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RESEARCH ARTICLE

Emergency Department-Attended Injuries Resulting from School-Based Violence in Baltimore Adolescents, 2019-2020

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ABSTRACT

BACKGROUND: Our objective is to describe violence-related injuries to early adolescents that occurred at school, resulting in emergency department (ED) evaluation.

METHODS: This retrospective cohort study at an urban academic pediatric ED in Baltimore, MD, identified patients 10-15 years old who presented with an injury from intentional, interpersonal violence that occurred at school between January 2019-December 2020. Descriptive statistics were used to summarize patient and event characteristics.

RESULTS: Of 819 youth 10-15 years of age evaluated for a violence-related injury, school was the location in 115 cases (14.0%). All events occurred prior to the statewide stay at home order (March 30, 2020). School-injured youth had a mean age of 12.7 ± 1.7 years and were predominantly male (64.3%). Of the 115 cases, 75 (65.2%) involved an altercation with a peer, 26 (22.6%) involved a teacher or school staff, 6 (5.2%) involved a family member, 1 (0.9%) involved police, 6 (5.2%) involved an unknown party, and 1 (0.9%) involved an unrelated but known adult. All injured youth were discharged from the ED.

CONCLUSIONS: School-based violence is a well-recognized cause of traumatic injuries to adolescents and may involve peers, teachers, or school staff.

Keywords: school-violence; intentional violence; adolescence; pediatric medical record review.

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During adolescence, violence is a leading cause of death and morbidity.[1] In addition, exposure to violence, recognized as an adverse childhood experience, often has long-term effects on youths' lives.[2,3] For instance, youth violence is correlated with physical, mental, and social health issues, including increasing the risk of injury, sexually transmitted infections, and a wide range of chronic diseases and leading causes of death, such as suicide.[4]

School is the second most common place children spend their time, following their home,[5] and is also a place where violence may occur. According to the 2019 Youth Risk Behavior Survey, 12.0% of adolescent participants said they were in a physical fight on school property and 16.7% said they were bullied on school property.[6] While there are many studies that show the significant health-related issues related to violence exposure and ongoing efforts to reduce injuries in a school setting, there is still a high prevalence of school-based violence.[7-9] School violence is described as violent acts that take place on or near school property, during the school day or at

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school sponsored events.[10] ''School'' is referenced as the location, not a type of injury and may encompass a variety of circumstances of violence which occur on its grounds including fights, shootings, stabbings, or other assaults.[10]

Although the school is a recognized setting for violence, including numerous instances of mass shootings, less is known about the overall epidemiology and circumstances of other school-based violence events that result in intentional/interpersonal medically attended injuries or how the pandemic may have impacted these patterns, given school closures and disruptions to learning.[11] Violence-related injuries refer to injuries from intentional, or purposeful, physical force or action.[12] Interpersonal violence refers to violence between individuals and according to the World Health Organization, includes both family/intimate partner violence and community violence.[13]

Our objective is to describe violence-related intentional/interpersonal injuries to 10- to 15-year-old adolescents that occurred at school, resulting in ED evaluation and treatment. We focused on this early adolescent age group given that it is a known period of increasing problem behavior, reflects a stage in which educational outcomes may be impacted, and is an age group that is often not as well addressed with violence prevention interventions, which are often targeted to older adolescents and young adults.[14,15] We also explored the potential impact of the pandemic as well as gender differences in the population to better guide our efforts in prevention of violence-related injuries at school.

METHODS

Participants

We conducted this retrospective cohort study in Baltimore, Maryland, at an urban academic pediatric ED, with an estimated census of 35,000 patients. This hospital is also a level 1 pediatric trauma center and the patient population is 60% Black/African American and 10% Hispanic/Latinx. The majority of the pediatric ED patients (60%) have public medical insurance.

Instrumentation and Procedure

The study methodology has been described in detail.[16] Briefly, through a query of electronic health records (EHR), charts were identified of patients 10-15 years old who presented with a violence-related injury that occurred at school between January 1, 2019 and December 31, 2020 using methodology established in prior work to identify youth with violence-related injuries.[17-19] This includes the time after which a statewide stay-at-home order was issued (March 30, 2020) and phases of re-opening, which allowed for school attendance. The patient's chief complaint and final diagnosis were reviewed to identify visits that were potentially attributable to an injury, determined by the ICD-10 and E-codes. A chart review was completed by 2 abstractors to confirm that the patient was presenting at the ED for an evaluation of an injury and to identify injury mechanisms that were intentional/interpersonal for this analysis. Intentional/interpersonal injuries were considered those injuries that resulted from purposeful physical force/actions between individuals. Injuries from self-harm were not included.

For patients in which the abstractors were unable to determine the mechanism or intentionality, the research team met as a group to discuss for consensus. After this, 10% of the charts not discussed were selected at random and were reviewed by a senior investigator (L.M.R.) for accuracy; there was 100% agreement with the abstractors' classifications for this random sample. All patients, who presented for an evaluation of an intentional injury due to a violent event identified as occurring at school, were included in this study. The determination that a violence-related injury had occurred at school was made through a review of the EHR's clinical provider, nursing, and/or social worker notes. Demographic and clinical data were abstracted.

Data Analysis

Data were entered in Microsoft Excel for Mac 2020 (Microsoft Corporation, Redmond, Washington) and analyzed using SPSS Statistics V.26.0.[20] Descriptive statistics were used to summarize the clinical characteristics of the ED visits and *t*-tests, chi-square analysis, and Fisher's exact test were used to evaluate gender differences within this population. The hospital institutional review board approved this study and granted a waiver of the HIPAA Privacy Authorization. Data collected were limited to what was essential for research purposes. Standard provisions were employed to ensure the protection of research participant privacy, the maintenance of confidentiality of identifiable research data, and data security.

RESULTS

Overall Study Population

Of 2780 youth 10-15 years of age that were evaluated in the pediatric ED for injuries, 819 (29.5%) were evaluated for an intentional/interpersonal-violence-related injury. For these youth with interpersonal-violence-related injuries, school was the location of the injury event in 115 cases (14.0%), which were included in the final analysis.

School-Based Violence

All 115 (100%) of the school-based injury events occurred prior to the stay-at-home order and no

Table 1. **Characteristics of Injuries Due to School Violence from January 2019 to December 2020**

	Overall Study Population, n = 115	Female Youth, n = 41	Male Youth, n = 74	*p*-Value for Gender Comparison
Proportion of interpersonal injury visits in PED	115/819 (14.0%)			
Patient characteristics				
Age in years				
10	15 (13.0%)	3 (7.3%)	12 (16.2%)	
11	21 (18.3%)	8 (19.5%)	13 (17.6%)	.35
12	19 (16.5%)	10 (24.4%)	9 (12.2%)	
13	14 (12.2%)	4 (9.7%)	10 (13.5%)	
14	24 (20.9%)	8 (19.5%)	16 (21.6%)	
15	22 (19.1%)	8 (19.5%)	14 (18.9%)	
Mean age in years (+ SD)	12.7 + 1.7	12.7 ± 0.5	12.6 ± 0.7	.77
Gender				
Male	74 (64.3%)			
Female	41 (35.7%)			
Race				
Black or African American	102 (88.7%)	40 (97.6%)	62 (83.8%)	.06
White or Caucasian	8 (7.0%)	0 (0%)	8 (10.8%)	
Other	5 (4.3%)	1 (2.4%)	4 (5.4%)	
Ethnicity				
Hispanic or Latino	5 (4.3%)	2 (4.9%)	3 (4.1%)	.56
Not Hispanic or Latino	108 (93.9%)	39 (95.1%)	69 (93.2%)	
Unknown	2 (1.7%)	0 (0%)	2 (2.7%)	
Health insurance				
Public	95 (82.6%)	35 (85.4%)	60 (81.1%)	
Private	12 (10.4%)	5 (12.2%)	7 (9.5%)	.44
None	7 (6.1%)	1 (2.4%)	6 (8.1%)	
Characteristics of event				
Transport to hospital				
EMS (ambulance/air)	19 (16.5%)	7 (17.1%)	12 (16.2%)	
Interfacility transport	1 (0.9%)	1 (2.4%)	0 (0%)	.60
Non-EMS (car or walk in)	73 (63.5%)	26 (63.4%)	47 (63.5%)	
Police	21 (18.3%)	7 (17.1%)	14 (18.9%)	
Other party involved				
Family member	6 (5.2%)	4 (9.8%)	2 (2.7%)	
Police	1 (0.9%)	0 (0%)	1 (1.3%)	.14
Teacher/School staff	26 (22.6%)	5 (12.2%)	21 (28.4%)	
Unknown party	6 (5.2%)	2 (4.9%)	4 (5.4%)	
Unrelated but known adult	1 (0.9%)	1 (2.4%)	0 (0%)	
Unrelated but known peer	75 (65.2%)	29 (70.7%)	46 (62.2%)	
ED arrival time				
12 AM-6 AM	2 (1.7%)	1 (2.4%)	1 (1.3%)	.81
6 AM-12 PM	19 (16.5%)	8 (19.5%)	11 (14.9%)	
12 PM-6 PM	68 (59.1%)	22 (53.6%)	46 (62.2%)	
6 PM-12 AM	26 (22.6%)	10 (24.4%)	16 (21.6%)	
Was a social work consult obtained?				
No	71 (61.7%)	28 (68.3%)	43 (58.1%)	.38
Yes	44 (38.3%)	13 (31.7%)	31 (41.9%)	
ED disposition				
Admit/admit to OR	0 (0%)	0 (0%)	0 (0%)	1.0
Discharge	115 (100%)	41 (100%)	74 (100%)	

school-based injuries were reported while the order was in effect. None of these events reflected a school shooting. Table 1 summarizes the study population. School-injured youth had a mean age of 12.7 ± 1.7 years, were predominantly male (64.3%), African American (88.7%), non-Hispanic or Latino (93.9%), and the majority had public health insurance (82.6%). None of the youth had a repeat visit during the study period for a school-based violence-related injury. Of the 115 school-based injury events, 75 (65.2%) involved an altercation with a peer, 26 (22.6%) involved a teacher or other school staff member, 6 (5.2%) involved an altercation between the patient and a family member, 1 (0.9%) involved police, 6 (5.2%) involved an unknown party, and 1 (0.9%) involved an unrelated but known adult. For the 6 events involving family members, 5 involved a parent and 1 involved an extended family member. The most common ED arrival times were 12 PM-6 PM (59.1%) and 6 PM-12 AM (22.6%). Social work consults were obtained for 44 of the 115 youth patients (38.3%). Transportation to the ED was by car or walk-in in 73

(63.5%) cases, and by police in 21 cases (18.3%). All the injured youth were discharged from the ED.

There were no statistically significant differences between female and male youth in patient or event characteristics within this study population. Trends of note include that a majority of males were involved with teacher or school staff member events (80.8%) and a more balanced gender distribution was seen for events that involved peers (61.3% among males), that is consistent with the gender distribution for the overall study population.

DISCUSSION

In our study population of 10- to 15-year-old adolescents, 1 in 7 of violence-related interpersonal injuries that result in medical attention in the ED for adolescents, occur at school. The majority (65.2%) of these school-based injuries result from peer violence, whereas in the overall ED population of youth treated for interpersonal violence-related injuries that occur in any setting, 19.2% are attributed to peer violence.[16] Although the majority of violence-related injuries occurring at school resulted from peer violence, more than 20% resulted from an altercation with a teacher or school staff. An interesting finding is that while staff are identified as included in altercations, it is unclear if any of the staff involved were school police or a school resource officer. Similarly, it was notable that 5% of events were due to an altercation with a family member, most often a parent. We were surprised to find instances of family violence occurring at school. These data are concerning because there is evidence that adolescents, who are affected by violence-related injuries resulting from an altercation at school, may have significant long-term health outcomes later in life. These include difficulty forming emotional attachments to others, difficulty with their working memory and executive functioning. Affected youth may also be at increased risk of engagement in sexual behavior, substance abuse, or involvement in the legal system.[21]

It was also surprising that no ED visits due to violence-related injuries at school occurred during our pandemic time frame, including both during the stay-at-home order as well as when some area schools allowed in-person attendance. It is important to note that no increase in school-related violent injuries was observed in this pediatric ED during the later pandemic period (September 4, 2020 to end of study period), when schools were returning to in-person education, including a period when schools were providing students with a combination of virtual and in-person learning as a hybrid educational instruction model, in the geographical area where the study was conducted. Potential hypotheses to explain this include the presence of COVID-19 safety protocols requiring 6-ft for social distancing between students, staff, and teachers which reduced interactions and possibly conflict, the decrease in the number of students in the classroom due to the hybrid educational instruction model, and the option of continuing all academic instruction virtually. It is also possible that the threshold for seeking medical attention was higher during the pandemic, which may have reduced pediatric ED visits for such injuries, coinciding with the overall decrease in pediatric ED visits seen nationally during the pandemic.[22] Additional research could be conducted to determine if there are differences in risk for violence between students (and their caregivers) who chose to attend school in-person compared to those who chose to learn virtually.

Despite this decline in school-related injuries, it is likely that youth continue to sustain violent injuries but these may have occurred in the home or in their community instead of at school. Polling suggests that injuries are increasing for those living at home and that quarantines have been linked with increasing child maltreatment and family violence.[16,23,24]

Although patients were commonly transported to the ED by car or walk-in, it was interesting that the nearly 18% of patients were transported to the ED by police. In a study from Philadelphia, researchers found that those who were injured and transported to the hospital by police, were more likely to be younger, injured by a firearm, more severely injured, and more likely to have hypotension at arrival than those injured and transported by EMS.[25] Also in the study from Philadelphia, a policy instructed police officers to transport patients with penetrating wounds directly to a trauma center and that transport should not be delayed for the arrival of EMS.[25] Police are known to ''scoop and run'' to transport violently injured individuals to the hospital, which may shorten the time between injury and hospital care, when EMS is unavailable or too far away from the violent event location, this includes events at school.[26] Police transport may improve survival for violently injured individuals, and it may lead to an improvement of perceptions of police in communities.[26] Current studies show that there is little evidence to support Police-to-Hospital Transport; however, some show that survival rates are better for violently injured individuals transported by police.[26] Given that the patients in this study were all discharged from the ED, it appears that the injuries may have been minor suggesting that high acuity and severity of injury was not contributory in this patient population. Other reasons that could explain the high number of police transports include the presence of a police officer on school property, police being called to reduce a violence escalation, or police requested for an emergency petition for a child to be assessed by a medical provider.

Our study found that school-based violent events were 2 times higher for males than females, supporting previous studies that indicate that males are more likely to experience violence-related injuries.[27] This knowledge may inform targeted efforts for violence prevention programs in schools. Additional research is needed to determine if, during a pandemic, violence among youth is also associated with conflicts with parents and alcohol and drug use.[27] Although injury visits were more common among males, the presence of nearly 36% females experiencing violence injuries in this study highlights an important population that requires focus for prevention and intervention, particularly given that they may be at increased risk of recidivism. Prior work shows that while males are more likely to be victims of interpersonal violence, such as shootings, females may have an increased risk of recidivism for an injury after presenting with an assault in comparison to males.[1] Homicide is a leading cause of death for women and is the third leading cause of death overall for adolescents.[28] The comparison of patient and event characteristics by gender did not yield significant differences, although this could have been limited by small sample size and the relatively low acuity presentation of the injuries, as indicated by the lack of hospital admission for any injuries.

Public Health Implications

These data support the need to provide opportunities for education and prevention in school. School-based prevention programs can lower rates of aggression and violent behavior for students. Youth mentorship programs as well as street outreach programs, like *Safe Streets*, can reduce youth violence at the community level by connecting at-risk youth to staff trained in conflict mediation and who are able to refer the youth to community services.[29] Parent- and family-based programs can improve family relationships and lower the risk of violence.[29] The next steps for Injury Prevention Specialists are to partner with school systems to provide school-based prevention programs to the students and staff to increase awareness and provide strategies to mitigate school-based violence prevention. After the implementation of school-based violence prevention programs, parent- and family-based programs can be implemented in the community, along with street outreach programs, to provide the community with strategies to mitigate violence in the home and on the street.[30]

Injury Prevention Specialists can also use the ED as a setting for interventions to prevent future violence to at-risk youth when they present to the ED for treatment of violence-related injuries, as the ED is a common point of contact between health care professionals and youth to provide counseling and to connect the patient to community resources.[29] Due to the low number of patients in the study that received social work engagement, these may represent missed opportunities for Injury Prevention Specialists to be notified to provide violence prevention strategies and community resources to the patient during their time in the ED. For youth suffering from an assault-related injury, they may benefit from a violence intervention within the first 6 months of the injury, during which is the highest risk for recidivism.[1]

Implications for School Health

Although generalizability may be limited by the single institution focus, the availability of patient and event descriptors of injuries, including other party involved, mode of arrival to the ED, and involvement of social work, is a strength. Other limitations to the study include the presence of a small sample size of school-based violent injuries which limits subgroup analysis, incomplete or inaccurate documentation (including a location of the violent event not being reported) that is common with retrospective chart reviews, misinterpretation by data abstractors, and the potential for selection bias. Although this hospital is the only pediatric trauma center in the state, it is possible that some injured youth may have presented to other medical facilities for care, which limits the ability to estimate the magnitude or prevalence of medically-attended school violence-related injuries from these data. Similarly, this study included only students who were evaluated in the ED for injuries relating to school violence; this will underestimate the number of youths impacted by school violence as we studied only those who received medical attention. However, this work does provide preliminary data that can guide the development of targeted interventions, both ED and school based, to address interpersonal violence occurring in schools and resulting in medically attended injuries.

Future studies, with prospective collection of data and patient/parent interview, could provide additional clinical and event information that is of importance in determining the extent of the problem as well as the best preventive strategies to employ. Such data could include specific circumstances on the physical altercation, the perceived role of the patient in the altercation (ie, victim, perpetrator), the presence of bullying, details on what school the patient attends and whether or not the school was in-person, hybrid, or virtual, etc. Given that our study did not follow patients outside of the stated timeframe, or interview patients, we are unable to determine how many of the involved patients had, or will have, a repeat injury from school violence. This is an opportunity for future research.

In our published study, we found that in peer-related injuries that ICD-10 codes were less reliable

in identifying patients with these injuries and many patients were initially missed due to coding discrepancies. We used the methodology described in this paper to optimize our catchment of these patients for the earlier studies. Various studies on the reliability of medical coding have shown different levels of reliability.[17-19] For these reasons, we used the methodology described for the continuation of this work.

Conclusion

School-based violence is a well-recognized cause of traumatic injuries to adolescents and may include events involving peers as well as teachers, other school staff, and family members. Medically-attended events did not occur in our patient population during the pandemic, which may reflect school closures, decreased in-person attendance, social distancing requirements or thresholds for seeking medical evaluation. Our findings support the need for trauma systems to prioritize both ED-based efforts to screen and intervene for school-based violence and school-based interventions to decrease violence.

Research Ethics Approval

The hospital institutional review board approved this study (IRB00246826). This study does not involve human participants or animal subjects.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

L.M.R. and V.J. conceptualized and designed the study, designed the data collection instruments, coordinated and supervised data collection, carried out the initial analyses, interpreted the data, and reviewed and revised the manuscript. M.M. designed the data collection instruments, analyzed and interpreted the data, drafted the initial manuscript, and reviewed and revised the manuscript. C.W. designed the data collection instruments, analyzed and interpreted the data, and reviewed and revised the manuscript, and conceptualized and designed the study focused on school violence. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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