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Trauma

In harm's way: Unintentional firearm injuries in young children

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ABSTRACT

Purpose: Firearm-related trauma represents a major source of preventable injury and death. Many firearm injuries in young children are unintentional, and the true incidence may be underestimated. We sought to characterize the morbidity of unintentional firearm injuries.
Methods: National Trauma Data Bank data from 2007 to 2014 was obtained for patients aged 0–14 sustaining gunshot wounds (GSW). We analyzed demographics, injury severity score, hospital and ICU length of stay (LOS), ventilator days, discharge to rehab, and mortality. We categorized intention as assault, unintentional, self-inflicted or other, and compared unintentional firearm injuries against all others using Student's *t* test or chi-square analysis.
Results: We identified 7487 GSW patients aged 0–14, of whom 2514 (33.6%) sustained unintentional injuries. The mortality rate for unintentionally injured patients was 9.2%, compared with 14.2% for all other intentions ($p < 0.0001$). Unintentionally injured children were more likely to be male ($p = 0.01$) and Caucasian ($p < 0.0001$) and had lower rates of ICU admission ($p = 0.02$), ventilator use ($p = 0.0004$), and discharge to rehab ($p < 0.0001$).
Conclusions: Unintentional injuries comprise one-third of firearm injuries and approximately 10% of GSW-related mortality in young children. Since these injuries are entirely preventable, our findings suggest a major opportunity to reduce disease burden.
Level of Evidence: IV.

Trauma is a leading cause of pediatric and adolescent morbidity and mortality, and gunshot wounds (GSW) contribute substantially to the overall disease burden [1,2]. Although gun violence is a worldwide phenomenon, the United States leads developed countries in annual pediatric firearm trauma [3]. A number of epidemiologic studies have attempted to describe the scope of pediatric GSW injuries, and these almost uniformly demonstrate that such injuries are more common in older children and adolescents, African-Americans, and lower socioeconomic neighborhoods [4–6]. Among pediatric GSW victims, unintentional injuries generally occur less frequently than assaults, but are much more common among children than adults [6,7].

The demographics of unintentional pediatric firearm injuries run counter to the prevailing trend in pediatric GSW patients – that is, they are more common in younger, Caucasian children [8,9]. Furthermore, a majority of unintentional injuries occur in the home, where mere firearm availability is associated with an increased risk for injury [10]. The full scope of the problem of unintentional firearm injuries is unknown and difficult to characterize, since these injuries can be misclassified and underreported [11]. Since no recent studies have compared unintentional firearm injuries against other injury intentions, we sought to compare the demographics of these two populations. Furthermore, we hypothesized that children sustaining unintentional firearm injuries would have similar outcomes to intentionally injured pediatric GSW victims.

1. Methods

We obtained data from the National Trauma Data Bank (NTDB) for all children 0–14 years old who sustained GSW injuries for the years 2007 to 2014 inclusive. The NTDB is maintained by the American College of Surgeons' Committee on Trauma and contains de-identified data for both adult and pediatric patients from over 900 trauma centers across the United States. No IRB approval was required since these data are de-identified to maintain patient confidentiality. Data points collected included demographics, location of injury, Injury Severity Score (ISS), intensive care unit (ICU) admission and length of stay (LOS), ventilator

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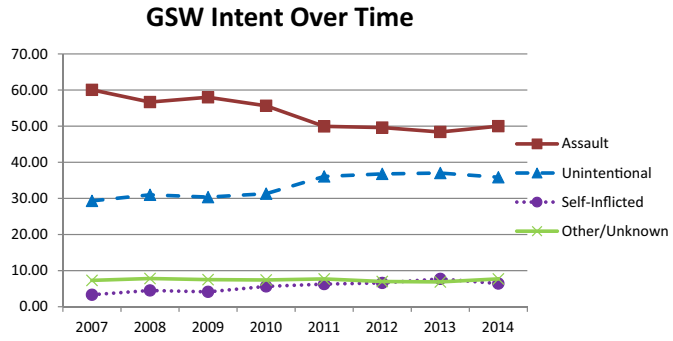

Fig. 1. Pediatric GSW by intent over the study period. Assault injuries decreased, while unintentional injuries increased; self-inflicted and injuries of unknown etiology remained relatively constant.

use, overall LOS, discharge disposition and mortality. Mortality was the primary outcome of interest, with secondary outcomes including overall and ICU LOS, ventilator use and duration, and discharge to a rehab facility. GSW injury intent was categorized as assault, unintentional, self-inflicted or other/unknown based on available codes from the NTDB. We analyzed patients sustaining unintentional GSW injuries, and compared this group of patients against the remainder of the population using chi-square analysis for categorical variables and Student's t-test for continuous variables. Significance levels were set at $p = 0.05$.

2. Results

We identified a total of 7487 patients 0–14 years old who sustained firearm injuries from 2007 through 2014, representing 1.0% to 1.3% of all pediatric trauma captured in the NTDB over this period. From 2007 to 2014, the overall incidence of GSW injuries decreased (data not shown). Grouped by intent, assaults accounted for the vast majority of pediatric GSW injuries (53.40%), followed by unintentional injuries (33.57%), self-inflicted injuries (5.64%), and those with unknown/undetermined intent (7.41%). Over time, however, the incidence of assault injuries decreased from 60.1% to 50.0% of all GSWs in this age range, while unintentional injuries increased from 29.3% to 35.9% and self-inflicted injuries increased from 3.3% to 7.7% (Fig. 1).

When comparing unintentional firearm injuries against the remainder of the GSW population, children sustaining unintentional injury were younger (9.3 versus 10.2 years, $p < 0.0001$), and more likely to be male (78.8% versus 75.5%; $p = 0.001$) and Caucasian (51.6% versus 22.3%; $p < 0.0001$). Firearm injuries increased with age, irrespective of intent, although the greatest increases with age were observed for assaults (Fig. 2). Interestingly, from 1 to 11 years of age, similar numbers of patients sustained assault and unintentional injuries. Unintentional

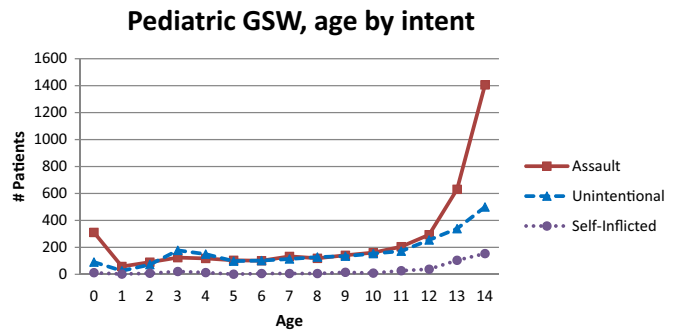

Fig. 2. Pediatric GSW by intent and age. For injuries of any intent, the incidence increased sharply with adolescence. However, the incidence of unintentional and assault-related injuries is nearly identical in the 1–11 age range.

Table 1
Demographics of pediatric firearm injuries.

	Unintentional (n = 2514)	Intentional (n = 4973)	p value
Age			<0.0001
0–1 years	117 (4.7%)	422 (8.5%)	
2–4 years	400 (15.9%)	436 (8.8%)	
5–10 years	731 (29.1%)	963 (19.4%)	
11–12 years	427 (17.0%)	655 (13.2%)	
13–14 years	839 (33.4%)	2497 (50.2%)	
Gender			0.001
Male	1981 (78.8%)	3747 (75.5%)	
Female	529 (21.1%)	1214 (24.5%)	
Race			<0.0001
Caucasian	1296 (51.6%)	1110 (22.3%)	
African-American	793 (31.5%)	2605 (52.4%)	
Other	425 (16.9%)	1258 (25.3%)	
ISS			<0.0001
1–3	975 (38.8%)	1885 (39.6%)	
4–8	484 (19.3%)	698 (14.7%)	
9–15	501 (19.9%)	1013 (21.3%)	
16–24	235 (9.3%)	580 (12.2%)	
25–75	202 (8.0%)	579 (12.2%)	
Injury Location			<0.0001
Home	1631 (64.9%)	2223 (44.7%)	
Public Building	51 (2.0%)	217 (3.3%)	
Recreation	131 (5.2%)	294 (3.3%)	
Street	161 (6.4%)	1327 (23.4%)	
Other/Unknown	540 (21.5%)	1255 (25.2%)	

Patients sustaining unintentional injuries were significantly younger, less severely injured, and more likely to be male and Caucasian relative to intentional injuries.

GSW injuries occurred predominantly in the home, whereas the reminder of GSW injuries tended to occur in public settings (64.9% versus 44.7%; $p < 0.0001$; Table 1).

Overall mortality in our population of young children was 14.4%. However, children with unintentional firearm injuries had significantly lower mortality compared to those sustaining intentional injuries (9.2% versus 14.2%; $p < 0.0001$). Compared to children sustaining intentional GSWs, patients with unintentional injuries had significantly decreased injury severity, rates of ICU admission, ventilator usage, and mortality (Table 2). Interestingly, however, there were no differences in ventilator days, ICU LOS or overall hospital LOS between patients with unintentional and intentional firearm injuries. More children with unintentional firearm injuries were discharged home rather than to rehab or another inpatient facility (66.0% versus 58.7%; $p = 0.004$).

Table 2
Outcomes for unintentional vs. intentional pediatric firearm injuries.

		Unintentional (n = 2514)	Intentional (n = 4973)	p Value
ICU utilization				0.02
	Yes	767 (30.5%)	1649 (33.2%)	
	No	1747 (69.5%)	3324 (66.8%)	
ICU LOS		5.2 (8.3)	5.5 (8.5)	0.42
Ventilator utilization				0.0004
	Yes	388 (15.4%)	933 (18.8%)	
	No	2126 (84.6%)	4040 (81.2%)	
Ventilator days		4.4 (6.2)	4.8 (8.6)	0.41
Discharge Disposition				0.004
	Home	1660 (66.0%)	2912 (58.7%)	
	Rehab	79 (3.1%)	200 (4.0%)	
	Inpatient facility	102 (4.1%)	231 (4.7%)	
Hospital LOS		4.9 (8.8)	5.2 (9.7)	0.19
Mortality				<0.0001
	Yes	232 (9.2%)	708 (14.2%)	
	No	2282 (90.8%)	4265 (85.8%)	

Outcomes for pediatric GSW by intent. Patients sustaining unintentional injuries were less likely to require ICU admission or ventilator use, more likely to be discharged home, and less likely to die as a result of their injuries.