower trunk (sexual assault) as discussed above. We found that adolescents were most likely to be injured in the street, while younger patients were more likely to be injured at home. Children 10 to 14 years of age were most likely to be assaulted at school and by a friend or acquaintance. This finding is consistent with other studies [6, 11] which found that older children and adolescents tended to experience more violent injury further away from home.

Table 3: Demographics by major diagnoses.

| | Concussion | | | | | Contusion/abrasion | | | | | Fracture | | | | | Laceration | | | | | Internal organ | | | | | Puncture | | Strain/sprain | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *n* | *N* | L95% | U95% | % | *n* | *N* | L95% | U95% | % | *n* | *N* | L95% | U95% | % | *n* | *N* | L95% | U95% | % | *n* | *N* | L95% | U95% | % | *n* | *N* | L95% | U95% | *p* value % | |
| Average age ± 1 SD (years) | | | 15.7 ± 3.1 | | | | | 14.2 ± 4.9 | | | | | 15.2 ± 4.8 | | | | | 15.8 ± 3.9 | | | | | 14.9 ± 4.7 | | | | | 15.7 ± 4.1 | | | | 12.8 ± 3.4 | | $<10^{-4}$ | |
| Age group (years) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | $<10^{-4}$ |
| ≤4 | 21 | 521 | 259 | 1,048 | 0.4 | 2,593 | 86,948 | 69,164 | 108,853 | 6.0 | 874 | 19,635 | 13,197 | 29,013 | 3.9 | 491 | 16,550 | 13,414 | 20,463 | 2.2 | 774 | 22,313 | 16,894 | 29,300 | 4.4 | 69 | 3,450 | 1,466 | 7,932 | 2.9 | 4,886 | 129,464 | 102,769 | 161,714 | 14.3 | |
| 5 to 9 | 141 | 4,052 | 1,113 | 2,407 | 3.1 | 3,037 | 120,383 | 105,934 | 136,576 | 8.3 | 506 | 15,804 | 12,089 | 20,601 | 3.1 | 1,030 | 36,397 | 30,391 | 43,578 | 4.8 | 735 | 26,130 | 20,929 | 32,578 | 5.2 | 118 | 5,793 | 2,452 | 13,171 | 4.8 | 4,101 | 111,056 | 98,876 | 124,500 | 12.3 | |
| 10 to 14 | 977 | 32,386 | 28,653 | 36,431 | 25.0 | 8,513 | 382,981 | 344,797 | 423,737 | 26.2 | 2,983 | 119,891 | 109,051 | 131,465 | 23.8 | 3,170 | 123,542 | 113,531 | 134,524 | 16.3 | 2,898 | 118,838 | 107,770 | 130,665 | 23.6 | 395 | 15,928 | 11,669 | 21,439 | 13.3 | 6,020 | 199,344 | 184,713 | 214,864 | 22.0 | |
| 15 to 19 | 2,055 | 92,459 | 87,784 | 96,805 | 71.4 | 16,556 | 868,838 | 823,252 | 913,282 | 59.5 | 7,080 | 348,368 | 336,168 | 360,094 | 69.2 | 11,961 | 580,629 | 566,895 | 594,709 | 76.6 | 6,882 | 337,023 | 323,713 | 349,836 | 66.8 | 2,468 | 95,005 | 80,830 | 105,034 | 79.1 | 10,595 | 465,591 | 430,544 | 500,445 | 51.4 | |
| Sex | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Male | 2,209 | 88,863 | 85,458 | 92,118 | 68.6 | 17,187 | 817,807 | 799,437 | 836,067 | 56.0 | 9,003 | 404,347 | 397,859 | 410,522 | 80.1 | 12,584 | 584,098 | 574,357 | 593,543 | 77.0 | 7,258 | 330,499 | 319,044 | 341,591 | 65.4 | 2,493 | 95,855 | 85,385 | 104,032 | 78.1 | 8,676 | 321,102 | 278,833 | 365,974 | 35.4 | $<10^{-4}$ |
| Female | 992 | 40,717 | 37,462 | 44,122 | 31.4 | 13,521 | 641,552 | 623,293 | 659,923 | 44.0 | 2,463 | 100,166 | 93,991 | 106,654 | 19.9 | 4,107 | 174,229 | 164,784 | 183,970 | 23.0 | 4,056 | 175,037 | 163,945 | 186,492 | 34.6 | 622 | 26,824 | 18,647 | 37,294 | 21.9 | 16,973 | 585,673 | 540,801 | 627,942 | 64.6 | |
| Race | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| White | 1,050 | 61,213 | 49,560 | 71,955 | 59.1 | 8,050 | 509,297 | 323,501 | 714,234 | 42.6 | 3,268 | 191,941 | 134,381 | 250,850 | 48.0 | 3,571 | 217,560 | 129,901 | 324,845 | 35.3 | 3,133 | 181,413 | 118,947 | 244,972 | 48.7 | 327 | 15,093 | 8,837 | 24,497 | 16.1 | 7,541 | 335,598 | 224,197 | 451,099 | 47.1 | $<10^{-4}$ |
| Black | 1,055 | 25,423 | 16,713 | 36,749 | 24.6 | 12,568 | 432,994 | 338,667 | 537,019 | 36.3 | 4,202 | 131,405 | 99,596 | 167,727 | 32.9 | 7,469 | 258,985 | 205,292 | 315,976 | 42.0 | 3,257 | 107,107 | 76,181 | 144,502 | 28.8 | 1,606 | 51,090 | 31,864 | 68,961 | 54.6 | 9,629 | 250,810 | 183,117 | 328,001 | 35.2 | |
| Amerindian | 348 | 15,352 | 9,262 | 24,413 | 14.8 | 4,082 | 238,734 | 110,819 | 452,710 | 20.0 | 1,434 | 73,738 | 38,143 | 130,543 | 18.4 | 2,241 | 132,636 | 65,844 | 237,813 | 21.5 | 1,537 | 80,809 | 82,477 | 141,447 | 21.7 | 391 | 26,795 | 13,068 | 46,598 | 28.6 | 2,771 | 121,803 | 62,083 | 219,569 | 17.1 | |
| Asian | 32 | 1,500 | 704 | 3,156 | 1.4 | 241 | 13,146 | 6,329 | 27,347 | 1.1 | 68 | 2,741 | 1,399 | 5,358 | 0.7 | 134 | 6,756 | 3,388 | 13,304 | 1.1 | 83 | 3,195 | 1,714 | 5,960 | 0.9 | 15 | 630 | 300 | 1,320 | 0.7 | 119 | 3,751 | 2,278 | 6,052 | 0.5 | |
| Reason | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Altercation | 848 | 31,990 | 28,080 | 36,256 | 24.7 | 8,723 | 433,742 | 401,212 | 467,764 | 29.7 | 4,422 | 200,255 | 181,833 | 219,047 | 39.7 | 6,014 | 267,732 | 243,181 | 293,319 | 35.3 | 2,797 | 117,918 | 108,136 | 128,307 | 23.3 | 517 | 22,389 | 16,402 | 29,934 | 18.3 | 3,875 | 168,912 | 146,004 | 194,520 | 18.6 | $<10^{-4}$ |
| Robbery/burglary | 52 | 1,361 | 907 | 1,944 | 1.1 | 341 | 15,701 | 11,092 | 22,038 | 1.1 | 152 | 5,910 | 4,286 | 8,118 | 1.2 | 307 | 14,770 | 9,937 | 21,845 | 1.9 | 188 | 7,810 | 5,460 | 11,173 | 1.5 | 67 | 2,335 | 1,779 | 3,055 | 1.9 | 142 | 5,464 | 3,990 | 7,436 | 0.6 | |
| Sexual assault | 4 | 109 | 26 | 518 | 0.1 | 434 | 14,988 | 10,508 | 21,454 | 1.0 | 19 | 542 | 252 | 1,160 | 0.1 | 111 | 4,397 | 2,579 | 7,509 | 0.6 | 24 | 685 | 354 | 1,264 | 0.1 | 3 | 104 | 25 | 491 | 0.1 | 14,212 | 432,545 | 364,102 | 501,944 | 47.7 | |
| Other specified | 34 | 1,050 | 505 | 2,164 | 0.8 | 1,185 | 39,257 | 32,109 | 47,871 | 2.7 | 3,334 | 9,620 | 7,009 | 13,111 | 1.9 | 180 | 7,523 | 5,992 | 9,406 | 1.0 | 242 | 8,247 | 6,926 | 9,808 | 1.6 | 126 | 5,225 | 2,760 | 9,692 | 4.3 | 480 | 14,014 | 11,154 | 17,593 | 1.5 | |
| Unknown | 2,253 | 94,483 | 89,475 | 99,077 | 72.9 | 19,984 | 954,054 | 918,015 | 988,946 | 65.4 | 6,512 | 287,307 | 269,977 | 304,014 | 57.0 | 10,038 | 461,959 | 438,196 | 484,997 | 60.9 | 8,031 | 369,375 | 357,471 | 380,625 | 73.1 | 2,374 | 91,294 | 85,838 | 96,193 | 74.4 | 6,924 | 285,213 | 236,054 | 339,345 | 31.5 | |
| Perpetrator | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Spouse/partner | 76 | 3,703 | 2,786 | 4,898 | 2.9 | 1,336 | 75,153 | 64,655 | 87,277 | 5.1 | 2,221 | 11,350 | 9,177 | 13,968 | 2.3 | 455 | 22,299 | 18,660 | 26,548 | 2.9 | 365 | 18,710 | 15,824 | 22,092 | 3.7 | 57 | 3,265 | 2,306 | 4,600 | 2.7 | 671 | 33,651 | 28,385 | 39,902 | 3.7 | $<10^{-4}$ |
| Parent | 87 | 3,639 | 2,799 | 4,717 | 2.8 | 3,704 | 146,722 | 125,661 | 170,760 | 10.1 | 446 | 14,696 | 11,850 | 18,153 | 2.9 | 526 | 20,384 | 17,673 | 23,514 | 2.7 | 641 | 24,273 | 19,868 | 29,574 | 4.8 | 35 | 1,567 | 920 | 2,662 | 1.3 | 2,620 | 77,860 | 67,379 | 89,779 | 8.6 | |
| Other relative | 116 | 4,948 | 3,499 | 6,958 | 3.8 | 2,055 | 98,017 | 86,255 | 111,213 | 6.7 | 656 | 25,953 | 22,389 | 30,003 | 5.1 | 1,490 | 59,888 | 53,020 | 67,584 | 7.9 | 606 | 23,630 | 20,272 | 27,502 | 4.7 | 99 | 3,909 | 2,110 | 7,140 | 3.2 | 3,542 | 100,251 | 89,235 | 112,359 | 11.1 | |
| Friend/acquaintance | 869 | 32,355 | 29,285 | 35,635 | 25.0 | 6,835 | 324,462 | 308,681 | 340,789 | 22.2 | 2,232 | 97,439 | 87,891 | 107,658 | 19.3 | 3,143 | 135,055 | 117,798 | 154,207 | 17.8 | 2,477 | 112,084 | 101,766 | 123,151 | 22.2 | 350 | 16,400 | 9,385 | 27,382 | 13.4 | 6,678 | 222,728 | 206,400 | 239,863 | 24.6 | |
| Multiple | 816 | 28,528 | 24,231 | 33,354 | 22.0 | 5,142 | 232,283 | 184,625 | 289,415 | 15.9 | 1,548 | 62,270 | 56,930 | 80,075 | 12.3 | 2,210 | 101,729 | 75,852 | 134,637 | 13.4 | 2,782 | 114,150 | 99,390 | 130,431 | 22.6 | 184 | 8,192 | 6,784 | 9,876 | 6.7 | 2,548 | 22,857 | 79,531 | 98,031 | 2.5 | |
| Stranger | 75 | 2,243 | 1,697 | 2,954 | 1.7 | 464 | 20,543 | 16,638 | 25,249 | 1.4 | 294 | 11,392 | 8,421 | 15,329 | 2.3 | 506 | 22,978 | 19,039 | 27,686 | 3.0 | 284 | 13,024 | 10,414 | 16,329 | 2.6 | 445 | 15,212 | 10,084 | 22,426 | 12.4 | 806 | 27,509 | 19,951 | 37,725 | 3.0 | |
| Other specified | 7 | 180 | 65 | 505 | 0.1 | 576 | 31,207 | 27,000 | 36,049 | 2.1 | 1,030 | 46,843 | 41,853 | 52,291 | 9.3 | 203 | 10,145 | 8,192 | 12,591 | 1.3 | 32 | 1,476 | 1,011 | 2,174 | 0.3 | 22 | 1,634 | 761 | 2,429 | 1.3 | 427 | 19,331 | 15,689 | 23,760 | 2.1 | |
| Unknown | 1,154 | 53,975 | 48,955 | 59,140 | 41.7 | 10,408 | 525,182 | 474,478 | 578,101 | 36.0 | 5,002 | 228,203 | 215,366 | 240,881 | 45.3 | 8,147 | 385,365 | 363,027 | 407,704 | 50.8 | 4,095 | 197,224 | 181,541 | 213,340 | 39.0 | 1,917 | 72,664 | 60,419 | 84,047 | 59.2 | 8,178 | 331,872 | 302,980 | 361,926 | 36.6 | |
| Incident locale | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Unknown | 973 | 37,540 | 27,924 | 48,865 | 29.0 | 10,090 | 486,378 | 396,979 | 584,669 | 33.3 | 4,781 | 206,266 | 168,773 | 245,772 | 40.9 | 6,703 | 303,689 | 238,023 | 374,481 | 40.0 | 4,403 | 205,820 | 163,797 | 250,700 | 40.7 | 1,009 | 41,077 | 28,179 | 56,359 | 33.5 | 8,684 | 334,006 | 281,306 | 390,084 | 36.8 | $<10^{-4}$ |
| Home | 404 | 18,581 | 15,550 | 22,080 | 14.3 | 8,040 | 360,952 | 300,799 | 428,650 | 24.7 | 2,018 | 83,889 | 69,133 | 100,951 | 16.6 | 3,071 | 139,087 | 109,378 | 174,687 | 18.3 | 1,909 | 73,122 | 56,722 | 93,222 | 14.5 | 454 | 20,018 | 16,721 | 23,824 | 16.3 | 10,299 | 312,898 | 265,981 | 363,467 | 34.5 | |
| School/sports | 1,070 | 40,060 | 36,697 | 43,578 | 30.9 | 6,756 | 327,984 | 297,589 | 360,492 | 22.5 | 2,387 | 108,056 | 96,161 | 120,869 | 21.4 | 2,871 | 127,793 | 109,758 | 148,139 | 16.8 | 2,669 | 119,812 | 106,771 | 133,919 | 23.7 | 297 | 14,400 | 7,557 | 26,032 | 11.7 | 3,114 | 122,514 | 109,004 | 137,389 | 13.5 | |
| Street | 326 | 16,993 | 10,587 | 26,408 | 13.1 | 2,660 | 142,208 | 99,245 | 200,971 | 9.7 | 1,045 | 49,317 | 32,877 | 72,612 | 9.8 | 2,005 | 97,382 | 67,356 | 139,264 | 12.8 | 880 | 43,006 | 28,007 | 64,963 | 8.5 | 1,016 | 32,164 | 19,665 | 48,839 | 26.2 | 1,535 | 57,788 | 37,634 | 87,693 | 6.4 | |
| Other property | 428 | 16,407 | 13,697 | 19,567 | 12.7 | 3,162 | 141,780 | 110,483 | 180,684 | 9.7 | 1,236 | 15,664 | 45,937 | 70,242 | 3.1 | 2,044 | 90,119 | 69,860 | 115,219 | 11.9 | 1,453 | 63,776 | 47,218 | 85,083 | 12.6 | 339 | 15,019 | 10,845 | 20,512 | 12.2 | 2,016 | 79,372 | 63,661 | 98,484 | 8.8 | |
| Anatomic location | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Unknown | 0 | 0 | 0 | 0 | 0.0 | 772 | 28,408 | 14,449 | 55,606 | 1.9 | 6 | 188 | 50 | 706 | 0.0 | 20 | 668 | 303 | 1,593 | 0.1 | 0 | 0 | 0 | 0 | 0.0 | 11 | 282 | 123 | 675 | 0.2 | 1,758 | 57,573 | 35,005 | 93,134 | 6.3 | $<10^{-4}$ |
| Head/neck | 3,201 | 129,580 | 5,183 | 8,773 | 100.0 | 17,788 | 864,682 | 824,024 | 904,442 | 59.2 | 5,583 | 264,463 | 253,135 | 275,473 | 52.4 | 12,642 | 573,946 | 559,559 | 587,549 | 75.7 | 10,948 | 491,673 | 485,475 | 495,990 | 97.3 | 408 | 17,648 | 12,317 | 24,781 | 14.4 | 3,890 | 142,121 | 124,602 | 161,602 | 15.7 | |
| Upper trunk | 0 | 0 | 0 | 0 | 0.0 | 3,518 | 165,040 | 149,743 | 181,706 | 11.3 | 405 | 15,027 | 11,900 | 18,909 | 3.0 | 567 | 24,961 | 19,873 | 31,251 | 3.3 | 219 | 8,024 | 5,308 | 12,083 | 1.6 | 686 | 27,184 | 21,677 | 33,626 | 22.2 | 1,514 | 66,079 | 53,504 | 81,345 | 7.3 | |
| Lower trunk | 0 | 0 | 0 | 0 | 0.0 | 2,132 | 99,615 | 82,023 | 120,699 | 6.8 | 94 | 3,782 | 2,773 | 5,143 | 0.8 | 338 | 14,859 | 12,212 | 18,053 | 2.0 | 148 | 5,848 | 3,792 | 8,999 | 1.2 | 563 | 21,602 | 16,145 | 28,412 | 17.6 | 12,596 | 372,305 | 305,338 | 443,180 | 41.1 | |
| Upper extremity | 0 | 0 | 0 | 0 | 0.0 | 4,557 | 220,084 | 206,079 | 234,977 | 15.1 | 4,553 | 193,522 | 180,018 | 207,197 | 38.4 | 2,637 | 121,514 | 112,792 | 130,769 | 16.0 | 0 | 0 | 0 | 0 | 0.0 | 663 | 28,567 | 20,328 | 38,877 | 23.3 | 2,871 | 130,726 | 113,810 | 149,631 | 14.4 | |
| Lower extremity | 0 | 0 | 0 | 0 | 0.0 | 1,943 | 81,653 | 74,288 | 89,758 | 5.6 | 826 | 27,540 | 21,733 | 34,793 | 5.5 | 490 | 22,571 | 19,873 | 25,638 | 3.0 | 0 | 0 | 0 | 0 | 0.0 | 784 | 27,396 | 22,720 | 32,718 | 22.3 | 3,026 | 138,051 | 109,095 | 173,028 | 15.2 | |
| Disposition from ED | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Release | 2,909 | 122,178 | 116,361 | 125,441 | 94.6 | 29,616 | 1,411,193 | 1,386,136 | 1,423,273 | 98.4 | 9,872 | 456,900 | 437,159 | 470,879 | 91.3 | 15,821 | 722,625 | 713,651 | 728,787 | 97.4 | 9,952 | 460,606 | 436,482 | 475,624 | 92.6 | 1,858 | 80,187 | 61,549 | 95,415 | 66.3 | 23,717 | 839,692 | 805,339 | 859,951 | 94.7 | $<10^{-4}$ |
| Admit | 281 | 6,984 | 3,720 | 12,800 | 5.4 | 591 | 22,691 | 10,611 | 47,748 | 1.6 | 1,501 | 43,395 | 29,417 | 63,137 | 8.7 | 512 | 19,370 | 13,208 | 28,344 | 2.6 | 1,175 | 36,752 | 21,735 | 60,877 | 7.4 | 1,214 | 40,805 | 25,578 | 59,444 | 33.7 | 1,341 | 46,856 | 26,596 | 81,208 | 5.3 | |
| Hospital size | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Small | 196 | 24,037 | 16,936 | 33,237 | 18.5 | 2,505 | 303,948 | 203,890 | 435,948 | 20.8 | 727 | 88,418 | 62,628 | 121,777 | 17.5 | 950 | 115,360 | 72,894 | 176,128 | 15.2 | 447 | 54,788 | 29,372 | 97,975 | 10.8 | 76 | 9,216 | 4,932 | 16,697 | 7.5 | 1,472 | 179,271 | 125,237 | 249,204 | 19.8 | $<10^{-4}$ |
| Medium | 259 | 30,923 | 20,422 | 44,614 | 23.9 | 2,680 | 337,993 | 228,847 | 478,856 | 23.2 | 867 | 109,777 | 79,067 | 148,099 | 21.8 | 1,236 | 157,013 | 100,959 | 233,093 | 20.7 | 724 | 96,528 | 62,890 | 142,361 | 19.1 | 97 | 12,077 | 5,717 | 24,045 | 9.8 | 1,079 | 140,281 | 89,325 | 212,748 | 15.5 | |
| Large | 457 | 40,610 | 29,739 | 53,335 | 31.3 | 5,333 | 470,519 | 254,826 | 754,407 | 32.2 | 1,984 | 175,824 | 124,248 | 235,334 | 34.9 | 3,188 | 281,850 | 147,684 | 448,436 | 37.2 | 2,497 | 222,527 | 165,010 | 283,459 | 44.0 | 600 | 52,913 | 26,805 | 82,563 | 43.1 | 3,234 | 286,070 | 191,165 | 401,555 | 31.5 | |
| Very large | 1,004 | 22,977 | 15,498 | 33,017 | 17.7 | 12,193 | 278,097 | 181,852 | 408,947 | 19.1 | 4,404 | 100,428 | 73,419 | 134,131 | 19.9 | 7,547 | 171,618 | 105,662 | 262,220 | 22.6 | 4,624 | 10,582 | 68,704 | 155,961 | 2.1 | 2,014 | 45,606 | 24,548 | 72,172 | 37.2 | 9,132 | 208,948 | 143,011 | 293,549 | 23.0 | |
| Children's | 1,285 | 11,035 | 6,336 | 18,685 | 8.5 | 7,999 | 68,927 | 37,217 | 125,078 | 4.7 | 3,485 | 30,075 | 15,985 | 55,064 | 6.0 | 3,773 | 32,678 | 15,246 | 68,115 | 4.3 | 3,023 | 25,830 | 15,318 | 42,921 | 5.1 | 328 | 2,866 | 1,141 | 7,079 | 2.3 | 10,738 | 92,284 | 46,612 | 173,753 | 10.2 | |

*n* = actual number of ED visits; *N* = estimated number of ED visits; L95% = lower 95% confidence interval of the estimate; U95% = upper 95% confidence interval of the estimate. Those categories comprising less than 1% of the variables as described in the appendix are excluded; thus, the percentage sum will not add up to 100.

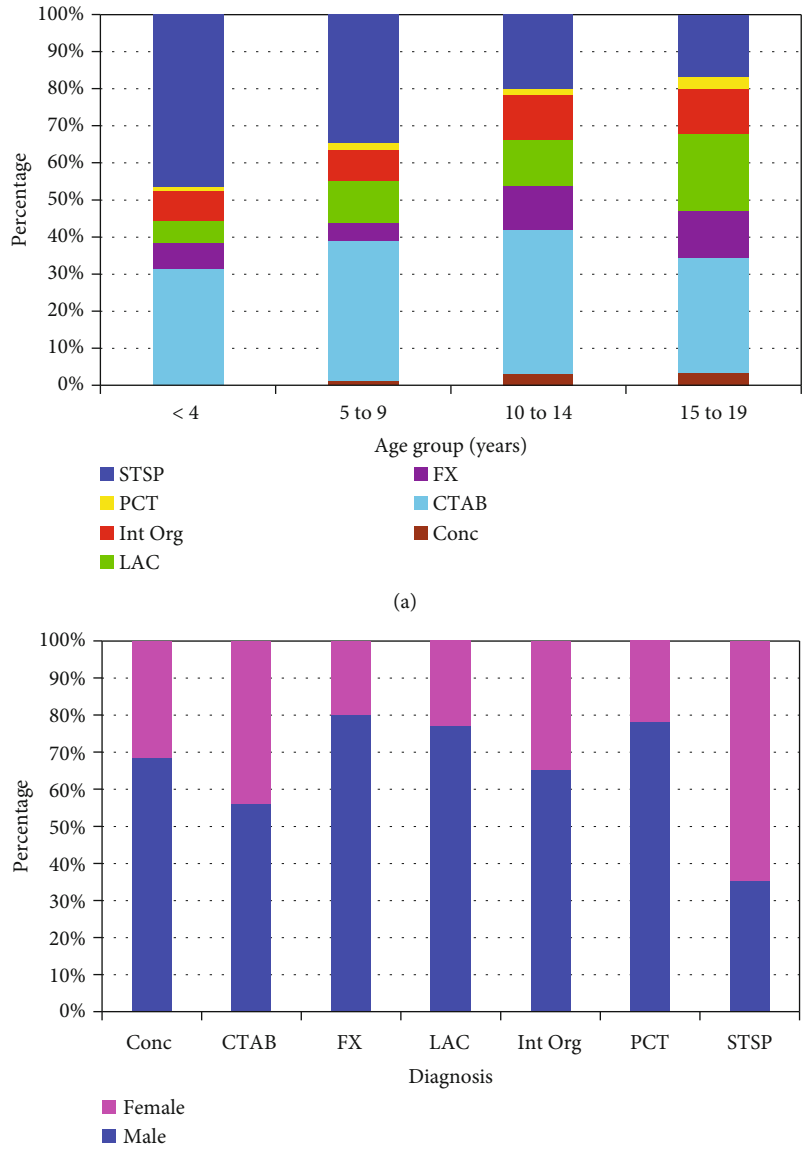



Figure 3: Diagnosis in child and adolescent assault victims. STSP = strain/sprain; PCT = puncture; Int Org = internal organ injury; LAC = laceration; FX = fracture; CTAB = contusion/abrasion; Conc = Concussion. (a)By age group ($p < 10^{-4}$). (b) By gender ($p < 10^{-4}$).

The study of Herbert et al. [5] from Cape Town, South Africa, had a younger population while Mollen et al. [3] studied victims of violence limited in the age from 8 to 24 years; however, both noted that most of the injuries were either to the extremities or the head. We found that in those ≤ 4 years old, most of the injuries were to the lower trunk, which has been noted by others to be more serious than other areas of injury [5].

*4.2. Our Findings.* Most patients in this study were children 15 to 19 years old (64.7%). They were more likely to be male in all age groups except those ≤ 4 years old. As has been previously noted, victims of sexual assault are more likely to be female [13]. In this study, females were more likely to be injured by a partner (8.5% vs. 0.7%) compared to males, but both sexes were more likely to be assaulted by a known person. More importantly, sexual assault accounted for 87.4% of all assaults in females (Table 1). This is likely a low estimate, as many cases of sexual assault are not reported to health care providers [14–18] or police [19]. The perpetrator was unknown in 45.2% of male and 33.5% of female victims (Table 1).

All of the diagnoses (concussions, contusions/abrasions, fractures, lacerations, internal organ injuries, and punctures) were most likely to occur in 15- to 19-year-olds and male patients and least likely to occur in the younger patients. Strains and sprains were the only injuries to occur more often in female patients and have a younger average age of injury presentation. This finding differs from Mollen et al. [3] who found that females were more likely to sustain bruises/abrasions and be injured in an event involving multiple perpetrators. They also noted that older patients were less likely to

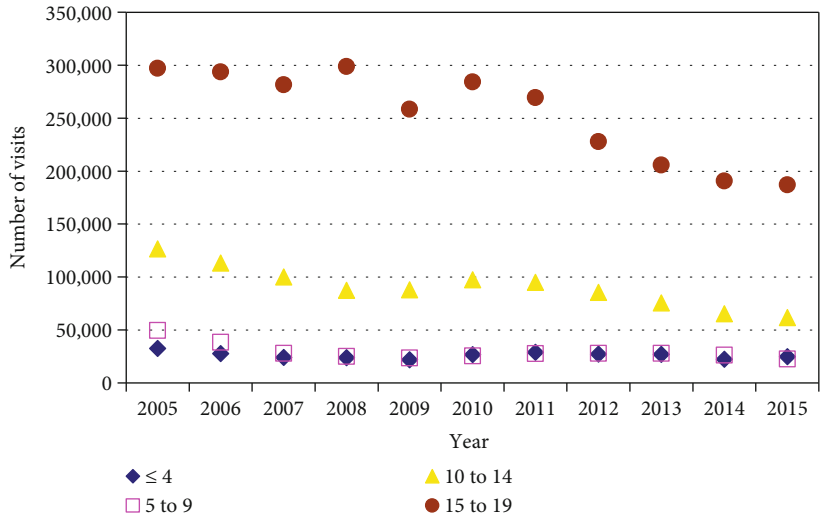



Figure 4: Number of assaults in child and adolescent assault victims over time and by age group. There was a gradual decrease for all age groups except for those ≤ 4 years of age. The number of assaults decreased by 23.7% for those ≤ 4 years old ($p = 0.28$, $r^2 = 0.13$), 54.4% for those 5 to 9 years old ($p = 0.026$, $r^2 = 0.44$), 51.1% for those 10 to 14 years old ($p < 10^{-6}$, $r^2 = 0.84$), and 37.0% for those 15 to 19 years old ($p = 0.0007$, $r^2 = 0.84$).

sustain a fracture [3]. This information may coincide with results from a study of Indianapolis youth [6] which found that there was a significant spike in violent injury events between the ages of 13 and 16. This is in contrast to Mollen et al. [3] who found that females were more likely to sustain bruises/abrasions and be injured by multiple perpetrators. They also found that older patients were less likely to sustain a fracture. The discrepancies between this study and that of Mollen et al. [3] are likely due to the fact that their study was limited to the Philadelphia area, thus not representative of the entire US, as well as limiting the patient age from 8 to 24 years.

Although concussions only accounted for 3.0% of the diagnoses, nearly all occurred in those ≥ 10 years of age. This is likely due to the fact that those ≥ 10 years old also accounted for nearly all of the altercations. Altercations often involve fighting, where exchanges of blows are likely to result in a concussion if delivered to the head. Within the youngest age group (≤ 4 years old), strains/sprains were quite common. These are typically less severe injuries than fractures, concussions, and internal organ injuries. The exact reason why there are more strains/sprains in this age group cannot be stated with certainty. Possible explanations are that, in spite of parents being the most common perpetrator of the assault of the four different age groups, the assault involved lower amounts of energy being delivered to the patient, resulting in a strain/sprain. Also, if the perpetrator was another child, such as in a day care center, a younger child would also likely not be able to deliver adequate injury that would result in a fracture or concussion. However, nearly 50% of the children in the ≤4-year-old age group were assaulted by parents or other relatives. These could also be defined as child abuse, battered child syndrome, or nonaccidental trauma. This leads to the next topic.

*4.3. Government and Other Social Factors.* All 50 of the states in the US have mandatory reporting of potential or actual child abuse to appropriate legal authorities for certain professionals and groups [20]. These include social workers, teachers/other school personnel, all health care workers, counselors and mental health professions, child care providers, and law enforcement officers. Also, anyone can file a concern for child maltreatment with appropriate authorities, and in 18 states, it is law that any person who suspects child abuse or neglect is required to report such concerns [20]. Most states have a toll-free number to call to report suspected abuse. Child Welfare Information Gateway, a service of the Children's Bureau (https://www.childwelfare.gov), provides a list of state child abuse reporting numbers. Another source on how and where to file a report of suspected child abuse and neglect is the National Child Abuse Hotline and can be reached 7 days a week, 24 hours a day, at its toll-free number, 1.800.4-A-CHILD (1.800.422.4453).

Once such a report has been filed, then each state's Child Protective Services agency follows its own investigation algorithm. The Child Protective Services response is often differential [21]. In serious cases, the state will take legal custody of the child and place them into foster care. In less serious cases, they will use community agencies to support families who are considered lower risk, recognizing that variations in families' needs and strengths require different approaches. In-home services play an important role in safety and permanence for the majority of families that receive a report of child maltreatment [22].

There is now an even stronger push to keep children in their own home when possible. The 2018 signing of the Family First Prevention Services Act (H.R. 1892) [23] redirects federal funds to provide services to keep children safely with their families and out of foster care, and when foster care is needed, it allows federal reimbursement for care in family-

based settings and certain residential treatment programs for children with emotional and behavioral disturbance requiring special treatment. As the data used in this was collected before the implementation of this law, further research and follow-up will be needed to assess its impact on the incidence of child maltreatment occurring in their own home.

*4.4. Limitations.* There are certain limitations to this study. One potential limitation is the accuracy of the NEISS data. However, two studies have demonstrated over 90% accuracy [24, 25]. The NEISS only identifies individuals who sought care in an ED. It does not include those who might have been treated in urgent care centers, physician offices, and other non-ED venues or those persons who did not seek medical care, and therefore, the assault was never reported to any agency collecting such data. Another limitation is injury severity. The only proxy of injury severity with NEISS data is disposition from the ED as being treated and released or admitted to the hospital. The NEISS-AIP does not include fatal injuries nor does it record the Injury Severity Score. Finally, the race was not known in 20.4% of the patients; this is due to either the patient refusing to divulge such information or it not being collected on the medical record so that the NEISS coders could include it. However, acknowledging these limitations, we noted many interesting findings as described above.

## 5. Conclusion

These data provide a comprehensive overview of child and adolescent assault victims presenting to the ED in the USA. They can be used as background data for further study. The decreasing numbers of assaults over the 11 years of the study are encouraging, but there still exist challenges in decreasing the number for those ≤ 4 years old.

## Appendix

## A. NEISS Definitions [26]

*A.1 Assault.* Assault is defined as injury from an act of violence where physical force by one or more persons is used with the intent of causing harm, injury, or death to another person or an intentional poisoning by another person. This category includes perpetrators as well as intended and unintended victims of violent acts (e.g., innocent bystanders). This category excludes unintentional shooting victims (other than those occurring during an act of violence), unintentional drug overdoses, and children or teenagers "horsing" around.

*A.2 Hospital Strata.* Four are based on size (the total number of ED visits reported by the hospital, which are small (0–16,830), medium (16,831–21,850), large (28,151–41,130), and very large (>41,130)), and one includes children's hospitals of all sizes. The actual age is also categorized into 18 different groups in 5-year increments with the last group including all those ≥ 85 years old. The injured body part is classified into five major locations (head/neck, upper trunk, lower trunk, upper extremity, and lower extremity).

*A.3 Incident Locale.* This is categorized into home/apartment/mobile, school/sports, street, other property, farm, and unknown. Other property consists of stores, office buildings, restaurants, churches, hotel/motels, hospital/nursing homes, adult day care facility, fraternity/sorority houses, theaters, sidewalks, and parking lots/garages.

*A.4 Perpetrator.* This is categorized into spouse/partner, parent, other relative, unrelated caregiver, friend/acquaintance, official authorities, multiple perpetrators, stranger, other specified, and unknown.

*A.5 Reason for Assault.* This is categorized into altercation, robbery/burglary, drug-related, sexual assault, gang-related, other specified, and unknown.

*A.6 Causative Agent of Injury.* This is categorized into motor vehicle occupant, motorcyclist, pedal cyclist, pedestrian, other transport, fall, struck by/against, cut/pierced, overexertion, fire/burn, poisoning, inhalation/suffocation, drowning/-near drowning, machinery, foreign body, dog bite, other bite/sting, firearm gunshot, BB/pellet gunshot, and natural/environmental causes.

## Data Availability

The raw data is in the public domain and housed by the Inter-University Consortium for Political and Social Research (ICPSR). It can be accessed at https://www.icpsr.umich.edu/icpsrweb/ICPSR/search/studies?q=all+injury+program. The refined data are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that there are no conflicts of interest.

## Authors' Contributions

RTL conceived and designed the study. RTL, SP, and MS collected and analyzed the data. RTL performed the statistical analyses. RTL, SP, and MS prepared the original manuscript. RTL, SP, and MS participated in manuscript reviews and approved the final manuscript.

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