



ORIGINAL RESEARCH CONTRIBUTION

Sex Differences in Characteristics of Adolescents Presenting to the Emergency Department with Acute Assault-related Injury

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Abstract

Objectives: Adolescents with a history of peer assault are known to report high rates of other risky behaviors. The characteristics of adolescents seeking care in the ED for acute assault-related injury are less well established. This knowledge deficit is particularly noticeable for adolescent female victims of peer assault. This study's objectives were: 1) to characterize the demographics and risk behaviors of youths presenting to the emergency department (ED) with acute assault-related injury and 2) to compare assaulted youths' demographic characteristics, past experiences with violence, and other risk behaviors by sex.

Methods: A systematic sample of adolescents (ages 14 to 18 years) presenting to an urban ED with acute assault-related injury (excluding dating violence, sexual assault, and child abuse) was recruited. Consenting participants self-administered a computerized survey about demographics, history of peer and dating aggression, and theoretical correlates of violence (e.g., alcohol and other drug use, depressive symptoms, weapon carriage). Multivariate logistic regression was performed to identify factors that were differentially associated with presentation to the ED for acute assault-related injury for females versus males.

Results: Of 3,338 adolescents completing a screening survey during the 36-month study period, 197 had presented to the ED with acute assault-related injuries; seven of these were excluded from this study due to being victims of dating violence. Most ($n = 179$, 94.2%) of these 190 acutely assaulted participants were discharged home. The majority reported a history of past-year peer aggression ($n = 160$, 84.2%) and past-year violent injury ($n = 106$, 55.8%). Similar rates of past-year peer aggression, past-year violent injury, alcohol use, and weapon carriage were observed for adolescent males and females presenting with acute assault-related injury. Males and females also reported similar age, race, socioeconomic status, and education levels. Compared to males, females were less likely to report living with a parent (odds ratio [OR] = 0.25, 95% confidence interval [CI] = 0.08 to 0.84) and were more likely to report depressive symptoms (OR = 2.59, 95% CI = 1.23 to 5.48) and past-year dating aggression (OR = 2.23, 95% CI = 1.04 to 4.82).

Conclusions: Male and female adolescents with acute assault-related injuries were very similar. Both reported extremely high rates of past year peer violence, assault-related injury, and substance use. The greater prevalence of some risk factors among adolescent females, such as depressive symptoms, dating aggression, and independent living status, should be further investigated.

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Violence is the second leading cause of death for youth aged 10 to 24 years.¹ Almost 700,000 adolescent patients presented to the emergency department (ED) in 2008 for care of an assault-related injury.² Higher rates of substance use, alcohol abuse, and depression are documented in adolescents with a history of violent injury than in those without a history of violence seeking general ED care.³⁻⁵ The characteristics of youth seeking care in the ED for acute assault-related injury are less well established. Existing data on acutely assaulted adolescents rely heavily on identification of patients using retrospective chart or log reviews, convenience samples, or restricted participant eligibility.⁶⁻¹¹

Youth violence, defined here as violence experienced by adolescents, excluding dating violence, sexual violence, or child abuse, is often described and conceptualized as a problem of adolescent males. Yet between 19 and 27% of adolescent females participating in national surveys reported having been in a serious fight in the past year,^{12,13} and one-third of assaulted adolescents seen in the ED in 2008 were female.² The majority of adolescent females' assaults are reported to be caused by peers, not dating partners.^{3,8,14} Non-ED-based research suggests that adolescent females with a history of assault may be at increased risk of depression¹⁵⁻¹⁸ compared to females without a history of assault and compared to males with a history of assault. As adolescent females are more likely to fight at home or school, violently injured females may also be less likely to report heavy alcohol use (compared with young males with a history of violence).¹⁸⁻²¹

The relative prevalence of these and other potential risk factors for acute assault-related injury among the two sexes have yet to be defined. Indeed, the sole study comparing characteristics of males and females presenting to the ED with acute assault-related injury is limited by studying only preadolescents (age 8 to 14 years) and being a convenience sample.¹⁴ More successful violence prevention interventions may be possible if evidence-based risk factors for both sexes can be addressed.^{18,22} Recognizing this critical gap in the literature, the Department of Justice, Centers for Disease Control and Prevention, and National Institutes of Health have recently called for increasing attention to both the effect and the prevention of peer violence among adolescent females.²²⁻²⁴

The primary objectives of this analysis were twofold: 1) to characterize the prevalence and associated risk behaviors among a systematic sample of youth seeking ED care for acute assault-related injury and 2) to compare the demographic characteristics, past experiences with violence, and mental health correlates of future violence by respective sex. We hypothesized that adolescent females would report lower alcohol use and higher rates of depressive symptoms than males, which could be used as the basis for future sex-specific ED-based violence prevention interventions.

METHODS

Study Design and Population

This study consisted of a cross-sectional, self-administered audio computer-assisted self-interview (ACASI) of

adolescents aged 14 to 18 years presenting to an inner-city, Level I trauma center ED. These surveys were completed as part of the recruitment phase of a larger randomized controlled trial of an ED-based alcohol and violence intervention.^{25,26} The study site was Hurley Medical Center in Flint, Michigan, with a census of approximately 50,000 adult and 25,000 pediatric patients per year. Hurley Medical Center is the only public hospital in this economically disadvantaged city, which has similar levels of poverty and crime as Detroit, Michigan; Camden, New Jersey; St. Louis, Missouri; and Oakland, California.²⁷ The population of Flint is almost 50% African American.²⁸ Study procedures were approved by the University of Michigan and Hurley Medical Center institutional review boards (IRBs), and a certificate of confidentiality was obtained from the NIH.

Survey Content and Administration

Consenting participants completed a self-administered ACASI on a tablet laptop computer, with touch screen and audio via headphones. ACASI results in improved reliability and validity of sensitive questions, compared to traditional paper-and-pencil surveys.²⁹⁻³¹ The survey was administered in English only (consistent with the study site population; no participants were excluded for language restrictions). The median screen time was 12.3 minutes (interquartile range = 9.1). Participants received a token \$1.00 gift (e.g., notebook, pens) on completion of the survey. The survey was self-administered (via headphones, due to low literacy), unless an injury or disability precluded completion by the subject (~8%). Survey content was adapted from previous, validated studies.

Demographic Information. Age, race, ethnicity, sex, education history, grades, who the patient lived with, childbearing, and receipt of public assistance were assessed using items from the National Study of Adolescent Health (Add Health).³² For the purposes of analysis, age was kept as a continuous variable; race and ethnicity was collapsed into white non-Hispanic and other, in accordance with the racial and ethnic distribution in Flint. Education history and grades were collapsed into "dropped out of school" versus "in school" and "mostly Ds and Fs" versus "better than Ds."

Alcohol and Other Drug Use. Frequency and quantity of alcohol consumption were measured using the Alcohol Use Disorders Identification Test (AUDIT-C).^{33,34} Binge drinking was also assessed using the AUDIT-C; however, in accordance with standard recommendations for adolescents, binge drinking quantity was lowered from the original "6 or more ..." to "5 or more drinks on one occasion."³⁴ Past-year use of cigarettes, marijuana, and other illicit substances was assessed using questions from Add Health.³² For the purposes of analysis, binge drinking, cigarette, and marijuana questions were dichotomized as yes/no. Self-reported use of any illicit substance other than marijuana (e.g., cocaine, inhalants, prescription pills, and "other drugs") were collapsed together, due to the low frequency of use of nonmarijuana substances; this new category was also analyzed as a yes/no dichotomy.

Depressive Symptoms. Participants' depressive symptoms were measured with a modified version of a single-item screen for depression derived from the Diagnostic Interview Schedule-III-R.³⁵ Single- and two-item depression screens have been shown to be sensitive and specific in both primary care and ED populations.^{35–38} This item adapted the single-question screen used by Rost (with lifetime depression sensitivity between 0.83 and 0.94) to a past-year screen: "In the past 12 months, have you had two weeks or more where nearly every day you felt sad, depressed, or you lost interest in most things?"³⁵

Peer Aggression. Past-year aggression against peers (strangers or friends; excluding dating partners and family members) was assessed using a modified version of the Revised Conflict Tactics Scale (CTS-2), a tool that has been validated with adolescents.³⁹ Consistent with the CTS-2, peer aggression was divided into moderate (i.e., pushed, shoved, slapped) and severe (i.e., hit or punched, kicked, slammed into a wall, beat up, used a knife or gun). The survey assessed frequency as well as types of events; for analysis, answers were dichotomized into yes/no categories.

Dating Aggression. Past-year dating aggression (e.g., violence toward someone you are dating or "going with" a boyfriend or girlfriend) was measured using a collapsed version of the Conflict in Adolescent Dating Relationships Inventory.⁴⁰ The original four-item scale was collapsed into two questions: moderate aggression toward a dating partner, such as throwing something that could hurt, twisting arms or hair, pushing, shoving, grabbing, or slapping; and severe aggression toward a dating partner, such as punching or hitting with something that could hurt, choking, slamming against a wall, beating up, burning or scalding on purpose, kicking, or using a knife or gun. In analysis, responses were dichotomized into any aggression toward a dating partner in the past year (yes) versus no aggression toward a dating partner (no).

Weapon Carriage. Carriage of knives, razors, and guns was assessed with two questions adapted from previous studies of at-risk youth.⁹ In analysis, answers were dichotomized as carriage of any weapon in the past year (yes) versus no weapon carriage (no).

Previous Injuries. Past-year injury of all types (including falls, cuts, motor vehicle-related injuries, bicycle and scooter injuries, sports- and exercise-related injuries, and assault-related injuries) was self-reported using a subset of the Adolescent Injury Checklist (yes/no).⁴¹ Only past-year assault-related injuries were examined in this paper.

In addition to the ACASI, a chart review was completed by trained research assistants (RAs). Chief complaint at current visit (e.g., medical illness [e.g., abdominal pain, asthma] and injury type [ICD-9-CM E800–E999]) were abstracted from the medical chart. Injury visits were classified as intentional (E950–E969) or unintentional (E800–E869, E880–E929). Disposition after the current ED visit and the number of ED visits

in the last year were also abstracted. Chart reviews were audited regularly to maintain reliability in keeping with the criteria described by Gilbert et al.⁴²

Recruitment was conducted by trained, bachelor- or masters-level RAs from 12PM to 11PM, 7 days a week, between September 2006 and September 2009. A consecutive sample of all 14- to 18-year-old adolescents presenting to the ED for both medical illness and injury were approached based on electronic tracking logs. This study includes only those patients seen in the ED because of an acute assault-related injury caused by peer or stranger (not a date or partner, as victims of dating violence may have different characteristics from those with nondating assault-related injuries).^{43–45} Exclusion criteria included presentation with acute suicidal ideation, abnormal vital signs, insufficient cognitive orientation, or a complaint of sexual assault or child abuse (see Figure 1 and our previous publications

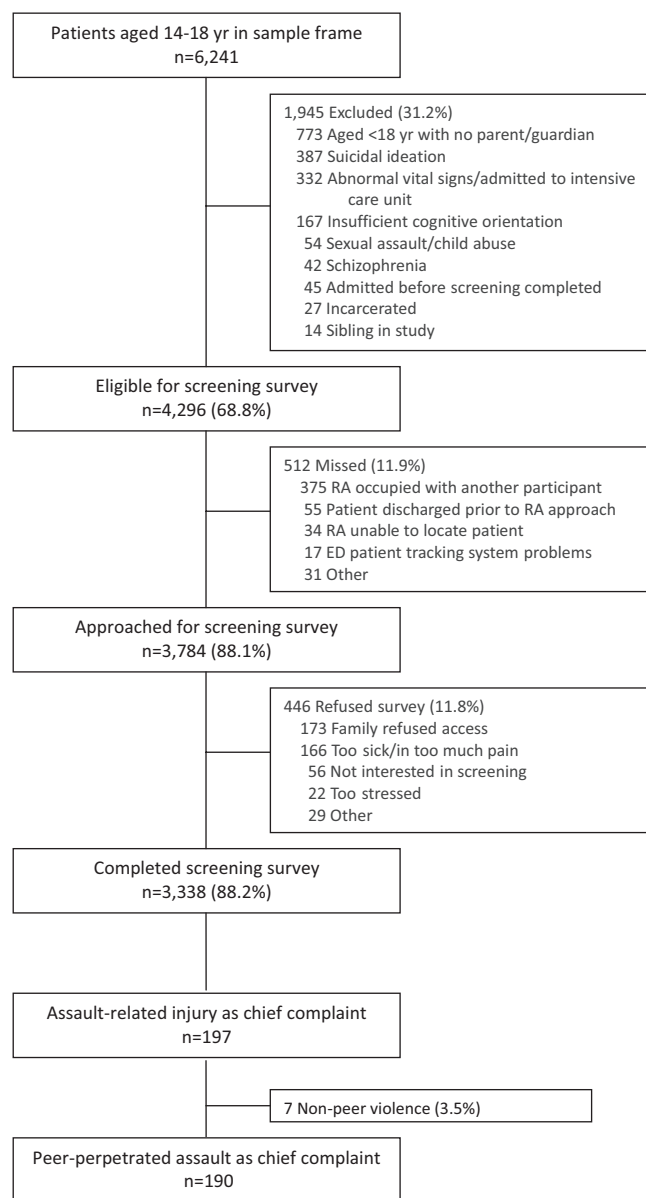


Figure 1. Patient flowchart.

for further details).^{25,26} Parental consent as well as adolescent assent was obtained for youths under age 18 years; consent was obtained from adolescents aged 18 years. Due to IRB regulations, we were unable to collect data on participants who were ineligible or missed or who presented to the ED when study personnel were not present.

Data Analysis

Statistical analyses were conducted using SAS 9.1.3 (SAS Institute, Cary, NC). Descriptive statistics (means with standard deviations [SD] for continuous variables and proportions with confidence intervals [CI] for categorical variables) were used to describe the distribution of demographic characteristics, risk behaviors, and aggression. Estimates of association between these exposure variables and being female were calculated using odds ratios (OR). Multivariate logistic regression analysis was then performed to determine sex differences in demographic characteristics, risk behaviors, and aggression. Independent variables were retained in the final model based on theory and significance in the bivariate analysis. Goodness-of-fit of the model was assessed using the Hosmer-Lemeshow test.

RESULTS

Of the 4,296 adolescents eligible for screening for this study, 3,784 (88%) were approached by RAs for screening, and 3,338 (88% of those approached) completed the survey. Among eligible participants, those who agreed to participate were slightly more likely to be African American, female and seeking care for an injury (refusal rates: African American 11.0% [$n = 244$], white 12.2% [$n = 164$], nonwhite 16.4% [$n = 38$]; $\chi^2 = 6.08$, $p = 0.05$; male 13.0% ($n = 224$) vs. female 10.7% ($n = 222$), $\chi^2 = 4.72$, $p = 0.03$; medical chief complaint 12.6% ($n = 276$) vs. injury chief complaint 9.4% ($n = 147$), $\chi^2 = 9.79$, $p = 0.002$). Of all patients participating in the screening survey, 197 had a chief complaint corresponding to assault-related injury. Of these, five females and two males were excluded from current analysis because they reported that their injury was caused by someone other than a peer. The final sample for this analysis was therefore 190 adolescents presenting to the ED with an acute, peer assault-related injury (see Figure 1).

Characteristics of Overall Sample

The mean (\pm SD) age of patients presenting to the ED with acute assault-related injury was 15.9 (± 1.6) years, and one-third ($n = 64$) were female. Almost two-thirds ($n = 121$) of patients were nonwhite, and 59% ($n = 112$) reported that their family was receiving public assistance (e.g., Medicaid, food stamps, WIC). Almost all patients ($n = 179$) were discharged home from the ED on the day of the study.

Past-year Violence of Overall Sample

Overall, 84.2% ($n = 160$) of adolescents presenting to the ED with assault-related injury reported past-year aggression against a peer, two-thirds of whom ($n = 126$) reported committing severe aggression.

Almost one-third of both sexes reported aggression toward dating partners in the past year ($n = 58$); one-third of those adolescents reporting dating violence endorsed moderate dating violence (29.5%, $n = 56$), and one-fifth reported severe violence (18.4%, $n = 35$).

Bivariate Analysis by Sex

Based on unadjusted, bivariate analysis, females and males seeking care for assault-related injury reported similar demographics and ED service usage, with the exception that females were less likely to live with their parents than males. We found no sex differences in self-reported past-year peer aggression or assault-related injuries. Females were, however, more likely than males to report assaulting a dating partner in the past year, more likely to report severe dating aggression, less likely to report marijuana use, and more likely to report depressive symptoms (see Table 1 for more details).

Multivariate Analysis by Sex

On multivariate logistic regression analysis, there were no sex differences in demographic characteristics, past-year peer aggression, alcohol and other illicit drug use, or past-year ED visits. Females were significantly more likely to report depressive symptoms and past-year dating aggression than males. Females with acute assault-related injury were less likely to report living with a parent than males (see Table 1, last column, for complete analysis). Hosmer-Lemeshow goodness-of-fit test showed that the multivariate model was well-calibrated to fit the data ($\chi^2 = 3.66$, $df = 8$, $p = 0.89$).

DISCUSSION

Our study describes a consecutive, systematic sample of youth recruited during an ED visit for non-partner assault-related injury, including a large sample of females. The high prevalence of past-year assault-related injury and peer aggression in this population is striking and is similar to rates reported in other ED-based studies of more severely injured populations.⁷⁻⁹ Of note, males and females had similarly high rates of self-reported history of peer aggression, substance use, and weapon carriage. Given that 95% of these violently injured adolescents were discharged directly home from the ED, our findings substantiate the importance of addressing violence during the ED visit.^{46,47} ED-based youth violence prevention programs focused on reducing substance use and weapon carriage, both well-known risk factors for violence among young men, may be warranted for both females and males.

We found that adolescent females were twice as likely as males to report past-year depressive symptoms. The rates of depressive symptoms reported among the females in our sample are also five times higher than that reported in community samples of adolescent girls.^{48,49} This finding may have substantial implications for interventions to prevent both violence and the mental health sequelae of violence. Known risk factors for both violence and depression include poor self-esteem, indifference to personal safety, and inability to regulate one's emotional responses to stressful

Table 1
Demographic and ED Visit Characteristics of Adolescent Females Versus Males Presenting to the ED with Peer-perpetrated Violent Injuries (n = 190)

	All (n = 190)	Female (n = 64)	Male (n = 126)	Unadjusted OR (95% CI)	Adjusted OR* (95% CI)
Demographics					
Age, yr (mean, SD, range)	15.9, ±1.6, 4.0	15.8, ±1.6, 4.0	15.9, ±1.6, 4.0		
Hispanic (yes vs. no)	10 (5.3%)	4 (6.3%)	6 (4.8%)	t-test: p = 0.59	0.82 (0.63–1.07)
Race (nonwhite vs. white)	121 (63.7%)	44 (68.8%)	77 (61.1%)	1.33 (0.36–4.91)	0.90 (0.41–1.98)
Dropped out of school (yes vs. no)	25 (13.2%)	11 (17.2%)	14 (11.1%)	1.41 (0.74–2.63)	
Grades Ds and below (yes vs. no)	48 (25.3%)	17 (26.6%)	31 (24.6%)	1.66 (0.71–3.90)	
Live with parent (yes vs. no)	166 (87.8%)	51 (81.0%)	115 (91.3%)	1.11 (0.56–0.77)	0.25 (0.08–0.84)†
On public assistance (yes vs. no)	112 (59.0%)	36 (56.3%)	76 (60.3%)	0.41 (0.17–0.98)†	
Have children (yes vs. no)	10 (5.3%)	5 (7.8%)	5 (4.0%)	0.85 (0.46–1.56)	
ED visits				2.05 (0.57–7.35)	
Discharged home (yes vs. no)	179 (94.2%)	63 (98.4%)	116 (92.1%)	5.43 (0.68–43.4)	
ED visits in past year (yes vs. no)	54 (28.4)	23 (35.9%)	31 (24.6%)	1.72 (0.89–3.33)	1.60 (0.76–3.37)
ED visits in past year for intentional assault (yes vs. no)	9 (5.1%)	4 (6.3%)	5 (4.0%)	1.61 (0.42–6.25)	
Other violence					
Any dating aggression in the past year	58 (30.5%)	29 (45.3%)	29 (23.0%)	2.77 (1.46–5.28)†	2.23 (1.04–4.82)†
Any peer aggression in the past year	160 (84.2%)	54 (84.4%)	106 (84.1%)	1.02 (0.45–2.33)	0.53 (0.19–1.46)
Past-year intentional injury (prior to this ED visit)	106 (55.8%)	36 (56.3%)	70 (55.6%)	1.03 (0.56–1.89)	
Risk factors for violence					
Have had alcohol in past 12 months	68 (35.8%)	18 (28.1%)	50 (39.7%)	0.60 (0.31–1.14)	
Binge drinking in past 12 months	41 (21.6%)	12 (18.8%)	29 (23.0%)	0.77 (0.36–1.64)	0.55 (0.18–1.62)
Have used tobacco in past 12 months	70 (36.8%)	22 (34.4%)	48 (38.1%)	0.85 (0.45–1.60)	
Have used marijuana in last 12 months	78 (41.1%)	19 (29.7%)	59 (46.8%)	0.48 (0.25–0.91)†	0.51 (0.23–1.14)
Have used any illegal drugs except marijuana in past 12 months	22 (11.6%)	6 (9.4%)	17 (12.7%)	0.71 (0.26–1.91)	
Depressive symptoms	71 (39.9%)	31 (52.5%)	40 (33.6%)	2.18 (1.16–4.13)†	2.59 (1.23–5.48)†
Have carried a weapon in past 12 months	55 (29.0%)	16 (25.0%)	39 (31.0%)	0.74 (0.38–1.47)	

*Adjusted for age, race, independent living status, ED visits in last year, peer aggression in last year, dating aggression in past year, alcohol binge in last year, marijuana use in last year, and depressive symptoms.
†Significant difference.

situations.^{18,50–52} Adolescent females' propensity to depressive symptoms^{52–54} may therefore increase their risk of violent injury.^{4,11,15,55,56} Conversely, females may be more likely to develop internalizing (depressive) symptoms rather than externalizing (angry) symptoms as a response to previous violent exposures.^{11,52,57,58} This finding deserves further, longitudinal studies to fully understand the interrelationship between violence and depressive symptoms. Providing adolescent females with effective emotional regulation and problem-solving skills could potentially reduce the future incidence of both violence and depression.⁵⁹ Developing interventions that target both violence and depressive symptoms, particularly for adolescent females seeking care for peer-perpetrated violent injury, may therefore be indicated. The high rate of depressive symptoms among injured males also deserves further study.

Adolescent females with assault-related injury were also two times as likely to report dating aggression as their male peers. In other, non-ED-based studies, dating violence and peer violence correlate.^{20,30,60,61} Other studies also report higher rates of dating violence among females than males,^{60,62,63} as well as correlations being a dating violence perpetrator and a victim.^{30,61} It is therefore possible that many adolescent females are reporting dating aggression that occurs in the context of self-defense. Alternatively, males may be less likely to report dating aggression due to social stigma.⁶⁴ Qualitative and quantitative investigation of this result, including assessments of victimization and motivation, would be worthwhile.

The sole notable demographic difference between sexes was that assault-injured females were less likely to live with a parent than assault-injured adolescent males. Living with a parent may have a stronger positive role in preventing violence for girls than for boys.⁶⁵ Adolescent females and males with assault-related injury were equally likely to be receiving public assistance and to report poor grades; this is not surprising, in light of the strong role of neighborhood and family characteristics in determining adolescents' conflict resolution skills.⁶⁶

LIMITATIONS

Our study conclusions are restricted by a few important limitations. First, behaviors assessed in this study were obtained via self-report. Recent reviews have concluded, however, that self-reports of risk behaviors (e.g., alcohol, tobacco, drug use, and violence) among adolescent and young adults demonstrate good reliability and validity.^{67–72} Moreover, adolescents and young adults are more likely to report risky behaviors using computerized surveys and when privacy and confidentiality are assured (as in this study, which had an NIH certificate of confidentiality).^{67,72–75} Second, as adolescents presenting on the overnight shift were excluded from the study, findings do not generalize to these patients. As this study focused on peer violence, our findings also do not generalize to adolescents presenting with injuries due to sexual assault, child abuse, or dating violence. Third, this cross-sectional study limits conclusions regarding causality and cannot account for

the context of the dating aggression. Finally, although a strength of this study is the focus on an inner-city ED, a logical focus for violence prevention initiatives, the findings may not generalize to suburban or rural EDs. Future studies are needed to examine effects with other samples, including Hispanic adolescents.

CONCLUSIONS

This study shows alarming rates of past-year aggression (85%) and past-year assault-related injury (56%) among a systematic sample of adolescents seeking ED care for acute, peer-perpetrated assault. These rates were remarkably similar for adolescent females and males with assault-related injury. Male and female adolescents with acute injuries also reported similarly high levels of past-year alcohol and substance use. Increased prevalence of some risk factors among adolescent females, such as depressive symptoms, dating aggression, and independent living status, should be accounted for in the future as well.

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Call for Papers

The Evidence-based Diagnostics section is seeking submissions. These manuscripts will evaluate a single emergency medicine-relevant diagnosis using a systematic review and meta-analysis to summarize high quality clinical research focusing on history, physical exam, readily available lab tests, and common imaging strategies. Evidence quality will be graded using the Quality Assessment Tool for Diagnostic Accuracy Studies. The highest quality evidence will then be summarized to report point-estimates or ranges for pre-test probability, diagnostic accuracy including interval likelihood ratios, and test-treatment thresholds for definitive tests. Authors are encouraged to contact the section editor, Christopher Carpenter, MD (carpenterc@wusm.wustl.edu) with specific questions for this series.