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Emergency Department Utilization among Assault Injured Youth: Implication for Youth Violence Screening

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Abstract

Objective—Assault is a common cause of youth emergency department (ED) visits. Little is known about prior ED utilization patterns among assault-injured youth. This study's objectives were to determine whether, and how, prior ED visit history distinguishes assault-injured youth from unintentionally injured youth.

Methods—A five-year retrospective, case-control study was conducted using a hospital-billing database. Youth ages 13 to 24 years presenting to the ED of an urban Level I Trauma center in 2011 with an E-code of physical assault-or weapon-related injuries were compared 1:1 to randomly assigned, age- and sex- matched controls with an E-code corresponding to unintentional injury. Bivariate, t-test, Wilcoxon rank sum tests, and conditional logistic regression were performed to determine how previous ED visits distinguished assault-injured youth from unintentionally injured youth.

Results—In 2011, 964 patients presented with assault-related injuries. Over the previous five years, assault-injured youth had a median of 1 prior ED visit (Interquartile range (IQR): 0 – 3); unintentionally injured youth had a median of zero prior ED visits (IQR: 0 – 2). Assault-injured youth had significantly higher median numbers of previous psychiatric and assault-related ED visits when compared to unintentionally injured youth. Youth with one previous psychiatric ED visit had a four-fold increased odds (AOR 4.05, 95% CI 2.41–6.83) of having a 2011 assault-related ED visit compared to unintentionally injured youth.

Conclusion—Assault-injured youth are more likely to have had prior ED use particularly for psychiatric illnesses and assault-related injury. Targeted youth violence screening may be appropriate for such patients.

Keywords

Violence; mental health; adolescent; screening; pediatric emergency; injury prevention

Introduction

Injury is a major cause of morbidity and mortality among youth. More youth in the United States (U.S.) die as a result of injuries than any other cause.¹ Thirty percent of these injuries are the result of peer violence.¹ According to the Centers for Disease Control and Prevention (CDC), homicide is the third leading cause of death among youth aged 10 to 24 years¹, and the leading cause of death for black males ages 15 to 25 years.¹

Violence and unintentional injuries are also major causes for emergency department (ED) visits among youth in the U.S.^{2, 3} Approximately 700,000 young individuals (aged 10–24) present to EDs annually because of non-fatal violent injury, and just over 7 million present because of non-fatal unintentional injury.¹ Presenting to the ED for a violent injury is thought to be predictive of both future victimization and perpetration.⁴ Rates of repeat ED/hospital visits for violence-related injuries have been reported to range from 6% to as high as 40%^{5–8} and as many as 20% of these patients are victims of homicide within 5 years of admission.⁷

ED visits may provide for distinct youth violence screening opportunities. Previous studies have shown that youth often utilize the ED as a primary source of care.^{9, 10} Youth who use the ED primarily for medical care are more likely to report substance abuse, smoking, poor health, depression, and a history of abuse;¹⁰ these findings identify major risk factors and/or consequences of youth violence.^{11, 12}

It has been suggested that ED staff are uniquely positioned to implement screening tools, prevention programs, and interventions for violently injured youth.¹³ Interventions during an assault-related ED visit could be influential in preventing re-injury from assault and retaliatory homicide.¹⁴ Some studies suggest that it is important to identify and intervene not just with youth presenting for an acute assault-related injury, but also for youth with a history of peer violence. For example, findings from randomized, controlled trials of brief violence interventions among youth presenting to an urban ED who screened positive for past-year violence showed a reduction in violent behaviors up to one year after the ED visit.^{15–17} Together, this evidence highlights the impact that early identification of and intervention with youth at risk for violent-related injury can have on reducing peer violence.

However, universal screening for any behavioral issue is difficult to undertake in the ED setting.^{18–23} As such, identifying the populations at highest risk for peer violence may allow targeted, instead of universal, violence screening. Determining whether youth presenting for an acute, assault-related injury had distinct patterns of ED utilization prior to their injury may help determine who should be preferentially screened for youth violence in the ED. In this study, assault-injured youth were compared to unintentionally injured youth since they are expected to have similar demographic characteristics and risk factors for injury-related ED visits.²⁴

The objective of this study was to determine, first, whether previous ED visit history distinguishes youth presenting for care of an assault-related injury from youth presenting for care of an unintentional injury; and, second, to characterize previous ED utilization among assault-injured youth. The study hypothesis was that assault-injured youth are more likely to have a history of multiple previous ED visits and have distinct utilization patterns when compared to unintentionally injured youth.

Methods

Study Design and Setting

A five-year, retrospective, case-control study was designed utilizing a hospital-billing database from the EDs of the only Level 1 Trauma Center for both adult and pediatric patients in a Northeast state. This hospital has separate adult and pediatric EDs and has the largest ED volumes in the area. The annual census for the adult ED is 110,000 patients and the pediatric ED cares for 50,000 patients annually.

ED visit data from this hospital are compiled into a hospital-billing database that contains patient demographics, billing information, and other medical encounter information. This database also contains diagnosis codes and external cause of injury codes (E-codes), which are assigned according to state-wide mandate,^{25, 26} and which were used to identify case and control subjects for the purpose of this study. Study procedures were approved and conducted in compliance with the guidelines of the Institutional Review Board for Human Subjects at the institution.

Selection of Participants

The case population was defined as any youth from the ages of 13 to 24, inclusive, who presented for care of an assault-related injury at the Level I Trauma Center's EDs from January 1, 2011 through December 31, 2011. This age range covers the age groups in which violence is most prevalent, and corresponds with the ages considered in the Centers for Disease Control and Prevention definition of youth violence.^{1,27} "Assault" was defined as an intentionally inflicted injury, excluding those that were self-inflicted, due to sexual assault, or child maltreatment. The index assault-related ED visit was operationalized using E-codes by ICD-9-CM (International Classification of Diseases, 9th Revision, Clinical Modification)²⁸, as assigned by the hospital billing coders. (See appendix A for list of physical assault-related injury E-codes.) The hospital billing coders review each chart and assign an E-code based on the mechanism and intentionality of the injury. This study was conducted in a state that mandates E-coding for ED visits, and national data from our state shows that approximately 98% of ED visits for injury are given an E-code.²⁶

For each case identified, stratified randomization was performed whereby one age and sex matched control subject presenting to the ED with an unintentional injury during the same time period was randomly selected for the control group. Assault-injured youth were compared to unintentionally injured youth since they are expected to have similar demographic characteristics and risk factors for injury-related ED visits.²⁴ Control subjects

were identified using E-codes for sports-related and unintentional injuries. (See appendix B for a list of unintentional injury E-codes.)

Methods and Measurements

After identification of the case and control groups, a five-year retrospective data extraction of prior ED visits and demographics was conducted (time period: January 1, 2006 to December 31, 2010) to characterize and determine if there were distinguishable differences between the two groups. The hospital-billing database became available in 2006, allowing for a five-year retrospective data extraction for all previous ED visits in both the case and control group. All previous ED visits as far back as five years prior to each subject's index ED visit, along with each visit's ICD-9 codes/E-codes and disposition were also extracted.

Each previous ED visit was categorized into medical/surgical, psychiatric, assault-related, and unintentional injury visits using standard categorizations of ICD-9 codes and E-codes for each visit. Psychiatric visits included all psychiatric diagnoses, self-inflicted injuries, and drug and alcohol intoxication in accordance with the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition and ICD-9 coding which lists substance use and dependence under mental health disorders. Assault-related visits included all assaults, however unlike the index assault-related ED visit these visits included child maltreatment. Medical/surgical visits consisted of ED visits that did not have an ICD-9 code for a psychiatric diagnosis or an E-code for injury.

Demographic information - including age, sex, race, ethnicity, type of insurance and ED disposition - was extracted from the hospital-billing dataset. Race and ethnicity (Hispanic and non-Hispanic) data were combined into one variable with the following categories: White non-Hispanic, Black non-Hispanic, Hispanic and Other. The "Other" race/ethnicity category included the following race categories: Asian (1.3%), Hawaiian-Pacific Islander (0.26%), and "all other" (23%). Insurance status consisted of three categories: private, public, and uninsured. Disposition was defined as whether the subject was admitted or discharged at the time of their index visit; as only three patients (two study subjects and one control subject) died, their data was combined with the "admitted" group.

The principal researcher trained two research assistants to categorize previous ED visits into the above categories. Research assistants were blinded to the study objective and design. The first 10 ED visit categorizations were directly observed and random quality checks were conducted (every 50 charts).

Data Analysis

Stata 12.1 software²⁹ was used to conduct statistical analyses. Descriptive statistics (counts, means, and proportions) were calculated to characterize the overall study population, provide mean and median number of previous ED visits, and categorize type of previous ED visits. The relationship between these characteristics among case and control subjects was assessed using t-test, McNemar's chi-squared test of association, and Wilcoxon signed-rank test, as appropriate. An exact Wilcoxon signed-rank test was performed to calculate the median difference and 95% CI between the study and control group for previous ED visits. Bivariate analysis was adjusted to account for matching design.

The independent relationship between previous ED use and having an index assault-related ED visit was assessed using conditional logistic regression, to account for the case control and matching design.³⁰ For model selection, the number of previous ED visits between 2006 and 2010 was chosen as the independent variable. As the number of previous ED visits was not normally distributed (range 0–52, mean: 1.9, median: 1), it was re-categorized into ordinal categories based on the quartiles of the number of previous ED visits: zero, one, two to four, and five or greater. For the same reason the number of ED visits for psychiatric and assault-related ED visits were categorized based on percentiles into: zero, one, and two or more. The dependent variable was whether or not the study subject presented with an assault-related ED visit in 2011 (case and control group). Additional adjusted models comparing previous psychiatric, assault-related, medical/surgical, and unintentional injury ED visits by case and control group were performed; these previous ED visits were each independent ordinal variables based on quartiles of the number of previous visits. A gender-stratified analysis was also performed whereby models comparing number of previous ED visits, previous psychiatric, and assault-related ED visits among females and males study subjects. Race/ethnicity, and insurance status were included in all adjusted models as covariates, since they were both relevant demographic variables and statistically significantly different between the case and control groups. Due to the lack of statistical software available to calculate diagnostic statistics for conditional logistic regression, model diagnostics were performed using standard logistic regression diagnostics.³¹

Cases and controls with missing data on race/ethnicity and type of prior ED visit including previous visits categorized as undetermined by E-code were excluded from analysis. Less than 1% of study subjects were missing race/ethnicity data, 2.9% of prior ED visits were missing ICD-9/E-codes, and 0.56% were coded as undetermined injury. A power and sample size calculation was not performed because the hospital-billing database is a fixed database that contained all the visit data for each ED visit from 2006 through 2011.

Results

Characteristics of study subjects

In 2011, 964 patients with assault-related injuries were identified, and 1:1 age and sex-matched controls were randomly selected from a pool of 5,120 potential control patients who presented to the ED with unintentional injury in 2011. Among assault-related ED visits in 2011, 66% were struck by or against assaults (E960.0, E968.2), 15% were due to cutting/piercing (E966), and 7% were firearm related (E965.0, .1, .4 and E968.6). Among the unintentionally injured control group, 42% were motor vehicle injuries (E810–819), 23% were falls (E880–886.9, E888), and 16% were sports related injuries (E849.4). Table 1 presents comparisons of demographic characteristics among cases and controls. There were statistically significant differences between the two groups in race/ethnicity, and insurance status.

Main results

Assault-injured youth had a median number of 1 previous ED visit (Interquartile range (IQR): 0–3) in the previous five years, whereas unintentionally injured youth had a median

of 0 prior ED visits (IQR: 0 – 2). The median difference in number of ED visits between study and control group was 0.75 (95% CI 0.5–1.5). (See Table 2.)

Assault- and unintentionally-injured youth did not differ in median number of previous medical /surgical and unintentional injury visits. Assault-injured youth had significantly more previous psychiatric ED visits (median difference of 0.75, 95% CI 0.5 –1.0) and assault-related ED visits (median difference of 0.75, 95% CI 0.5 –1.0) when compared to unintentionally injured youth.

In unadjusted conditional logistic regression, youth with five or more prior ED visits had twice the odds of having an assault-related index ED visit compared to those with no prior ED visits (Table 3). After adjusting for race/ethnicity and insurance status, youth with two to four and five or greater previous ED visits had a 41% and 45% increased odds of having an assault-related index ED visit, respectively. The odds of an assault-related index ED visit in 2011 were highest for youth with two or more previous assault-related ED visits. Youth with one previous psychiatric ED visit showed a four-fold increased odds (AOR 4.05, 95% CI 2.41–6.83) of having an index assault-related ED visit and youth with two or more previous psychiatric ED visits had 70% increased odds (AOR 1.70, 95% CI 1.01– 2.86) of having an assault-related index ED visit in 2011. There was no association between having a 2011 assault-related index visit for youth with previous medical/surgical (AOR 1.23, 95% CI 0.95–1.6) and there was a moderate association with unintentional injury ED visits (AOR 1.34, 95% CI 1.00–1.72). (See Table 4)

A gender-stratified analysis found that females had increasing odds of having an assault-related index ED visit as their overall ED utilization increased (AOR 2.27, 95% CI 1.32– 3.91 for females with 5 or more prior ED visits; versus AOR 1.14, 95% CI 0.76– 1.69 for males with 5 or more prior ED visits). Similarly, females had greater than a five-fold increased odds of being seen for an assault-related index ED visit if they had at least one previous psychiatric ED visit (AOR 5.12, 95% CI 2.17–12.06) or an assault-related ED visit (AOR 5.68, 95% CI 2.42–14.18). Males had over a two-fold increased odds of being seen for an assault-related index ED visit if they had at least one previous psychiatric visit (AOR 3.55, 95% CI 1.83–6.89) or assault-related ED visit (AOR 2.27, 95% CI 1.38– 3.74).

As mentioned previously, there were only three patients (two study subjects and one control subject) who died in the ED. Given the small number of subjects with this important outcome, further descriptive analysis of these study subjects was performed to characterize this group. The control subject had no previous ED visits while one study subjects had eight previous ED visits (Five medical/surgical, one unintentional injury and two intentional injury visits); the other study subject had two previous ED visits (one intentional injury and one unintentional injury visit).

Discussion

This retrospective age- and sex-matched case control study compared previous ED visits among assault-injured and unintentionally injured youth over a five-year period. This study was designed to gain a better understanding of previous ED utilization among youth

presenting to the ED for violence-related injuries, and to aid in the identification of potential high-risk youth who should be targeted for violence screening. Results from this study confirm our hypotheses that assault-injured youth are more likely to have a history of multiple previous ED visits and have distinct utilization patterns when compared to unintentionally injured youth. We corroborate previous work suggesting that youth treated in the ED for assault are more likely to return with future assault-related injuries,⁴⁻⁸ and provide new information regarding the relationship with number of prior ED visits and psychiatric-related ED visits.

Our results show that youth with two or more previous visits to the ED or those who were seen for one or more psychiatric concerns in the ED were more likely to have an assault-related index ED visit in 2011. These findings are consistent with our hypothesis along with prior literature in which mental health issues have been identified as both a risk factor and sequelae of violence.³²⁻³⁵ It may be particularly important to screen patients who present with mental health concerns to the ED for a history of peer violence, and to provide these patients with violence prevention resources.

The directional relationship between psychiatric and assault-related ED visits is, of course, impossible to determine from this study. It is possible that mental illness may increase the risk of violence. Indeed, a recent study suggests that placing patients on mood-stabilizers decreases rates of violence.³⁶ Alternatively, patients' presentation for mental illness – including post-traumatic stress disorder, depression, suicidality, and substance use – may reflect their previous violence exposure.^{37, 38}

Our study's chart review covered a five-year period and also showed that prior ED utilization increased the odds of having an index assault-related ED visit. This study therefore corroborates and expands on a recent ED-based study reporting that assault-injured youth were more likely to have had past-year ED visits, particularly for mental illness, compared to age and sex matched control subjects.³⁹ Although prospective studies are warranted, our study's design provides evidence of a distinct prior ED utilization pattern among assault-injured youth. This finding affirms that there are multiple opportunities in the ED setting to screen for youth violence, specifically among high ED utilizers and patients presenting with mental health illnesses.

Corresponding with national statistics,⁴⁰ females made up 32% of index assault-related ED visits in this dataset. Our gender-stratified analysis shows that previous psychiatric and assault-related ED visits more strongly increased the odds of an index assault-related ED visit for females, compared with males. The disparity in patterns of prior ED use among females and males may be due to a variety of reasons. It may reflect higher rates of psychiatric illness among young females with a history of violence,³⁷ gender-specific attitudinal and behavioral factors regarding health care utilization,⁴¹ or females' greater likelihood of care-seeking.^{42, 43} Further research could help delineate the cause of this difference in utilization history.

This study also offers further evidence that the ED is an appropriate setting to identify and intervene in the intentional injury cycle. The majority of intentionally injured patients in this

study and others' studies are discharged directly from the ED.⁴⁴ Previous studies have also acknowledged that these youth often lack a medical home, making the ED their primary source of medical care.^{9, 45–47} Indeed, 33% of assault-injured youth in this study were uninsured, making access to primary care difficult and unlikely for these high-risk youth. Assault-injured patients are therefore unlikely to be connected to violence intervention programs unless initiated in the ED. If a history of youth violence is not identified during an ED visit, it may, therefore, not be identified at all.

Limitations

This study was limited by its retrospective case-control design and the use of a single hospital-billing database. As a result, we were restricted in the data we could collect and missed injuries that presented for care to a different hospital. Although the study hospitals are the only Level 1 Trauma Centers for both adult and pediatric patients in the state, they capture approximately 26 to 34% of the state's total ED visits.^{48, 49} Additionally, we depended on hospital-assigned E-codes for study subject selection and it is possible we could have missed cases due to miscoding of an injuries' intentionality.⁵⁰ It is also possible that some intentional injuries were not identified by our selection methodology, and some injuries may have been missed if injured youth did not disclose that their injuries were intentional. Misclassification of race/ethnicity data is also possible given the large percentage of study participants in the "Other" race/ethnicity category and the manner in which this data is recorded. The lack of concordance between self-reported race/ethnicity and what is recorded in an electronic medical record has been reported in previous studies.^{51–53} This research includes evidence of race/ethnicity misclassification particularly among non-English speaking patients from our ED and also provides evidence of a large multiracial patient population,⁵³ which may explain the large percentage of study subjects in the "Other" race/ethnicity category. Finally, given the limitations of the hospital-billing database, we were unable to examine other potential correlates of confounders, such as whether the patients had a medical home or previous violence-related injuries that did not result in a visit to the ED. The strengths of this study are that it uses five years of hospital ED visit data and that it was performed in an urban ED, which is important when considering violence prevention and intervention; however these findings may not be generalizable to suburban and rural settings.

Conclusion

Previous studies have suggested that universal violence screening should be implemented, and while this may be ideal, it is often a difficult task to undertake and successfully implement in the ED setting.^{22, 54, 55} This study suggests that youth being evaluated for assault-related injuries, psychiatric concerns (including drug and alcohol intoxication), and high ED utilizers are at increased risk for future violence-related injuries. Accordingly, these patients should be preferentially assessed for a history of peer or partner violence, and for risk factors for future violent injury. Ideally, development of a brief youth violence-screening questionnaire that can be used by all medical providers and/or that is administered using technology such as computers or tablets would allow for more efficient screening. Further research into the feasibility of screening and providing injury prevention resources to high-risk youth is warranted.

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Table 1

Demographic Characteristics of Assault Injured and Unintentionally Injured Youth at 2011 Index Visit

	Assault-Injured Youth n= 964	Unintentionally Injured Youth n=964
Age (mean) ^a	19.6 (19.4 –19.8)	19.6 (19.4–19.8)
Sex ^a		
Male	658 (68.3%)	658 (68.3%)
Female	306 (31.7%)	306 (31.7%)
Race/Ethnicity		
White non-Hispanic	415 (43.1%)	559 (58.4%)
Black non-Hispanic	195 (20.3%)	115 (12.0%)
Hispanic	78 (8.1%)	85 (8.9%)
Other	275 (28.5%)	198 (20.7%)
Insurance Status		
Private	253 (26.24%)	404 (41.9%)
Public	382 (39.6%)	274 (28.4%)
Uninsured	319 (33.1%)	248 (25.7%)

^a Assault-injured study group and unintentionally injured control group were matched for age and sex

Table 2

Emergency Department Visits among Assault-Injured Youth and Unintentionally Injured Youth

	Assault-Injured Youth n= 964	Unintentionally Injured Youth n=964	p value
Disposition ^a			
Discharged	827 (85.8%)	868 (90.0%)	0.004
Admitted	137 (14.2%)	96 (10.0%)	
Median Number of Previous ED visits from 2006 to 2010 (interquartile range)	1 (0–3)	0 (0–2)	<0.001
Previous ED Visits			
0	420 (43.6%)	533 (55.3%)	<0.001
1	187 (19.4%)	178 (18.5%)	
2 to 4	212 (22%)	163 (16.9%)	
5 or more	145 (15%)	90 (9.3%)	
Previous Psychiatric ED visits			
0	833 (86.4%)	918 (95.2%)	<0.001
1	82 (8.5%)	22 (2.3%)	
2 or more	49 (5.1%)	24 (2.5%)	
Previous Assault-related ED visits			
0	821 (85.2%)	918 (95.2%)	<0.001
1	104 (10.8%)	35 (3.6%)	
2 or more	39 (4%)	11 (1.2%)	

^aDisposition of the index visit in 2011

Table 3

Conditional Logistic regression comparing Assault and Unintentional Injured Youth by Previous ED utilization

Previous ED Visits	Crude OR (95% CI)	Adjusted OR ^a (95%)
0	Reference	Reference
1	1.34 (1.04–1.71)	1.27 (0.98–1.65)
2 to 4	1.64 (1.29–2.09)	1.41 (1.09–1.81)
5 or more	2.03 (1.51–2.72)	1.45 (1.06–1.99)

^a Adjusting for race/ethnicity and insurance status

Table 4

Conditional Logistic Regression Comparing Assault and Unintentionally Injured Youth by Type of Previous ED Visit

	Crude OR (95% CI)	Adjusted OR ^a (95%CI)
Previous Psychiatric ED Visits		
0	Reference	Reference
1	4.24 (2.57–7.00)	4.05 (2.41– 6.83)
2 or more	2.18 (1.32–3.60)	1.70 (1.01– 2.86)
Previous Assault-related ED visits		
0	Reference	Reference
1	3.44 (2.28–5.19)	2.98 (1.95– 4.57)
2 or more	3.90 (1.98–7.68)	2.42 (1.18– 4.93)
Previous Medical/Surgical ED Visits		
0	Reference	Reference
1	1.36 (1.06–1.74)	1.23 (0.95– 1.60)
2 or more	1.64 (1.23– 2.09)	1.21 (0.93 – 1.57)
Previous Unintentional Injury ED Visits		
0	Reference	Reference
1	1.43 (1.13–1.82)	1.34 (1.00– 1.72)
2 or more	1.00 (0.75–1.34)	0.79 (0.58–1.09)

^a Adjusting for race/ethnicity and insurance status