

Risk for Repeat Emergency Department Visits for Violent Injuries in Youth Firearm Victims

Hyun Ja Lim¹, Michael McCart², W Hobart Davies³, Alice Calhoun⁴ and Marlene D. Melzer-Lange⁵

¹Department of Community Health and Epidemiology, College of Medicine, University of Saskatchewan, 107 Wiggins Road, Saskatoon, SK S7N 5E5, Canada. ²Department of Psychiatry and Behavioral Sciences, Medical University of South Carolina, 171 Ashley Avenue, Charleston, South Carolina, U.S.A. ³Department of Psychology, University of Wisconsin-Milwaukee, 2200 E. Kenwood Blvd. Milwaukee, Wisconsin, U.S.A. ⁴Valley Children's Hospital, 9300 Valley Children's Place, Madera, California, U.S.A. ⁵Section of Emergency Medicine, Department of Pediatrics, Medical College of Wisconsin, 9000 W. Wisconsin Avenue Milwaukee, Wisconsin, U.S.A.

Abstract

Objective: To identify significant risk factors associated with repeat emergency department (ED). Visits for violent injuries in youth firearm victims.

Methods: The study subjects of this retrospective cohort study were firearm victims aged 18 and younger presenting to a Pediatric Emergency Department/Trauma Center at Children's Hospital of Wisconsin between 1990 and 1995. The primary outcome was subsequent Emergency Department visits (REDV) at any emergency department in Milwaukee for a violent injury.

Results: A total of 495 subjects were eligible for the present study in the pediatric firearm victim's ED visit database. Eighty-five percent (n = 420) were males and 82% were African-Americans. Mean age was 15 years old (s.d = ±3.6). A majority of them had a single-parent family. Eighty-eight subjects (17.8%) had a prior history of ED visit due to violence. During the study time, 201 subjects had at least one REDV. In the multivariable model, a subject without a social worker consulting at the hospital were more likely to have REDV compared to subjects with a social worker consulting (O.R = 1.749; p-value = 0.047), controlling for guardian and disposition. Subjects disposed to detention center or police custody were more likely to have REDV compared to subjects disposed to home or a hospital (O.R = 5.351; p-value = 0.003).

Conclusion: Our analysis indicates that individuals with guardians, those who did not receive social worker intervention on their initial visit, and those discharged in police custody were associated with increased repeat ED visits due to a violent injury.

Keywords: adolescence, firearm injury, intentional injury, violence, emergency department utilization

Introduction

Fatal and nonfatal firearm-related injuries remain an important public health issue in the U.S.^{1,2} The pediatric and adolescent age group has the fastest rate of increase in incidence of fatal gunshot wounds.³ In 2002, more than 877,700 young people ages 10 to 24 were injured from violent acts and approximately 1 in 13 required hospitalizations in the U.S.⁴

Studies of intentionally injured adults and youth presenting to emergency departments noted a high rate of repeat intentional injury. Those initially admitted for treatment of assault were found to be at greater risk of subsequent treatment for assault than those admitted for noninjuries.⁵⁻⁹ In addition to direct medical cost by the government, insurance companies, and other private sources, impact on family work and finances is costly.^{10,11} Cutting and piercing wound survivors were 7 times more likely to be recidivists than were gunshot survivors.⁷ The incidence of recurrent trauma was highest in men, blacks and the uninsured⁸ and positive blood alcohol levels, and longer hospital stays were also significantly

Correspondence: Hyun Ja Lim, Department of Community Health and Epidemiology, College of Medicine, University of Saskatchewan, 107 Wiggins Road, Saskatoon, SK S7N 5E5, Canada. Tel: (306) 966-6288; Fax: (306) 966-7920; Email: hyun.lim@usask.ca.



Copyright in this article, its metadata, and any supplementary data is held by its author or authors. It is published under the Creative Commons Attribution By licence. For further information go to: <http://creativecommons.org/licenses/by/3.0/>.

associated with recidivism.¹² The recurrent rate of urban trauma as a chronic disease was estimated 35%–44%^{3,8} with a 20% 5-year mortality rate.⁹

Medical, public health, and legal professionals as well as policy-makers are aware of the personal and environmental factors related to adolescent victims of interpersonal violence. Injury literature enumerates victimization risk and protective factors and some compare socioeconomic, familial and individual influences to each other.^{13–15} Cheng et al. found that fighting was common among all groups that she studied: unintentional injury, violent injury and noninjured youth, but that youth who had endured past fights, past fight injuries, and seeing someone else shot were markers associated with assault injury.¹²

In order to develop strategies to prevent repeat violent injuries among youth, it is important to understand the risk factors for another violent injury. However, little is known about these characteristics among pediatric firearm victims. This analysis was undertaken to investigate significant individual and environmental risk factors associated with repeat ED visits for violence among adolescents. Understanding and addressing these factors will enable practitioners and health systems to develop targeted strategies to prevent repeat visits for intentional injuries.

Materials and Methods

This is a retrospective cohort study utilizing a firearm victim database. Milwaukee is a large American city with a population of approximately 700,000. The trauma center at Children's Hospital serves all youth firearm victims in Milwaukee, regardless of insurance status or location of injury. The study population was subjects aged 18 and younger who were presenting to a Pediatric Emergency Department/Trauma Center at Children's Hospital of Wisconsin between 1990 and 1995 who presented with firearm injuries. Patient information was obtained by (i) medical record review of sentinel event; (ii) ED records from Children's Hospital of Wisconsin and all other hospitals reviewed for subsequent events through 1997; and (iii) records from Milwaukee Medical Examiner's Office for subsequent death through 2003.

From medical records patient demographic information, prior injury history, type of injury, and cause of subsequent injuries and death if

applicable, were obtained. Type of injury was acquired upon registration at the Emergency Department. The primary outcome was the event of recurrent ED visit for intentional injury. Intentional injury included firearm injuries, stabbing, injuries sustained in a fight and physical or sexual assault. Age in years at the sentinel event was categorized into four categories: <12, 12–14, 15–16, and 17–18. Insurance type was categorized into three categories: Private (private, HMO), Public (public, HMO/public), and None. Disposition was categorized into three categories: Home, Hospital, and Other (detention center, police station). Guardian was categorized into four categories: Single mother/Single father, Two parents, Self, and Other. A prior history of ED visit due to violence and a social worker consulting at hospital were also obtained from the database. This study was approved by the Children's Hospital of Wisconsin Institutional Review Board (CHW, HRRC#159–95) and Medical College of Wisconsin Institutional Review Board (MCW, HRRC#283–05).

Descriptive statistics were used to summarize data. A Student t-test was used for continuous variables and Chi-squared test was used to compare categorical variables. Correlation analysis was conducted between covariates. The primary outcome, the REDV for intentional injury, was modeled by univariate and multivariable logit models.¹⁶ To identify potential predictors for the final model, the variables were first examined at individually using univariate analysis. Variables were identified as significant using a 0.1 alpha level in the univariate model, and only these were included in a stepwise method to determine a final model. For the final multivariable model, a 0.05 alpha level was used. For each effect from the models the odds ratio and 95% confidence intervals were calculated. The goodness of fit was assessed using the Hosmer-Lemeshow (HL) statistic.¹⁷ Univariate and multivariable logit models were performed by PROC LOGISTIC and PROC GENMOD procedures using SAS Version 9.

Results

A total of 516 subjects were available in the pediatric firearm victim's ED visit database. Twenty-one subjects were dead (17 died of initial injuries and 4 died after the study period) and not eligible for this study. Of 495 subjects, 85% (n = 420) were

males and 82% were African-Americans. Mean age was 15.1 years old (s.d = ± 3.6). A majority of them (58%) were from single-parent family and 29% from two-parent family. Forty-one percent had public insurance and 39% had no insurance. Eighty-eight subjects (17.8%) had a prior history of ED visit due to violence. At initial injury, social workers were present for only 22% of the total subjects. About 52% were discharged to home, 44% to a hospital, and 4.4% to a detention center or police station. Table 1 showed the demographic characteristics, injury sites, and disposition of the study subjects.

Table 1. Demographic characteristics, injury sites, and disposition of the study subjects. (N = 495).

Variables	Number of patient (%)
Age at initial injury	
0–11	60 (12.1%)
12–14	117 (23.6%)
15–16	161 (32.5%)
17–18	157 (31.7%)
Sex	
Male	420 (84.8%)
Female	75 (15.2%)
Race	
Black	406 (82.0%)
White	44 (8.1%)
Hispanic/Asian	45 (8.9%)
Social worker consulting	
Yes	109 (22.0%)
No	386 (78.0%)
Family	
Single mother/father	289 (58.4%)
Two Parent	142 (28.7%)
Relative/Foster parent	14 (2.8%)
Not Available	50 (10.1%)
Guardian	
Single mother	284 (57.4%)
Single father	13 (2.6%)
Two Parent	46 (9.3%)
Self	46 (9.3%)
Relative/Foster parent	38 (7.7%)
Not Available	68 (13.7%)

(Continued)

Table 1. (Continued)

Variables	Number of patient (%)
Prior history of ED visit	
Violent	88 (17.8%)
Non-violent/none	407 (82.2%)
Insurance	
Private	33 (6.9%)
HMO	62 (13.0%)
HMO/Public	101 (21.2%)
Public	96 (20.1%)
None	185 (38.8%)
Body region injured	
Leg	260 (52.5%)
Arm/shoulder	50 (10.0%)
Face/jaw	48 (9.7%)
Hand/wrist	47 (9.5%)
Head	27 (5.5%)
Torso (all)	63 (12.7%)
Disposition	
Home	255 (51.5%)
Hospital	218 (44.0%)
Detention/police	22 (4.4%)

Of 495 eligible subjects, 201 (41%) subjects had at least one REDV for violent injuries during the follow-up time (median follow-up time = 3.2 years). A total of 305 subsequent ED visits by 201 subjects were observed, with having multiple revisits (15%) and some persons a rather large number (5 revisits). Major causes of the REDV were due to another firearm injury (n = 62, 20.3%), laceration (n = 61, 20%), contusion (n = 45, 14.7%), and fight/brawl (n = 44, 14.4%). Comparing to the non-African-American, African-American subjects were more likely having REDV in age younger than 15 (p-value = 0.005), but that difference was not observed in age 15 or older group (p-value = 0.63). The REDV proportion of race by age group is shown in Figure 1 (Fig. 1: Proportion of repeat Emergency Department visits for violent injuries by age group and race). There was no difference in REDV between genders (p-value = 0.89).

The analysis showed that four factors were associated with REDV for violent injuries in the univariate logit models (Table 2): guardian, prior histories of ED visit for violence, social worker

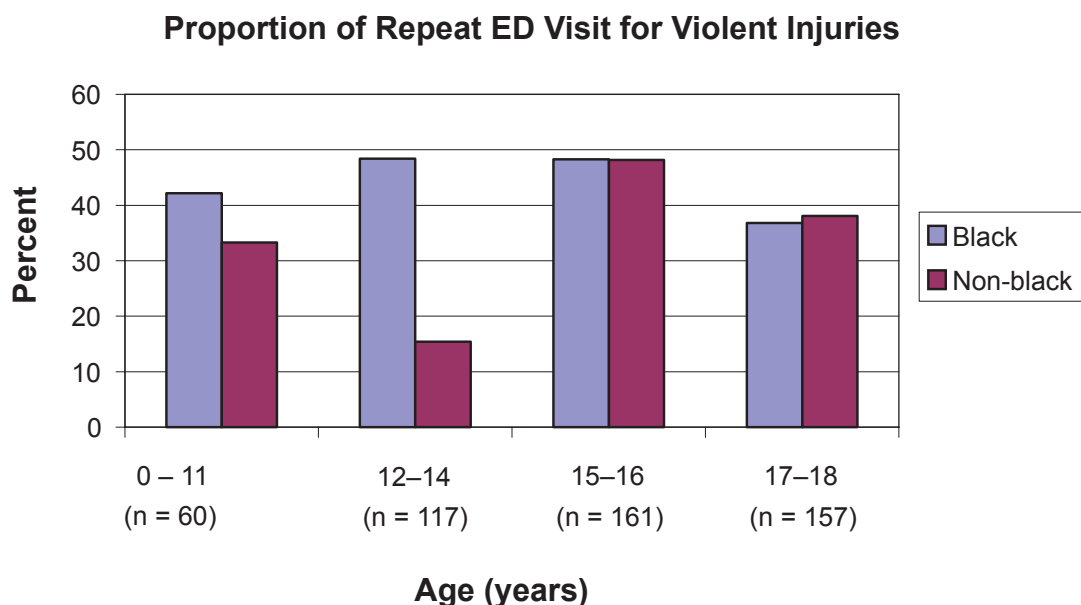


Figure 1. Proportion of repeat Emergency Department visits for violent injuries by age group and race.

consulting at the hospital, and disposition. Compared to a subject who did not have a prior history of ED visit due to violence, a subject who had a prior history of ED visit was more likely to have REDV (OR = 1.59, 95% C.I.: 1.002–2.53, $p=0.049$) in the univariate analysis. However, this association was not significant in the multivariable analysis.

The multivariable logit model (Table 3) showed that guardian, social worker consulting at the hospital, and disposition were significantly associated with REDV for violent injuries. In the multivariable model, a subject without a social worker consulting at the hospital were more likely to have REDV compared to subjects with a social worker consulting (O.R = 1.749; 95% C.I.: 1.008–3.036; p -value = 0.047), controlling for other significant predictors. Subjects disposed to a detention center or police custody were more likely to have REDV compared to subjects disposed to home or a hospital (O.R = 5.351; 95% C.I.: 1.757–16.3; p -value = 0.003), controlling for guardian and social worker present at hospital. For a subject reporting self as a guardian, the odds of REDV to no REDV were decreased by 62%, compared to a subject who had a single parent as guardian. The analysis showed no difference in REDV among other guardians. There was no interaction among factors in the multivariable model. A sensitivity analyses was also performed to investigate the influence of death cases. When

the analyses were extended to data when death cases were included as an event, the findings from our study remained unchanged.

Discussion

This study demonstrates the burden of ED visits for repeat violent injury for a cohort of youth firearm victims and delineates particular protective and risk factors for these repeat emergency department visits. Having a social worker consult at the initial visit and being 18 years of age were significantly associated with decreased repeat emergency department visits for violence; disposition to police custody was associated with an increased risk for a repeat injury. These factors represent individual, social, and environmental aspects of urban adolescents. In order to develop interventions to prevent youth violence recidivism, it is important to understand the scope of the problem as well as the likelihood for repeat injury from violent behavior.

Our study showed a self-guardian, a youth who has reached the age of 18 and can thus consent for himself, was the least likely to have a recurrent ED visit. Perhaps younger firearm victims may be at increased risk for a repeat violent injury as compared to youth who have reached at eighteen years. Also, youth who reached age 18 may have moved from our community, became incarcerated, or died in another community and thus were unavailable to make repeat emergency department

Table 2. Univariate analysis of repeat the Emergency Department visits for violent injuries with odds ratio and 95% confidence interval (N = 495).

Covariate	Odds ratio (95% C.I.)	P-value
Female	1.036 (0.629–1.707)	0.889
Race		
Black	1.00	
Other	0.699 (0.432–1.131)	0.14
Age		
17–19	1.00	
15–16	1.346 (0.859–2.11)	0.194
12–14	1.187 (0.727–1.939)	0.493
<12	1.138 (0.618–2.094)	0.678
Insurance		
Public	1.00	
Private	0.758 (0.461–1.249)	0.277
None	0.682 (0.457–1.018)	0.061
Prior history of ED visit	1.592 (1.002–2.53)	0.049
Social worker consulting	1.514 (0.968–2.368)	0.066
Guardian		
Single parent	1.00	
Two parent	0.643 (0.336–1.23)	0.182
Self	0.528 (0.271–1.029)	0.061
Relative	0.553 (0.21–1.169)	0.121
Anatomy		
Leg	1.00	
Arm/shoulder	1.432 (0.778–2.635)	0.249
Hand/wrist	1.245 (0.663–2.338)	0.496
Face/jaw	1.422 (0.764–2.646)	0.267
Head	2.101 (0.944–4.673)	0.069
Torso (all)	1.036 (0.588–1.827)	0.908
Dispose to		
Home	1.00	
Hospital	0.859 (0.592–1.244)	0.42
Police/Detention center	4.872 (1.466–10.22)	0.006

visits in our surveillance area. No statistical difference was observed in REDV between self-guardian subjects to two parents or relatives guardian subjects, but a trend that a youth with a single parent guardian was more likely to have REDV was observed. This result may suggest lower socioeconomic status, parental ability to supervise, or family instability.^{16–18} Family instability may be one of the most important

reasons for increased repeat adolescent assault victimization.

Our study showed that social worker support at the sentinel ED visit was associated with decreased repeat visits for violence. The American Academy of Pediatrics and the Society of Adolescent Medicine both recommend psychosocial support for youth firearm victims at the time of their injury.¹⁹ Wilkinson et al. noted that although emergency department staff

Table 3. Multivariate analysis of repeat Emergency Department visits for violent injuries with odds ratio and 95% confidence interval. (N = 495).

Covariate	Odds ratio (95% C.I)	P-value
Guardian		
Single parent	1.00	0.118
Two parent	0.59 (0.338–1.143)	0.008
Self	0.379 (0.184–0.78)	0.121
Relative	0.547 (0.255–1.173)	
Social worker		
consulting	1.00	
Not consulting	1.749 (1.008–3.036)	0.047
Dispose to		
Home	1.00	
Hospital	1.06 (0.669–1.61)	0.804
Police/Detention center	5.351 (1.757–16.3)	0.003

counsel victims of violence, only 17% of hospitals had any formal training on youth violence.²² The U.S. Department of Justice recommends timely support of “promising multi-service programs to reach families and gun victims within 24 hours of the shooting.” Other professionals have recommended increasing violence prevention/intervention support and training for physicians, nurses and crime victim specialists in the emergency setting.^{23–27} Our results further support these recommendations.

Disposition to police custody was associated with 5-fold increased risk for repeat emergency department visits for violence. Rivara et al.²⁸ found that young assault patients were significantly more likely to have had legal warnings or convictions as compared to youth presenting for unintentional injuries to an emergency department. Conversely, Borowsky and Ireland²⁹ found no difference in police contact for a group of adolescents between those suffering a subsequent fight-related injury and those who had not. Our results indicate that youth discharged in police custody are a high-risk group requiring intensive violence prevention services.

Our study has several limitations. First, our study examined repeat emergency department visits in Milwaukee hospitals and the death records in Milwaukee County; any ED visits or deaths outside of our community would not been captured. In addition, since the data were created from the medical records and the study subjects were not actively followed, it is not possible to estimate lost to follow-up component of this study. Second, accurate socioeconomic information, such as

family income or neighborhood income, and neighborhood characteristics for the study subjects were not available, and thus the relationship between REDV for violent injuries and such variables limits us to infer causality in this study. A future study direction would be to focus on more specific individual and environmental factors.

The young firearm victims in this cohort are at high risk to visit the emergency department for repeat violent injuries. Psychosocial support provided by social workers and other health care professionals at the time of the emergency department visit may provide a significant contribution in diminishing these repeat injuries. Youth discharged to the detention center following their emergency department visit are in particular need for these services. This is a cohort of urban adolescents at higher risk for subsequent REDV. By increasing the understanding of risk factors for recidivism of ED visit due to risky behavior or violence, our study findings will help practitioners developing interventions and new strategies to prevent youth violence in similar settings.

Disclosure

The authors report no conflicts of interest.

References

1. Hemenway D, Kennedy BP, Kawachi I, et al. Firearm prevalence and social capital. *Ann Epidemiol*. 2001;11:484–490.
2. National Center for Injury Prevention and Control for Disease Control and Prevention. Injury mortality statistics. [http://www.cdc.gov/ncipc/wisqars].

3. Nance ML, Stafford PW, Schwab CW. Firearm injury among urban youth during last decade: an escalation in violence. *J Pediatric Surgery*. 1997;32:949–952.
4. Centers for Disease Control Prevention. Web-based Injury Statistics Query and Reporting System (WISQARS). [<http://www.cdc.gov/ncipc/wisqars>].
5. Litaker D: Guns and homicide in the home. *N Engl J Med*. 1994; 30:365–366.
6. Litaker D: Preventing recurring injuries from violence: the risk of assault among Cleveland youth after hospitalization. *Am J Public Health*. 1996;86:1633–1636.
7. Kaufmann CR, Branas CC, and Brawley ML. A population-based study of trauma recidivism. *Trauma*. 1998;45:325–332.
8. Morrissey TB, Byrd CR, Deitch EA. The incidence of recurrent penetrating trauma in an urban trauma center. *Journal of Trauma*. 1991;31:1536–1538.
9. Sims DW, Bivins BA, Obeid FN, et al. Urban trauma: a chronic disease. *J Trauma*. 1989;29:940–946.
10. Kizer KW, Vassar MJ, Harry RL, et al. Hospitalization charges, costs and income for firearm-related injuries at a university trauma center. *JAMA*. 1995;272:1768–1773.
11. Osberg JS, Kahn P, Rowe K, et al. Pediatric trauma: impact on work and family finances. *Pediatrics*. 1996;98:890–897.
12. Cheng TL, Schwarz D, Brenner RA, et al. Adolescent assault injury: risk and protective factors and locations of contact for intervention. *Pediatrics*. 2003;112:931–938.
13. Richards MH, Larson R, Miller BV, et al. Risky and protective contexts and exposure to violence in urban African American young adolescents. *Journal of Clinical Child and Adolescent Psychology*. 2004;33: 138–48.
14. Pape H, Pedersen W. Victims of violence in the general youth population. A longitudinal study of risk factors. *Tidsskrift for Den Norske Laegeforening*. 1997;117:3347–51.
15. Nance ML, Templeton JM, Oneill JA. Socioeconomic impact of gunshot wounds in an urban pediatric population. *J Pediatric Surg*. 1994;29:39–43.
16. Fahrmeir L, Tutz G. *Multivariate Statistical Modeling Based on Generalized Linear Models*. New York: Springer; 2001.
17. Hosmer DW, Lemeshow S. A goodness-of-fit test for multiple logistic regression model. *Comm Stat Ser A*. 1980;9:1043–1069.
18. Smith CJ, Beltran A. Grandparents raising grandchildren: challenges faced by these growing numbers of families and effective policy solutions. *Journal of Aging and Social Policy*. 2000;12:7–17.
19. Minkler M, Fuller-Thomson E. Second time around parenting: factors predictive of grandparents becoming caregivers for their grandchildren. *International Journal of Aging and Human Development*. 2000;50:185–200.
20. Durkin MS, Davidson LL, Kuhn L, et al. Low-income neighborhoods and the risk of severe pediatric injury: a small-area analysis in northern Manhattan. *Am J Public Health*. 1994;84:587–92.
21. Duke N, Risnick MD, Borowsky IW. Adolescent firearm violence: Position paper of the Society for Adolescent Medicine. *Journal of Adolescent Health*. 2005;37:171–174.
22. Willkinson DL, Kurtz EM, Lane P, et al. The emergency department approach to violently injured patient care: a regional survey. *Injury Prevention*. 2005;11:206–8.
23. Fein JA, Ginsburg KR, McGrath ME, et al. Violence prevention in the emergency department: clinician attitudes and limitations. *Arch Pediatr Adolesc Med*. 2000;154:495–8.
24. Fein JA, Kassam-Adams N, Gavin M, Huang R, et al. Persistence of posttraumatic stress in violently injured youth seen in the emergency department. *Arch Pediatr Adolesc Med*. 2002;156:836–840.
25. Phelps LR, Davies WH, McCart MR, et al. Concerns and coping of African-American mothers after youth assault requiring emergency medical treatment. *Journal of Pediatric Psychology*. 2006;31:388–396.
26. Marcelle DR, Melzer-Lange MD. Project UJIMA: Working together to make things right. *Wisconsin Medical Journal*. 2001;100:222–5.
27. Zun LS, Rosen JM. Psychosocial needs of young persons who are victims of interpersonal violence. *Pediatric Emergency Care*. 2003;19:15–19.
28. Rivara FP, Shepherd JP, Farrington DP, et al. Victim as offender in youth violence. *Ann Emerg Med*. 1995;26:609–614.
29. Borowsky IW, Ireland M. Predictors of future fight-related injury among adolescents. *Pediatrics*. 2004;113:530–6.