Pediatric Violence-Related Injuries in Boston

Results of a City-Wide Emergency Department Surveillance Program

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Context: Violence-related injuries among children are common, but age-based incidence data are not easily available.

Objectives: To describe injuries due to violence in a population-based case series of children and to estimate injury incidence.

Design: Prospective surveillance of children residing in Boston, Mass, who received pediatric emergency department treatment for violence-related injury during a 4-year period beginning April 15, 1995.

Setting: Pediatric emergency departments in Boston.

Patients: Children aged 3 through 18 years who came to a hospital emergency department between April 1995 and April 1999. Violence-related injuries were defined as those resulting from a situation of conflict involving 2 or more persons with intent to harm, as assessed by health care personnel caring for the patients. Self-inflicted injuries and injuries caused by child abuse (including any injury resulting from a conflict with a parent or guardian) were excluded. Homicides of Boston children aged 3 through 18 years who were killed during the study period were included based on police data.

Main Outcome Measure: Population-based violence-related injury rates.

Results: There were 2035 injury-related visits caused by violence, which reflects a rate of 52.7 (95% confidence interval, 50.5-54.9) per 10000 person-years. Most injuries were relatively minor; 6.4% of visits resulted in admission. The youth violence-related injury rate in Boston declined at an average rate of 12% annually during the period studied.

Conclusion: Pediatric emergency department monitoring of violence-related injury in Boston suggests that childhood injuries due to violence declined during the late 1990s.

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SUBJECTS AND METHODS

SUBJECTS

This report includes only pediatric patients who were residents of Boston, Mass. Data were collected on all children who came for treatment of violence-related injury to the emergency departments (EDs) of Boston Medical Center, Children’s Hospital of Boston, Massachusetts General Hospital (Boston), and New England Medical Center (Boston). The first 2 hospitals, which together accounted for more than 85% of all pediatric ED visits in Boston, began the surveillance program on April 15, 1995. The third hospital joined November 1, 1996, and the fourth joined February 1, 1997. The period studied was from April 13, 1995 to April 14, 1999. Two other nonhospital sites offer 24-hour urgent care services and may have diverted some local patients from the EDs; however, these sites were not included in this surveillance. The Massachusetts Department of Public Health estimated that 95% of all pediatric ED visits were accounted for by these 4 hospitals (Victoria Ozanoff, PhD, oral communication, April 1997).

METHODS

The detailed methods and rationale of this surveillance program have been previously published and are summarized below.

Definitions and Inclusion and Exclusion Criteria

Violence-related injuries were defined as those resulting from a situation of conflict involving 2 or more persons with intent to harm, as assessed by health care personnel caring for patients in the EDs. Only injuries that seemed to be caused by interpersonal violence, excluding child abuse, were included in this study. Exclusion criteria included: (1) unclear intent; (2) injuries resulting from child abuse (identified by International Classification of Diseases, Ninth Revision, Clinical Modification code E967.1); (3) the “other person involved” in the incident leading to injury was identified as a parent; or (4) injuries resulting from attempted suicide.

Completeness of Data

Patients were identified prospectively (at the time of visit) or retrospectively (by daily ED record review). All hospitals, as a matter of policy, accept patients older than 18 years. The 2 hospitals that contributed the greatest number of patients to the study routinely accept patients up to the age of 21 years. Three of the hospitals have adult and pediatric facilities in adjoining areas and all but the most severely injured patients younger than the cut-off age receive care in the pediatric ED. Older adolescents with severe, life-threatening injuries at these institutions may have been cared for in specially equipped adult trauma rooms and may not have been included in this study. In addition, children and adolescents who died at the scene were not included in the surveillance.

Data Collection

We collected data concerning patient age, sex, and residence, injury circumstance, victim-offender relationship, drug use by the patient, medical description of injury and procedures, and weapon use. Information concerning the body part(s) injured was systematically collected beginning in 1997. Reports of homicides of persons younger than 19 years were provided by the Boston Police Department.

Rate Calculations

To determine the annual incidence of violence-related injury, we analyzed data on injuries to Boston residents. Population-based injury occurrence rates were calculated for Boston residents only, using the results of the 1990 and 2000 US Census as the denominator. Age-specific population changes throughout the decade were approximated using a linear model, ie, assuming equal annual increases and decreases throughout the decade. We held the exposure (number of person-years) constant within each calendar year.

Numerator data were computed using all visits made by Boston residents. For the period in which only 2 hospitals participated, the actual incidence of violence-related injury was inflated by a factor of 1.16 to account for the proportion of visits seen at the other 2 centers. For the period in which 3 hospitals participated, the measured incidence of injury was inflated by a factor of 1.099 to account for the fourth hospital. These ratios were determined empirically, based on data from the period in which all 4 hospitals participated. The numerator data were computed using all visits made by Boston residents. For the period in which only 2 hospitals participated, the actual incidence of violence-related injury was inflated by a factor of 1.16 to account for the proportion of visits seen at the other 2 centers. For the period in which 3 hospitals participated, the measured incidence of injury was inflated by a factor of 1.099 to account for the fourth hospital. These ratios were determined empirically, based on data from the period in which all 4 hospitals participated. The number of events that occurred during a specified period was assumed to follow a Poisson distribution.

Poisson regression models were used to assess the trend of incidence rate change during the 4-year period. The confidence intervals (CIs) of incidence rate ratios were constructed using a robust procedure. Regression analyses were based on 128 age, sex, and year groups (ie, 16 age, 2 sex, and 4 year groups). Data analysis was performed using Stata 7.0 (Stata Corporation, College Station, Tex).

This study was approved by the human studies committee or institutional review boards at each hospital.

18 is partially accounted for by the influx of college students to Boston. There were many fewer 17-year-old (5887) than 18-year-old residents (9625) in 1990. The number of violence-related injury visits by 17- and 18-year-olds was 294 and 222, respectively.

INJURY CIRCUMSTANCE

One or more circumstances of injury were recorded for 79.8% of all patient visits. Commonly reported circumstances of injury included: an argument (38.9%), assault (20.0%), “horsing around” (5.8%), and crimes other than assault (3.6%). The relationships between the patient and the other individual(s) involved in the incident leading to injury were: friends or schoolmates (38.2%), sibling or other family member (10%), strangers (9.0%), and boyfriend or girlfriend (3.4%). The relationship of the patient to the other person(s) involved was unknown (or the patient was unwilling to say or the relationship was not documented) in 28.5% of all cases. The fraction of unreported relationships did not seem to be random: unknown or undocumented relationships...
were more commonly reported in adolescent than in younger patients (33.4% of those 13 years or older vs 17.8% of those 12 years and younger; \(P < .001\)). Compared with girls, boys were less likely to have any relationship recorded (33.6% missing for male patients vs 20.0% for females; \(P < .001\)). Boys were also more likely to report a stranger (10.0% vs 7.3%; \(P = .02\)) and less likely to report a friend or schoolmate (36.3% vs 41.6%; \(P < .01\)) or sibling or other family member (7.4% vs 14.4%; \(P < .01\)).

**INJURY DESCRIPTIONS**

Most injuries were relatively minor, involved the head, neck, and upper extremities, and were the results of unarmed fights (Table 2). Most patients were treated and released, 130 (6.4%) were admitted, and 2 died in the ED (0.1%).

Overall, weapon use (stab/cut, firearm, or blunt object) was reported in 23.5% of all injuries. No children younger than 10 years were treated for intentional injuries caused by firearms. Among 15- to 18-year-olds, the injury incidence rate for firearm use was 3.3 injuries per 10000 person-years. Within this age group, males experienced an 11-fold higher incidence of injury caused by firearms compared with females (rate, 6.1 for males vs 0.5 for females).

**INJURY DESCRIPTIONS**

![Graph showing average incidence rate of pediatric injuries, 1995-1999, per 10,000 person-years.](image)

**Table 1. Violence-Related Injury Incidence Rates by Age Group and Sex**

<table>
<thead>
<tr>
<th>Age, y</th>
<th>Sex</th>
<th>IR (95% CI)</th>
<th>IRR (M/F)</th>
<th>IRR (vs Age 3-4 y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-4</td>
<td>Female</td>
<td>8.6 (5.4-13.1)</td>
<td>1.41</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>12.2 (8.4-17.2)</td>
<td>1.41</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>10.5 (7.9-13.6)</td>
<td>1.41</td>
<td>NA</td>
</tr>
<tr>
<td>5-9</td>
<td>Female</td>
<td>19.3 (16.0-23.0)</td>
<td>1.64†</td>
<td>2.60†</td>
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<tr>
<td></td>
<td>Male</td>
<td>31.7 (27.6-36.3)</td>
<td>1.64†</td>
<td>2.60†</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>25.7 (23.0-28.6)</td>
<td>1.64†</td>
<td>2.60†</td>
</tr>
<tr>
<td>10-14</td>
<td>Female</td>
<td>41.7 (36.8-47.2)</td>
<td>1.76†</td>
<td>6.01†</td>
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<tr>
<td></td>
<td>Male</td>
<td>73.4 (66.8-80.5)</td>
<td>1.76†</td>
<td>6.01†</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>57.7 (53.6-62.2)</td>
<td>1.76†</td>
<td>6.01†</td>
</tr>
<tr>
<td>15-18</td>
<td>Female</td>
<td>71.2 (64.3-78.5)</td>
<td>1.72†</td>
<td>10.1†</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>122.4 (113.4-131.9)</td>
<td>1.72†</td>
<td>10.1†</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>96.8 (91.1-102.8)</td>
<td>1.72†</td>
<td>10.1†</td>
</tr>
</tbody>
</table>

*Rates are reported per 10,000 person-years. IR indicates incidence rate; CI, confidence interval; and IRR, incidence rate ratio.
†P < .01.

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These results are subject to the inherent limitations of a health care–based surveillance system. Only those injured children who received medical care from a pediatric ED for violence-related injuries, who disclosed the circumstances surrounding the injuries, and who were properly coded would have been included in this report. Each step in the process from injury to entry in the database could have led to undercounting. In addition, the study specifically excluded injuries caused by child abuse, ie, any injuries inflicted by a parent, thus resulting in an underestimate of the overall effects of violence on children.

Injury rates reported here for older adolescents, in particular, are likely to be lower than the actual rates experienced. Some older adolescents with severe injuries were treated at adult EDs and thus were not included in this report. In addition, our finding that histories of the relationship between the patient and the other person(s) involved were more likely to be incomplete for adolescents suggests that older pediatric patients may be reluctant to divulge detailed information, which may contribute to undercounting of violence-related injuries due to a failure to accurately ascertain intent.

The decline in hospital treatment for violence-related injury parallels the decline in violent crime, youth homicides in particular. The association of dropping crime rates and falling rates in pediatric violence-related injury suggests that the decrease in violence in Boston was widespread, including types of violence that are not usually included in criminal justice statistics.

Cheng et al recently reported their experience with injury surveillance of children aged 10 to 19 years in Washington, DC, from June 15, 1996, to June 15, 1998. They reported significantly higher rates of violence-related injury in Washington compared with our data from Boston: 70 events per 10000 person-years for youths aged 10 to 14 years in Washington compared with the 57.7 events reported here; for those aged 15 to 19 years, they reported 523 events per 10000 person-years compared with our reported rate of 189. They also found that violence-related adolescent morbidity and mortality declined in Washington, similar to the trend reported here.

Previous studies have shown that a history of previous injury seems to increase a young person’s likelihood of both fighting and weapon carrying, and may lead to serious mental health consequences. While most injuries treated were relatively minor and unlikely to lead to long-lasting physical disability, these minor injuries to younger children may offer a method to identify children at risk of more serious injury as they grow older.

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REFERENCES


