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Intimate Partner Violence-Related Fractures in the United States: An 8 Year Review

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Abstract

Background—Fractures associated with intimate partner violence (IPV) are devastating injuries that can have lifelong implications. With exception to the facial region, there are very limited epidemiological reports describing the types and location of IPV-related fractures. The objective of this study is to review a national database and describe trends associated with IPV-related fractures.

Methods—An analysis of all adults was performed using the National Trauma Data Bank from 2007 through 2014. Data including demographics, age, location of fracture, and drug/alcohol use were described and analyzed.

Findings—There were 1,352 records identified where the patient was diagnosed with an IPV-related fracture. Women accounted for 83% of the population and the mean age was 37.5 years. Approximately 30% of the population was diagnosed with vertebral, trunk, and rib fractures. Variances among fracture location were observed across age groups. Facial fractures were recorded more in the younger population (18–39 years) when compared to other age groups (40–59 years; 60+ years), $p < 0.0001$. Alternatively, rib and femur fractures were more common among survivors aged 60+ when compared to the younger age groups, $p < 0.0001$.

Interpretation—The ability to identify and respond to survivors of IPV in the healthcare setting is critically important. While facial fractures are common, they are not the only type of fractures that are seen. In many cases, healthcare professionals are the first line of defense in identifying suspected IPV cases. The findings of this paper build upon existing literature while also describing IPV-related fractures across the age spectrum.

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Author contribution

Austin Porter contributed to the literature search, study design, data analyses, data interpretation, writing, and critical revision.

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Introduction

Each year approximately 10 million U.S. men and women experience some form of physical violence by an intimate partner.(1) The types of injuries sustained from intimate partner violence (IPV) can range from abrasions to multisystem trauma that can result in death.(2) Relationships involving the most severe forms of IPV show an increase in frequency and severity over time that may result in homicide if the victim does not leave the relationship and/or the batterer seeks treatment or is incarcerated.(3) It is for this reason that research on the patterns of injury from IPV is needed. This research can inform and improve the treatment and screening services provided by healthcare professionals treating IPV survivors.

Several studies have examined maxillofacial fractures associated with IPV.(4–13) However, limited research has investigated the details of IPV-related fractures beyond maxillofacial locations. A study by Bhandari et. al., (2006) with 263 IPV survivors has moved beyond maxillofacial fractures to conduct a more complete examination of IPV-related musculoskeletal injuries, which were found to be the second most common manifestation of IPV. Identified musculoskeletal injuries ranged from sprains to fractures.(14) Yet, to the authors' knowledge no studies in the extant literature describe IPV-related musculoskeletal fractures across the age spectrum. The purpose of this study is to build on the current literature by conducting a secondary data analysis of a national database to investigate the relationship between IPV-related musculoskeletal fracture location and age of the IPV survivor.

Methods

National Trauma Data Bank (NTDB)

The data used for this study were obtained from the NTDB Research dataset, a product of the American College of Surgeons. The NTDB is the largest collection of trauma data available in the United States containing data from more than 800 trauma centers across the nation. Trauma centers, regardless of level of designation, are encouraged to submit data to the NTDB. The NTDB contains de-identified patient-level records with information on demographics, procedures, injury mechanism, and diagnoses.

Analysis

A review of all IPV-related fractures for adults 18 years and older was conducted using data entered from 2007 through 2014. The International Classification of Diseases, 9th Revision (ICD-9), External Cause of Injury Codes (E-codes) were used to identify patients who were victims of IPV. Cases involving the following E-codes or diagnosis codes were used to identify patients who were victims of IPV: E967.0 (child and adult abuse by father, stepfather, or boyfriend), E967.2 (child and adult abuse by mother, stepmother, or girlfriend), E967.3 (child and adult abuse by spouse or partner), 995.80 (adult maltreatment, unspecified), 995.81 (adult physical abuse), 995.83 (adult sexual abuse), and 995.84 (adult abuse and neglect). The ICD-9 diagnosis codes were used to identify victims of IPV who had sustained fractures. Cases involving diagnosis codes: 800.0–804.99 (Fracture of skull

and facial bones), 805.0–809.1 (Fracture of spine, ribs, and trunk), 810.0–819.1 (Fracture of upper limb), or 820.0–829.1 (Fracture of lower limb) were used to identify fracture cases and locations. Cases were defined as IPV-related fractures when E-codes and diagnosis coding criteria were met.

In addition to fracture location, demographic data, location of injury, hospital length of stay, drug and alcohol screening results, and patient outcomes were collected and analyzed. Patient ages were grouped into three categories (18–39, 40–59, and 60 years and older) based on approximate 20-year U.S. Census age groups.⁽¹⁵⁾ Data analysis was performed using SAS version 9.4 (SAS Institute, Cary, NC).

Descriptive statistics were used to summarize the data. General association and ANOVA tests were used to determine differences in fracture location by age strata. Statistical significance was set at $\alpha = 0.05$.

Results

Demographics

Between 2007 through 2014, there were 4,752,775 adult patient records in the NTDB. Among these records, 8,126 (0.17%) were identified as survivors of abuse, which resulted in 1,352 cases of IPV-related fractures. The average age of the patients who met criteria was 37.5 years with the age of patients ranging between 18 and 84 years old. As presented in Table 1, females accounted for 83% of this population. Whites made up nearly half (49.3%) of the population, Blacks contributed 32%, 8% identified as other, and the remaining were not recorded or unknown. Patients in this population suffered various fracture types. Nearly 50% of the study population sustained facial fractures with most of these fractures involving the nose and orbital bones. Patients with fractures in the vertebrae and trunk region (including ribs) accounted for almost 32% of the fractures diagnosed. Fractures in the upper and lower limb body region attributed to 16.5% and 13.1% of the diagnosed fractures in the population, respectively.

Fracture location

Skull and facial fractures—Skull and facial fractures accounted for more than half of the IPV-related fractures. Nasal fractures ($n=284$) were among the most commonly seen facial fractures in the population (see Figure 1). These were closely followed by orbital ($n=176$), mandible ($n=160$), and malar ($n=156$) fractures. There were 154 patients who sustained a basal skull fracture, followed by 88 cases where patients sustained skull vault fractures.

To identify age-related trends in IPV-related fractures, table 2 presents fracture locations stratified by age groups. There was a statistically significant decrease in the proportion of facial fractures across age categories with more than half of the patients who sustained a facial bone fracture being between the ages of 18–39 years (40–59 yrs: 45.6% and 60+: 24.6%, $p=0.0001$).

Vertebrae and trunk fractures—There were 424 patients with fractures located in the vertebrae and trunk region. Rib fractures were the most common fractures in this region with 237 fractures reported. Other fractures described in this region were flail chest (n=10) and sternum (n=13). Fractures along the vertebrae were the second most common fractures with 196 patients accounting for 220 vertebral fractures. These fractures included those observed in the cervical, dorsal, lumbar, and sacral regions. Fractures located in the lumbar region of the vertebrae were most common (n=97) followed by cervical (n=53), dorsal (n=50), and sacral (n=20).

There was a statistically significant increase in the proportion of rib fractures across age categories going from 13.8% in 18–39 year olds to 24.6% among patients 60 years and older ($p<0.0001$). Vertebral fractures among age groups accounted for approximately 14% of observed fractures in each age category. There was no statistically significant difference across age groups in the proportion of pelvic fractures.

Extremity Fractures

There were 223 patients with IPV-related fractures involving their upper extremities. Fractures in distally located bones were more common. The most common extremity fracture were to the radius and ulna (n=80). There were 177 patients with fractures to the lower extremities. Similarly to the upper extremities, there was an increase in the frequency of fractures that were more distally located.

There were no statistically observed differences among age groups that involved fractures in the upper extremities. However, the proportion of fractures to the humerus, and radius and ulna did increase among patients 60 years and older. With the exception of femur fractures, there were no statistically significant differences observed across age groups involving fractures to the lower extremities. Fractures to the tibia and fibula or ankles ranged from 3.5% to 6.5% across age groups. Conversely, there was a statistically significant difference in the proportion of patients with femur fractures across age groups as nearly 2% of 18–39 and 40–59 year olds sustained this type of injury compared to 14% of older patients ($p<0.0001$).

Concomitant Fractures

As previously stated, many patients in this population suffered from fractures in multiple locations. Table 3 presents results on patients with fractures in more than one location. The most commonly associated fractures were facial and skull fractures (51.4%). Similarly, 44.7% of patients presenting with pelvis fractures also had a vertebrae fracture.

Alcohol and Drug Use

There were 413 (30.6%) cases where alcohol use by the patient was confirmed by testing. Among these confirmed cases, 102 (7.5%) contained trace levels of alcohol and 311 (23.0%) were beyond the legal limits set by the state where the hospital reporting was located. Nearly 28% of the study population tested negative for alcohol. The remaining 569 (42.1%) of the cases included in this study were not tested for alcohol. Among those cases only 22 (1.6%) patients were not tested because alcohol use was not suspected. There was a statistically

significant difference in alcohol use across age groups with 19.3% of confirmed alcohol use cases being among patients 60 years and older and 38.3% of cases being among patients 40–59 years old ($p<0.0001$).

Drug use was confirmed in 305 (22.6%) cases. Among patients with positive drug tests, 238 (17.6%) patients tested positive for illicit drugs or illegal use of prescription drugs and 42 (3.1%) patients tested positive for drugs they had been prescribed. There were 181 (13.4%) patients who tested negative for (prescription or illicit) drug use. Nearly 64% of the study population was not tested for drugs. Similar to alcohol testing, drug tests were not routinely conducted. There were no significant differences across age groups regarding drug use.

Patient outcomes

Patients with IPV-related fractures would spend an average of 5 days in the hospital. More than 25% of the population was admitted to an intensive care unit (ICU) with a mean ICU length of stay of 4.9 days. More than 150 (11.4%) required immediate surgical intervention as they were discharged to the operating room from the emergency department. The mean injury severity score (ISS) was 9.9. When stratified by age groups, there was a statistically significant increase in mean ISS ranging from 9.8 among 18–39 year olds to 12.3 among patients 60 years and older ($p=0.02$). There were 26 (1.9%) total deaths with 10 deaths occurring in the emergency department.

Discussion

The results presented in this paper provide a glimpse at the type of IPV-related injuries and traumas that far too many women and men endure. Abuse is grossly under-reported.(16) Most survivors of violence do not receive treatment for their injuries. Those who do present to healthcare professionals for care are frequently not forthcoming with the truth about how their injuries were inflicted.(8) Psychosocial factors such as fear, stigma, threat, shame, and guilt as well as logistical and financial concerns such as threat of further violence, financial considerations, transportation, and the safety of others in the household are all factors that keep survivors of IPV from reporting.(16) Negative experiences reporting violence in the past further reduce the likelihood that a survivor will report their violence.(16)

Most best-practice guidelines for identifying and responding to interpersonal violence in healthcare settings focus on women and children as the survivors of violence.(17) Although our findings are consistent with the literature that most IPV is against women, it is important to note that 16.6% of the patients included in this study were men. Regardless of gender, healthcare professionals can play a critical role in supporting survivors of violence.(17–20) Much of the literature focused on the role of primary care providers in screening for violence and to a lesser extent, primary care-based interventions to aid patients who are currently experiencing IPV.(21,22) However, the Institute of Medicine, the US Department of Health and Human Services, and the US Preventive Services Task Force all recommend that IPV screening and counseling, especially among female patients, should be integrated throughout the healthcare delivery system to identify survivors, promote safety, and improve health outcomes.(23) While there is no single best screening method, universal screening in emergency departments is recommended to maximize identification of survivors.

Appropriate training of staff may be necessary to implement universal screening successfully.(24,25) Additionally, minimizing language barriers, maintaining privacy, and having a same-sex screener can help increase reporting. Currently the US Preventive Services Task Force does not recommend routine screening for elder abuse or neglect.(26).

Outside of screening, however there has not been research to assist healthcare providers in identifying which patients are at greatest risk for being survivors of violence. Our research makes an important contribution to the literature by providing healthcare professionals information to help them to identify survivors of violence. This information may be particularly useful to providers in medical fields that are underutilized in violence screening efforts including orthopedics, neurosurgery, otolaryngology, and plastic surgery because it provides them with epidemiologic evidence that can support guidelines in those fields on how to identify survivors of violence.(27).

Fractures are not an uncommon physical injury occurring in IPV.(28) However, much of the literature regarding interpersonal violence and fractures is focused on facial fractures.(4–10,29,30) While facial fractures are commonly seen, they account for less than half of the fractures reported in this study. A study conducted by Muelleman et. al., highlighted the types of IPV-related injuries that were seen among women.(11) Their study showed that while 51.1% of the women sustained facial injuries, 20.3% had thoracic injuries and 18.1% had lower extremity injuries.(11) Additionally, a study conducted by Petridou et. al., indicated that 30.1% of the IPV survivors sustained injuries to the face.(31) This study also showed that 16.7% and 16.4% of women were diagnosed with injuries to the upper limbs and trunk, respectively.(31) Bhandari et al. noted that among IPV patients, 40% had neck and facial fractures and 28% had musculoskeletal injuries.(14) This diverse pattern of fractures was also noted in the present study. It is important to note that even though facial fractures are the most common fractures, skull, rib and several types of extremity fractures are also commonly seen. Among the extremities, forearm and ankle fractures were most common. These fractures patterns are suggestive that they occurred as a result of a fall during abuse instead of direct trauma.

We also attempted to evaluate patterns of concomitant fractures in our population. Multiple injuries have been identified as a potential identifying risk factor for abuse, but no studies have evaluated the pattern of multiple fractures as an identifying factor.(6) The areas of two highest correlations existed between skull and facial fractures as well as between pelvis and vertebra fractures. We believe that these patterns of concomitant fractures could serve also as potential identifiers for patients who may have been abused. Given the prevalence of extremity fractures associated with IPV, physicians encountering patients with these extremity fractures should be aware that 1 of 6 women have a history of abuse.(20) Our data indicate that a heightened awareness is advised when treating women with extremity fractures.

Our examination of the age of the survivor in IPV-related fractures is a unique contribution to the literature. While it was observed that the number of fractures decreased as age increased, the location of some fractures varied significantly across age strata. Facial fractures were more commonly seen in the younger population (18–39 years). This finding

supports the results of other studies that found higher rates of facial injuries among younger survivors. In a study conducted by Le et. al., the mean age of their study population was 31.4 years which is more than 6 years younger than the mean age in the present study.(9) Le et. al., also found that 81% of their population presented with maxillofacial injuries.(9) Whereas in the Muelleman study, the mean age of their study population 34 years which was slightly older when compared to the Le study. Approximately 51.1% of their study population reported facial injuries.(11) Neither of these studies stratified their study population into age groups so age-related trends could not be compared. However, the results presented in the current study suggest that while younger patients are more likely to sustain facial fractures, older patients are more likely to sustain rib and femur fractures. When examining the literature for abuse patterns in older patients particularly among the elderly noticeable rates of ribs and femur fractures were observed.(32)

Drug and alcohol use in IPV-related injuries has been well documented.(4,33–35) In a study by O’Meara et. al., alcohol use in 87% of the cases that presented with facial fractures due to interpersonal violence.(4) Furthermore, Kyriacou et. al., examined partner’s drug and alcohol use prior to the occurrence of intimate partner violence and found that more than half of survivors indicated that their perpetrators were under the influence of alcohol and 15% were under the influence of drugs before the assault.(36)

This study has several strengths. First, we are reporting the findings to describe IPV-related fractures from several years of national data collected from trauma centers. Consequently, the results presented in this study are from one of the largest samples of confirmed IPV-related fractures. The examination of NTDB diagnosis codes allowed us to categorize the location of the fractures. In addition, the use of the NTDB provides a wide array of information not typically included in administrative datasets such as ISS, drug and alcohol use, and ICU length of stay.

The limitations of our study include the lack of detail about injuries including the use of weapons. Research has shown that abusers will use weapons to inflict additional injury on their victims.(37) Knowledge about the use of weapons would facilitate our understanding of the relationship between type of weapon and fracture location and severity. Another limitation is that we did not have access to information about the survivor’s history of IPV-related injuries. This information would allow for the temporal examination of injury severity and fracture location.

Further research is needed to compare IPV-related injuries to other injury mechanisms (e.g., fall, motor vehicle crash), particularly in elderly populations who may sustain similar injuries due to instability rather than abuse. Future studies in this area should explore ways to support and train the healthcare professionals treating IPV-related injuries. The use of injury type and location as a preliminary indicator of IPV may be an underutilized tool in referring reluctant patients for further IPV-related screening and support services.

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What is already known on this subject

- IPV-related fractures are commonly seen in the facial region.
- Identification of survivors of IPV remains a challenge among physicians.

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What this study adds

- Fracture patterns vary significantly across age groups with younger survivors more likely to sustain fractures to the face and older survivors more likely to sustain fractures to the ribs and extremities.
- Physicians may look beyond facial fractures as possible indicators of IPV.

Figure 1.
Location and number of IPV-related fractures.

Table 1.

Patient demographics and fracture location

	Total Population (N=1,352)
Age in years: mean (SD)	37.5 (12.6)
Female, N(%)	1,128 (83.4%)
Race, N(%)	
White	667 (49.3%)
Black	432 (32.0%)
Other	204 (15.1%)
Unknown	49 (3.6%)
Fracture location, N(%)	
Nose	284 (21.0%)
Skull	210 (15.5%)
Ribs	237 (17.5%)
Malar	156 (11.5%)
Orbital	176 (13.0%)
Mandible	160 (11.8%)
Face (including nose, mandible, malar, and orbital)	651 (48.2%)
Vertebrae	196 (14.5%)
Humerus	47 (3.5%)
Radius/Ulna	80 (5.9%)
Pelvis	47 (3.5%)
Femur	34 (2.5%)
Tib/Fib	74 (5.5%)
Ankle	57 (4.2%)
Upper Extremity	223 (16.5%)
Lower Extremity	177 (13.1%)
Hospital length of stay [days]: Mean (SD)	5.1 (6.9)
ICU length of stay [days]: Mean (SD)	4.9 (7.0)
ISS: Mean (SD)	10.4 (9.7)
Positive alcohol, N(%)	413 (30.6%)
Positive drugs, N(%)	305 (22.6%)
Insurance status, N(%)	
Medicare/Medicaid	487 (36.0%)
Private insurance	283 (20.9%)
Self-pay	310 (22.9%)
Unknown	137 (10.1%)
Other	135 (10.0%)
Expired, N(%)	26 (1.9%)

Table 2:

Patient demographics and fracture location stratified by age

	18–39 years (N=788)	40–59 years (N=507)	60+ years(N=57)	p-value
Female, N(%)	670 (85.0%)	416 (82.1%)	42 (73.7%)	0.05
Race, N(%)				
White	349 (44.3%)	279 (55.0%)	39 (68.4%)	<0.0001
Black	275 (34.9%)	147 (29.0%)	10 (17.5%)	0.005
Other	130 (16.5%)	66 (13.0%)	8 (14.1%)	0.23
Unknown	34 (4.3%)	15 (3.0%)	0 (0.0%)	0.15
Fracture Location, N(%)				
Nose	167 (21.2%)	110 (21.7%)	7 (12.3%)	0.25
Skull	115 (14.6%)	88 (17.4%)	7 (12.3%)	0.32
Ribs	109 (13.8%)	114 (22.5%)	14 (24.6%)	<0.0001
Malar	85 (10.8%)	64 (12.6%)	7 (12.3%)	0.59
Orbital	106 (13.5%)	68 (13.4%)	2 (3.5%)	0.09
Mandible	111 (14.1%)	48 (9.5%)	1 (1.8%)	0.002
Face (including nose, mandible, malar, and orbital)	406 (51.5%)	231 (45.6%)	14 (24.6%)	0.0001
Vertebrae	110 (14.0%)	78 (15.4%)	8 (14.0%)	0.77
Humerus	24 (3.1%)	18 (3.6%)	5 (8.7%)	0.07
Radius/Ulna	45 (5.7%)	29 (5.7%)	6 (10.5%)	0.32
Pelvis	32 (4.1%)	13 (2.6%)	2 (3.5%)	0.36
Femur	18 (2.3%)	8 (1.6%)	8 (14.0%)	<0.0001
Tibia/Fibula	38 (4.8%)	33 (6.5%)	3 (5.3%)	0.43
Ankle	32 (4.1%)	23 (4.5%)	2 (3.5%)	0.88
Upper Extremity	123 (15.6%)	90 (17.8%)	10 (17.5%)	0.58
Lower Extremity	96 (12.2%)	68 (13.4%)	13 (22.8%)	0.07
Hospital length of stay [days]: Mean (SD)	4.5 (6.3)	5.7 (7.8)	7.1 (6.2)	0.0006
ICU length of stay [days]: Mean (SD)	4.7 (7.1)	5.0 (7.1)	5.8 (4.0)	0.76
ISS: mean (SD)	9.8 (9.5)	11.1 (9.5)	12.3 (12.4)	0.02
Positive Alcohol, N(%)	208 (26.4%)	194 (38.3%)	11 (19.3%)	<0.0001
Positive Drugs, N(%)	184 (23.4%)	115 (22.7%)	6 (10.5%)	0.08
Insurance status, N(%)				
Medicare/Medicaid	269 (34.1%)	179 (35.3%)	39 (68.4%)	<0.0001
Private insurance	163 (20.7%)	112 (22.1%)	8 (14.0%)	0.35
Self-pay	197 (25.0%)	110 (21.7%)	3 (5.3%)	0.002
Unknown	88 (11.2%)	44 (8.7%)	5 (8.8%)	0.33
Other	71 (9.0%)	62 (12.2%)	2 (3.5%)	0.04
Expired, N(%)	12 (1.5%)	12 (2.4%)	2 (3.5%)	0.38

Table 3:

Concomitant fracture patterns

		Fracture Location #1						
		Skull	Face	Vertebrae	Ribs	Pelvis	Upper Extremity	Lower Extremity
Fracture Location #1	Skull	-	108 16.6%	19 9.7%	12 4.8%	4 8.5%	25 11.2%	8 4.5%
	Face	108 51.4%	-	38 19.4%	46 18.3%	5 10.6%	44 19.7%	18 10.2%
	Vertebrae	19 9.1%	38 5.8%	-	51 20.2%	21 44.7%	25 11.2%	9 5.1%
	Ribs	12 5.7%	46 7.1%	51 26.0%	-	8 17.0%	32 14.4%	13 7.3%
	Pelvis	4 1.9%	5 0.8%	21 10.7%	8 3.2%	-	11 4.9%	10 5.7%
	Upper Extremity	25 11.9%	44 6.8%	25 12.8%	32 12.7%	11 23.4%	-	17 9.6%
	Lower Extremity	8 3.8%	18 2.8%	9 4.6%	13 5.2%	10 21.3%	17 7.6%	-