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Geriatric Assault Victims Treated at U.S. Trauma Centers: Five-Year Analysis of the National Trauma Data Bank

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Abstract

Introduction—While geriatric trauma patients have begun to receive increased attention, little research has investigated assault-related injuries among older adults. Our goal was to describe characteristics, treatment, and outcomes of geriatric assault victims and compare them to geriatric victims of and younger accidental injury assault victims.

Patients and Methods—We conducted a retrospective analysis of the 2008–2012 National Trauma Data Bank. We identified cases of assault-related injury admitted to trauma centers in patients aged ≥60 using the variable “intent of injury.”

Results—3,564 victims of assault-related injury in patients aged ≥60 were identified and compared to 200,194 geriatric accident victims and 94,511 assault victims aged 18–59. Geriatric assault victims were more likely than geriatric accidental injury victims to be male (81% vs. 47%) and were younger than accidental injury victims (67±7 vs. 74±9 years). More geriatric assault victims tested positive for alcohol or drugs than geriatric accident victims (30% vs. 9%). Injuries for geriatric assault victims were more commonly on the face (30%) and head (27%) than for either comparison group. Traumatic brain injury (34%) and penetrating injury (32%) occurred commonly. The median injury severity score (ISS) for geriatric assault victims was 9, with 34%

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having severe trauma (ISS≥16). Median length of stay was 3 days, 39% required ICU care, and in-hospital mortality was 8%. Injury severity was greater in geriatric than younger adult assault victims, and, even when controlling for injury severity, in-hospital mortality, length of hospitalization, and need for ICU-level care were significantly higher in older adults.

Conclusions—Geriatric assault victims have characteristics and injury patterns that differ significantly from geriatric accidental injury victims. These victims also have more severe injuries, higher mortality, and poorer outcomes than younger victims. Additional research is necessary to improve identification of these victims and inform treatment strategies for this unique population.

Keywords

violence; assault; elder abuse; geriatric trauma

Introduction

The substantial growth in the population of older adults, who are living longer with more active lifestyles, is anticipated to lead to a rise in geriatric patients with serious traumatic injuries.[1–3] Geriatric trauma patients have begun to receive increased attention from clinicians and researchers, who have recognized this important demographic shift, identified that older adults differ in important ways from younger trauma victims, and developed new management strategies.[1, 4–9] Despite this progress, little research has investigated assault-related injuries among older adults. These injuries are common, accounting for at least 6.5% of trauma admissions in patients aged ≥60 years.[10] An estimated 33,026 geriatric patients were treated in US emergency departments for assault-related injuries in 2001,[11] which will likely increase as the population of older adults grows. Many of these injuries may be due to physical or sexual elder abuse, defined specifically as when the perpetrator is a person in a position of trust with the victim.[11–15] Geriatric assault and elder abuse are under-recognized by health care providers,[16–19] which can lead to inadequate treatment and unsafe discharge. Improved understanding of violence-related injuries in older adults is critically needed to support more effective therapeutic efforts.

While most geriatric assault injuries do not need extended treatment,[11] some are severe enough to require hospitalization and management on a trauma service. Little is known about the injury patterns, treatment, and outcomes for these severely-injured patients.[10, 20]. In addition, no national description of injury patterns in severe geriatric assault injury exists. Beginning to identify characteristics and injury patterns in geriatric assault may give health care providers tools to aid in detection and treatment. Our goal was to describe injury patterns, treatment, and outcomes of geriatric assault victims treated at US trauma centers and to compare them to both geriatric victims of unintentional injury and younger adult assault victims. We hypothesized that these patterns, treatment, and outcomes in geriatric assault victims would differ meaningfully from geriatric accidental injuries and younger victims of violence-related injury.

Patients and Methods

This study used data from the National Trauma Data Bank (NTDB) v7.2 from 2008–2012. The NTDB, which is sponsored by the American College of Surgeons, includes data from >700 participating US trauma centers.[21] The NTDB includes comprehensive information about injuries, pre-hospital and emergency care, in-patient treatment, and outcomes, and has been used successfully by other researchers to analyze assault injuries in other populations[22] and penetrating injuries in older adults.[23]

Cases of assault-related injury admitted to trauma centers were identified using the variable "injury intentionality," which is automatically generated within the NTDB from International Classification of Patients Diseases – Revision 9 (ICD-9) E-codes in the medical record using the Centers for Disease Control and Prevention matrix for injury intentionality.[24, 25] Options for intentionality are: assault, unintentional, self-inflicted, other, or undetermined. Assault injuries were those with an "intent of injury" coded as "assault" and accidental injuries as those coded as "unintentional." Patients with injury intentionality coded as self-inflicted, undetermined, or other were excluded from the current analysis. We included all trauma types in this analysis: blunt, penetrating, burn and other/unspecified. Trauma type for each patient is automatically generated based on the mechanism of injury using the primary ICD-9 E-code from the medical record.[25]

Older adults were defined as patients aged ≥60. Though no consensus exists in the epidemiologic literature about the appropriate age cut-off for older adulthood, elder abuse and other violence-related statutes in most states have been written to protect adults aged ≥60. In addition, age ≥60 is the criterion used in the Older Americans' Act for eligibility for additional services and protections.[26] Also, much of the limited literature on this topic uses this cut-off.[10, 11] Notably, patients aged ≥90 are included in NTDB without age further specified. We have included all of these patients in the analysis.

We examined injury data including: total number and type of injuries, anatomic location(s) of injury(ies), and the Injury Severity Score (ISS). Injuries were identified using ICD-9 code. Given its clinical importance, we closely examined traumatic brain injury (TBI), defined by ICD-9 codes 850–854.1, as has been done by previous researchers.[27] We evaluated patient demographic characteristics. For analysis, we converted age into categorical strata: 60–64, 65–74, 75–84, and 85+. We also examined the presence of as many as 20 co-morbidities, which are coded by registrars from the medical records. Co-morbidities included, for example, bleeding disorder, congestive heart failure, CVA/residual neurological deficit, diabetes mellitus, disseminated cancer, and hypertension requiring medication. To characterize the population, we dichotomized this variable into patients with and without ≥3 co-morbidities. Functionally dependent health status is included as a co-morbidity within NTDB, but we also reported on it separately given its importance for the geriatric population. Because dementia was only evaluated within the NTDB beginning in 2012, we did not include it in this analysis. We evaluated alcohol use by trauma victims, which is assessed in NTDB via formal testing rather than clinician suspicion. Rather than using a threshold value to determine potential intoxication, we report here on the presence of any alcohol when tested. We also evaluated drug use, which is also assessed in NTDB via

formal testing rather than clinician suspicion and excludes drugs used for medical therapy. Outcomes of interest included in-hospital mortality, length of hospital stay, treatment in an intensive care unit, and surgical procedures performed.

Adults age 18 years and older (n=743,384) were eligible for inclusion in the current analysis. Adults with isolated hip fractures were excluded (n=26,576) to avoid bias, as these patients are included in NTDB for some, but not all, participating hospitals. Because the focus of this study was to compare intentional and unintentional injuries, adults with self-inflicted (n=14,443), other (n=1,780), or undetermined/missing (n=6,505) injuries were excluded. This analysis included 203,758 adults age ≥60 and 490,322 adults age 18–59 with an intentional or unintentional injury.

Data analysis was conducted using Stata, version 12 (StataCorp, College Station, TX). Results are presented as frequencies with proportions, mean with standard deviation (SD), or median with interquartile range (IQR). Comparisons between subgroups (e.g., older adult assault vs. older adult unintentional injury) were performed using Chi-square test, t-test, and Kruskal-Wallis test, as appropriate. Logistic regression was used to evaluate the independent association between older adult vs. younger adult assault and outcomes of interest (e.g., in-hospital mortality) adjusting for injury severity. All P values are two-tailed, with $P<0.05$ considered statistically significant.

This study was determined to be exempt from review by the Weill Cornell Medical College Institutional Review Board.

Results

3,564 victims of assault-related injury aged ≥60 were identified. The characteristics of these victims are described in Table 1 in comparison with geriatric victims of unintentional injury (n=200,194) and assault victims aged 18–59 (n=94,511). Geriatric assault victims were more likely than geriatric unintentional injury victims to be male and were typically younger than unintentional injury victims. Significantly more geriatric assault victims tested positive for alcohol or drugs than geriatric unintentional injury victims. Among geriatric assault victims, 11% had ≥3 co-morbidities and only 0.3% had functionally dependent health status, a significantly lower percentage in both as compared to geriatric unintentional injury victims. In-hospital mortality for geriatric assault victims was similar to unintentional injury victims, but assault patients more commonly required intensive care unit-level treatment than unintentional injury patients and were more likely to need laparotomy, thoracotomy, or craniotomy. Injuries for geriatric assault victims were most commonly on the face and head than for geriatric unintentional injury victims, and more than half of the assault victims had injuries on ≥3 body regions. Notably, geriatric assault victims were more than 6 times more likely to have neck injuries than older adult unintentional injury sufferers. Geriatric assault victims were also more than twice as likely to have open wounds.

Injury severity was greater in geriatric assault victims than younger adult assault victims. Even when controlling for injury severity, in-hospital mortality (unadjusted OR 1.57, 95% CI 1.39-1.78 adjusted OR 1.40, 95% CI 1.21–1.62), length of hospitalization (unadjusted β

2.08, 95% CI 1.79–2.39; adjusted β 1.58, 95% CI 1.29–1.87), and need for ICU-level care (unadjusted OR 1.65, 95% CI 1.54–1.76; adjusted OR 1.41, 95% CI 1.30–1.52) were significantly higher in older adults. Geriatric assault victims were less likely than younger victims to receive laparotomy or thoracotomy but trended towards more commonly receiving craniotomy. Geriatric assault victims were less likely than younger victims to have penetrating trauma but were more likely to have traumatic brain injury.

Characteristics of older adult assault victims by age strata are presented in Table 2. The total number of assault victims trended down significantly with higher age, and the percentage of male victims also trended down. Positive tests for alcohol and/or drug use decreased with age, however 25% of patients aged ≥85 used alcohol and/or drugs. Older assault victims with traumatic brain injury trended up with age, but patients aged ≥85 were slightly less likely than those aged 75–84. Fewer patients in the older categories received craniotomies. Notably, 2% of geriatric assault patients aged ≥85 received a laparotomy. In-hospital mortality increased with age.

A comparison of blunt vs. penetrating injuries among geriatric assault victims is presented in Table 3. Penetrating injuries carried a higher in-hospital mortality than blunt injuries. Blunt trauma victims were much more commonly injured in the head and face compared with victims of penetrating trauma, while penetrating trauma victims were much more commonly injured in other areas, including the neck, thorax, and abdomen. As might be expected given these patterns, victims of blunt trauma much more commonly had traumatic brain injury and required craniotomy, while penetrating trauma patients much more commonly required laparotomy or thoracotomy.

In Table 4, we describe characteristics of geriatric victims suffering traumatic brain injury. These patients were more likely to have suffered severe trauma and to have ≥3 body regions injured than non-TBI patients. They had a longer median hospital length of stay and were much more likely to require ICU-level care but did not have a higher in-hospital mortality.

Discussion

To our knowledge, this is the first study to describe in detail a national sample of severe geriatric assault injuries and compare them to unintentional geriatric injuries and younger adult assault victims. These findings may begin to improve understanding of the most seriously injured assault survivors.

Geriatric assault victims were much more commonly men and typically younger than geriatric unintentional injury victims. Previous research from the Centers of Disease Control has found similar characteristics among geriatric assault patients treated in Emergency Departments.[11] This finding of increased frequency among males is also consistent with the general pattern of findings for assault victimization by gender. Very few assault victims were documented as having functionally dependent health status or ≥3 co-morbidities. This suggests that active, independent older adults may be more likely or able to be involved in interactions or exchanges that results assault-related injuries severe enough to warrant hospitalization. Geriatric assault victims had comparable in-hospital mortality to accident

victims and more commonly required ICU care or major surgery. This underscores the potential for violence to inflict very severe injuries requiring significant care.

We found that injury severity was greater in geriatric assault victims than younger adult assault victims. Also, in-hospital mortality, length of hospitalization, and need for ICU-level care were significantly higher in older adults, even after controlling for injury severity. Our findings are consistent with Hadjizacharia and colleagues, who found that blunt trauma assault victims aged ≥55 were more severely injured than younger adults.[27] Also, even after correction for injury severity, victims aged ≥55 were found to have an increased length of stay in both the ICU and hospital and were more likely to die from their injuries.[27] Our findings confirm that assault, similar to other traumatic injuries and acute illnesses, has poorer outcomes in older adults, who have more co-morbidities and decreased physiologic reserve compared with younger adults. Mortality and length of hospital stay among geriatric assault victims also increased with increasing age. We found that geriatric assault victims were less likely than younger victims to receive laparotomy or thoracotomy, suggesting that surgeons may be more cautious about operating on older adult trauma patients, which has been described previously.[28] Older adults trended towards more commonly receiving craniotomies in our analysis, however. Also, Hadjizacharia and colleagues found no difference in rates of any of these surgeries between older and younger assault victims, suggesting that additional research is needed.[27]

Alcohol and/or drug use was commonly reported in older adult assault victims. This is consistent with research in younger adults, which has shown that as many as 70% of assault victims seeking medical treatment screen positive for alcohol or drug use.[29, 30] Studies have shown that substance use is more prevalent among crime victims compared to non-victims and heightens risk for further victimization.[30–32] In our study, alcohol and/or drug use was significantly more common in older victims of assault injury than accidental injury. This finding suggests that when older adults present to the hospital intoxicated and report accidental injury, providers should maintain a high index of suspicion for assault, similar to younger trauma victims. Of note, even the oldest old assault victims often were found to have used alcohol and/or drugs, underscoring that suspicion for their use must be maintained irrespective of age.

The majority of assaults on geriatric patients caused blunt traumatic injuries. This may reflect a preference of assailants for use of fists and feet. Previous researchers examining violence against women by men have hypothesized that blunt weapons are commonly chosen because the assailant believes that he is physically stronger and does not need a more harmful weapon.[33, 34] A similar phenomenon may contribute to the epidemiology of assault of older adults. Alternatively, in spontaneous altercations that escalates from arguments, fists and feet may be weapons the weapons most easily available. While blunt traumatic injuries were most common, the prevalence of penetrating trauma was also significant. This undermines the common perception that geriatric traumatic injuries are primarily blunt trauma.[23] Also, however, it may suggest that many blunt assaults against older adults are not identified by health care providers, who presume them to be unintentional injuries. In our study, penetrating trauma had a higher in-hospital mortality. This is consistent with previous

research in younger assault victims, which found that penetrating trauma victims more commonly required hospitalization for their injuries[35] and had higher mortality.[36]

Geriatric assault victims in our study most commonly had injuries to the head and face. Of particular note, facial injuries occurred in assault victims with 2.5 times the frequency of that in geriatric accident victims. Previous research has described in detail patterns of facial trauma in older adults, which are commonly fractures of the midface or nasal bone,[37–41] but these studies have included few assault victims. The significance of facial injuries in assault is well-established in younger assault victims, with 62%-83% of victims presenting to the Emergency Department having facial injuries.[34, 35, 42] The face is a common site of injury, likely because it is exposed and vulnerable to an assailant.[33, 34, 43] In addition, when desiring to incapacitate, badly hurt, or humiliate a victim, the head and face are attractive targets.[33, 43] Researchers have suggested that these injuries may be used to identify victims of violence or raise suspicion of violence-related injury[42, 44–47] and have even begun to identify patterns among maxillofacial injuries that may be suggestive of assault rather than accident.[48] In a multi-center study, most common facial fractures after assault were of the mandible, zygoma, and orbit, with these prominent areas more likely injured given that a fist to the face is the most common mechanism of injury.[43] Peri-orbital and peri-oral lacerations were more commonly due to assault while lacerations affecting the forehead were more common after falls.[48] In other studies, left-sided facial injuries are more frequent after assault than right-sided, likely because most assailants are right-handed.[34, 49, 50] Future research is needed to better define these patterns in geriatric assault patients to ascertain more conclusively how intentional and unintentional injuries may be effectively and accurately distinguished. In our study, neck injuries, while uncommon, were more than 6 times more frequent in assault-related injury than after an accident. This suggests that geriatric trauma patients with facial or neck injuries should likely be screened for assault. Traumatic brain injury occurred in a significant percentage of geriatric assault victims, particularly in the oldest age categories. In previous research, as many as 70% of blunt assault victims aged ≥55 suffered from TBI.[27] In our study, patients with TBI had significantly greater length of hospitalization and need for ICU care than those not suffering this injury. This emphasizes the importance in older assault victims of early identification, appropriate field triage, and aggressive management of TBI. Previous studies have shown that mortality after TBI in older adults is more than 38% and increases with age.[51–53] This injury is particularly dangerous for older adults on anti-coagulants including warfarin[54], anti-platelet agents including clopidogrel.[55], or the increasingly popular factor 10A inhibitors. Older adults with TBI have higher mortality and morbidity when treated at non-trauma centers.[56] Despite this, EMS more commonly transport older adults with TBI to non-trauma centers than younger adults, and older adults are less likely admitted.[56] To improve this, a new neurologic scale to optimize EMS detection of TBI in older adults that require transport to a trauma center has been proposed.[57] Given its frequency in assault-related injuries and its association with poor outcomes, EMS, ED providers, and trauma specialists should maintain a high index of suspicion for its presence, screen all geriatric assault victims for potential TBI, and evaluate thoroughly if any possibility exists.

Although not highlighted in our results, some of the assault victims in our study may be suffering from severe physical and/or sexual abuse rather than from violence by a stranger.

Using law enforcement data in Michigan, researchers found that, among victims of violent crime aged ≥65, 50% were assaulted by a family member, most commonly by an adult child (22.0%) or an intimate partner (12.9%).[15] Despite its frequency, elder mistreatment, even severe physical and sexual abuse, often goes undiscovered, with as few as 1 in 24 cases of elder abuse reported to the authorities.[12, 58] This may contribute to our finding that older adults with multiple co-morbidities and dementing illness were uncommonly hospitalized as assault victims. It is likely that many victims of severe elder abuse, who are commonly unable or unwilling to report the true cause of their injuries, were presumed by the treating clinicians to be victims of accidental injury. In other cases, which would not be captured in the NTDB, victims of elder abuse may never have reached treatment.

Unfortunately, research suggests that, even in trauma service admissions where elder abuse has been established, the abuse is not reported to the authorities in two-thirds of cases.[20] This is likely due to a poor understanding of elder abuse among trauma service clinical staff and inadequate training regarding the proper procedures for reporting suspected incidents.[20] Very little research has examined severe traumatic injuries in victims of physical elder abuse. Friedman and colleagues, in a case-control study comparing victims of severe physical elder abuse to other trauma victims, found that elder abuse victims had more severe injuries, were more commonly female, were more likely to abuse drugs or alcohol, and more frequently had dementia.[10] Future research is necessary to improve understanding of injury patterns that differentiate physical and sexual abuse from stranger assault and from accidental injury. Also, additional training in elder abuse is necessary for trauma specialists to improve identification and design interventions for these vulnerable older adults at very high risk for re-victimization.

Limitations

This study has several limitations. By using NTDB, we only examined injuries severe enough to require hospitalization and did not include those that resulted in fatalities in the field. We were unable to evaluate less severe injuries that were treated and released from Emergency Departments or outpatient clinics or that never received medical attention. The NTDB, which is based on voluntary submission of information by institutions with trauma registrars, cannot be used to generate population-based findings, and the quality and completeness of the data varies between institutions. In addition, admissions for isolated hip fractures, patients who are dead-on-arrival, and hospital transfers are included for some, but not all, participating hospitals. To avoid introducing potential bias, we excluded any isolated hip fractures. We were only able to include cases where the care team identified and documented that the injury(ies) were due to assault, so we likely missed cases where the injury was incorrectly presumed to be unintentional because the victim was unwilling or unable to report the assault. In fact, Friedman et al found, in a 1-year follow-up to a case-control study of severe physical elder abuse, that 3.3% of their control subjects, initially believed to be victims of accidental injury, had been substantiated by Adult Protective Services as victims of abuse.[20] As NTDB does not track the identity of the perpetrator, their relationship to the victim, or the dynamics that precipitated the violence, we were unable to distinguish between physical elder abuse and assault by a stranger, phenomena which may have important differences. When describing body regions injured, we did not distinguish

between major and minor injuries. Therefore, injuries in each region include a broad range of severity.

Conclusions

Older adults who are severely assaulted are much more commonly men and typically younger than geriatric victims of accidental trauma. They frequently have recently used alcohol or drugs. Typical injury patterns include facial and head injuries, and TBI is common. Penetrating injury also occurs frequently. Geriatric assault victims admitted to trauma centers have more severe injuries, higher mortality, and poorer outcomes than younger adult victims. Future directions include additional research to improve understanding of injury patterns and circumstances surrounding severe geriatric assault to aid in distinguishing between violence and unintentional injury. Recognition is critical to optimize outcomes and prevent re-victimization. In addition, trauma specialists may play an increased role in identifying, managing, and reporting severe physical and/or sexual elder abuse, an under-appreciated type of geriatric assault. Research focusing on differences between geriatric assault victims and younger assault victims is also necessary to inform treatment strategies for this unique population.

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References

1. Bonne S, Schuerer DJ. Trauma in the older adult: epidemiology and evolving geriatric trauma principles. Clin Geriatr Med. 2013; 29(1):137–150. [PubMed: 23177604]
2. Hashmi A, Ibrahim-Zada I, Rhee P, Aziz H, Fain MJ, Friese RS, Joseph B. Predictors of mortality in geriatric trauma patients: a systematic review and meta-analysis. J Trauma Acute Care Surg. 2014; 76(3):894–901. [PubMed: 24553567]
3. Jacobs DG. Special considerations in geriatric injury. Curr Opin Crit Care. 2003; 9(6):535–539. [PubMed: 14639075]
4. Calland JF, Ingraham AM, Martin N, Marshall GT, Schulman CI, Stapleton T, Stapleton T, Barraco RD. Eastern Association for the Surgery of Trauma. Evaluation and management of geriatric trauma: an Eastern Association for the Surgery of Trauma practice management guideline. J Trauma Acute Care Surg. 2012; 73(5 Suppl 4):S345–S350. [PubMed: 23114492]
5. Demetriades D, Sava J, Alo K, Newton E, Velmahos GC, Murray JA, Belzberg H, Asensio JA, Berne TV. Old age as a criterion for trauma team activation. J Trauma. 2001; 51(4):754–756. [PubMed: 11586171]
6. Ichwan B, Darbha S, Shah MN, Thompson L, Evans DC, Boulger CT, Caterino JM. Geriatric-specific triage criteria are more sensitive than standard adult criteria in identifying need for trauma center care in injured older adults. Ann Emerg Med. 2015; 65(1):92–100. [PubMed: 24908590]
7. Pellicane JV, Byrne K, DeMaria EJ. Preventable complications and death from multiple organ failure among geriatric trauma victims. J Trauma. 1992; 33(3):440–444. [PubMed: 1404516]
8. Perdue PW, Watts DD, Kaufmann CR, Trask AL. Differences in mortality between elderly and younger adult trauma patients: geriatric status increases risk of delayed death. J Trauma. 1998; 45(4):805–810. [PubMed: 9783625]

9. Scalea TM, Simon HM, Duncan AO, Atweh NA, Sclafani SJ, Phillips TF, Shaftan GW. Geriatric blunt multiple trauma: improved survival with early invasive monitoring. J Trauma. 1990; 30(2): 129–134. [PubMed: 2304107]
10. Friedman LS, Avila S, Tanouye K, Joseph K. A case-control study of severe physical abuse of older adults. J Am Geriatr Soc. 2011; 59(3):417–422. [PubMed: 21391932]
11. Public health and aging: nonfatal physical assault-related injuries among persons aged >60 years treated in hospital emergency departments--United States, 2001. MMWR Morb Mortal Wkly Rep. 2003; 52(34):812–816. [PubMed: 12944878]
12. Under the Radar: New York State Elder Abuse Prevalence Study: Self-Reported Prevalence and Documented Case Surveys 2012. http://ocfs.ny.gov/main/reports/Under%20the%20Radar%2005%2012%2011%20final%20report.pdf
13. Acierno R, Hernandez MA, Amstadter AB, Resnick HS, Steve K, Muzzy W, Kilpatrick DG. Prevalence and correlates of emotional, physical, sexual, and financial abuse and potential neglect in the United States: the National Elder Mistreatment Study. Am J Public Health. 2010; 100(2): 292–297. [PubMed: 20019303]
14. Lachs MS, Pillemer KA. Elder Abuse. N Engl J Med. 2015; 373(20):1947–1956. [PubMed: 26559573]
15. US Department of Justice Bureau of Justic Statistics. [Published July 2012. Accessed December 4, 2015] Smith E. Violent Crime against the Elderly Reported by Law Enforcement in Michigan, 2005–2009. http://www.bjs.gov/content/pub/pdf/vcerlem0509.pdf
16. Collins KA. Elder maltreatment: a review. Arch Pathol Lab Med. 2006; 130(9):1290–1296. [PubMed: 16948513]
17. Collins KA, Presnell SE. Elder neglect and the pathophysiology of aging. Am J Forensic Med Pathol. 2007; 28(2):157–162. [PubMed: 17525570]
18. Murphy K, Waa S, Jaffer H, Sauter A, Chan A. A literature review of findings in physical elder abuse. Can Assoc Radiol J. 2013; 64(1):10–14. [PubMed: 23351969]
19. Rosenblatt DE, Cho KH, Durance PW. Reporting mistreatment of older adults: the role of physicians. J Am Geriatr Soc. 1996; 44(1):65–70. [PubMed: 8537593]
20. Friedman LS, Avila S, Shah M, Tanouye K, Joseph K. A description of cases of severe physical abuse in the elderly and 1-year mortality. J Elder Abuse Negl. 2014; 26(1):1–11. [PubMed: 24313794]
21. American College of Surgeons. [Accessed December 4, 2015] National Trauma Data Bank. https://www.facs.org/quality%20programs/trauma/ntdb
22. Plurad DS, Talving P, Lam L, Inaba K, Green D, Demetriades D. Workplace assault is independently associated with mortality: a national trauma data bank analysis. J Occup Environ Med. 2011; 53(8):879–883. [PubMed: 21775899]
23. Lustenberger T, Inaba K, Schnuriger B, Barmparas G, Eberle BM, Lam L, et al. Gunshot injuries in the elderly: patterns outcomes. A national trauma databank analysis. World J Surg. 2011; 35(3): 528–534. [PubMed: 21203760]
24. Centers for Disease Control and Prevention. Recommended framework for presenting injury mortality data. MMWR Recomm Rep. 1997; 46(RR-14):1–30.
25. National Trauma Data Bank. National Trauma Data Standard Data Dictionary: 2010 Admissions. [Revised November 2009] http://www.ntdsdictionary.org/dataElements/documents/NationalTraumaDataStandardDictionary2010.pdf
26. National Health Policy Forum. The Basics: Older Americans Act of 1965: Programs and Funding. 2012. http://www.nhpf.org/library/the-basics/Basics_OlderAmericansAct_02-23-12.pdf
27. Hadjizacharia P, Plurad DS, Green DJ, DuBose J, Benfield R, Shiflett A, et al. Outcomes of blunt assault at a level I trauma center. J Trauma. 2009; 66(4):1202–1206. [PubMed: 19359938]
28. Hildebrand F, Pape HC, Horst K, Andruszkow H, Kobbe P, Simon TP, et al. Impact of age on the clinical outcomes of major trauma. Eur J Trauma Emerg Surg. 2016; 42:317–332. [PubMed: 26253883]
29. Buss TF, Abdu R, Walker JR. Alcohol, drugs, and urban violence in a small city trauma center. J Subst Abuse Treat. 1995; 12(2):75–83. [PubMed: 7623393]

30. Vaughn MG, Fu Q, DeLisi M, Beaver KM, Perron BE, Howard MO. Criminal victimization and comorbid substance use and psychiatric disorders in the United States: results from the NESARC. Ann Epidemiol. 2010; 20(4):281–288. [PubMed: 20097578]
31. Kilpatrick DG, Acierno R. Mental health needs of crime victims: epidemiology and outcomes. J Trauma Stress. 2003; 16(2):119–132. [PubMed: 12699200]
32. Niemcryk SJ, Hines R, Brawley M, Yount SI. Intentional and unintentional injury in the State of Nevada: 1989–1992. Am J Prev Med. 1998; 14(1):43–53. [PubMed: 9476835]
33. Ferreira MC, Batista AM, Ferreira Fde O, Ramos-Jorge ML, Marques LS. Pattern of oral-maxillofacial trauma stemming from interpersonal physical violence and determinant factors. Dent Traumatol. 2014; 30(1):15–21. [PubMed: 23675634]
34. Shepherd JP, Shapland M, Pearce NX, Scully C. Pattern, severity and aetiology of injuries in victims of assault. J R Soc Med. 1990; 83(2):75–78. [PubMed: 2319550]
35. Brink O, Vesterby A, Jensen J. Pattern of injuries due to interpersonal violence. Injury. 1998; 29(9):705–709. [PubMed: 10211203]
36. Ottochian M, Salim A, DuBose J, Teixeira PG, Chan LS, Margulies DR. Does age matter? The relationship between age and mortality in penetrating trauma. Injury. 2009; 40(4):354–357. [PubMed: 19232586]
37. Atisha DM, Burr T, Allori AC, Puscas L, Erdmann D, Marcus JR. Facial fractures in the aging population. Plast Reconstr Surg. 2016; 137:587–593. [PubMed: 26818295]
38. Berg BI, Juergens P, Soerensen Y, Savic M, Zeilhofer HF, Schwenzer-Zimmerer K. Traumatology of the facial skeleton in octogenarian patients: a retrospective analysis of 96 cases. J Craniomaxillofac Surg. 2014; 42:870–873. [PubMed: 24513308]
39. Toivari M, Helenius M, Suominen AL, Lindqvist C, Thoren H. Etiology of facial fractures in elderly Finns during 2006–2007. Oral Surg Oral Med Oral Pathol Oral Radiol. 2014; 118:539–545. [PubMed: 25442489]
40. Yamamoto K, Matsusue Y, Murakami K, Horita S, Sugiura T, Kirita T. Maxillofacial fractures in older patients. J Oral Maxillofac Surg. 2011; 69:2204–2210. [PubMed: 21683497]
41. Zelken JA, Khalifian S, Mundinger GS, Ha JS, Manson PN, Rodriguez ED, et al. Defining predictable patterns of craniomaxillofacial injury in the elderly: analysis of 1,047 patients. J Oral Maxillofac Surg. 2014; 72:352–361. [PubMed: 24139294]
42. Brink O. When violence strikes the head, neck, and face. J Trauma. 2009; 67(1):147–151. [PubMed: 19590325]
43. Boffano P, Roccia F, Zavattero E, Dediol E, Uglesic V, Kovacic Z, Vesnaver A, Konstantinovic VS, Petrovic M, Stephens J, et al. Assault-related maxillofacial injuries: the results from the European Maxillofacial Trauma (EURMAT) multicenter and prospective collaboration. Oral Surg Oral Med Oral Pathol Oral Radiol. 2015; 119(4):385–391. [PubMed: 25640305]
44. Perciaccante VJ, Ochs HA, Dodson TB. Head, neck, and facial injuries as markers of domestic violence in women. J Oral Maxillofac Surg. 1999; 57(7):760–762. [PubMed: 10416621]
45. Ochs HA, Neuenschwander MC, Dodson TB. Are head, neck and facial injuries markers of domestic violence? J Am Dent Assoc. 1996; 127(6):757–761. [PubMed: 8708277]
46. Muelleman RL, Lenaghan PA, Pakieser RA. Battered women: injury locations and types. Ann Emerg Med. 1996; 28(5):486–492. [PubMed: 8909268]
47. Allen T, Novak SA, Bench LL. Patterns of injuries: accident or abuse. Violence Against Women. 2007; 13(8):802–816. [PubMed: 17699112]
48. Lo S, Aslam N. Mechanisms and pattern of facial lacerations in the Accident Department. Int J Clin Pract. 2005; 59(3):333–335. [PubMed: 15857332]
49. Shepherd JP, Al-Kotany MY, Subadan C, Scully C. Assault and facial soft tissue injuries. Br J Plast Surg. 1987; 40(6):614–619. [PubMed: 3690094]
50. Le BT, Dierks EJ, Ueeck BA, Homer LD, Potter BF. Maxillofacial injuries associated with domestic violence. J Oral Maxillofac Surg. 2001; 59(11):1277–1283. [PubMed: 11688025]
51. McIntyre A, Mehta S, Aubut J, Dijkers M, Teasell RW. Mortality among older adults after a traumatic brain injury: a meta-analysis. Brain Inj. 2013; 27(1):31–40. [PubMed: 23163240]

52. Depreitere B, Meyfroidt G, Roosen G, Ceuppens J, Grandas FG. Traumatic brain injury in the elderly: a significant phenomenon. Acta Neurochir Suppl. 2012; 114:289–294. [PubMed: 22327710]

53. Mak CH, Wong SK, Wong GK, et al. Traumatic brain injury in the elderly: Is it as bad as we think? Curr Transl Geriatr Exp Gerontol Rep. 2012; 1:171–178. [PubMed: 24014175]

54. Franko J, Kish KJ, O'Connell BG, Subramanian S, Yuschak JV. Advanced age and preinjury warfarin anticoagulation increase the risk of mortality after head trauma. J Trauma. 2006; 61(1): 107–110. [PubMed: 16832256]

55. Wong DK, Lurie F, Wong LL. The effects of clopidogrel on elderly traumatic brain injured patients. J Trauma. 2008; 65(6):1303–1308. [PubMed: 19077618]

56. Sugerman DE, Xu L, Pearson WS, Faul M. Patients with severe traumatic brain injury transferred to a Level I or II trauma center: United States, 2007 to 2009. J Trauma Acute Care Surg. 2012; 73(6):1491–1499. [PubMed: 23188242]

57. Wasserman EB, Shah MN, Jones CM, Cushman JT, Caterino JM, Bazarian JJ, Gillespie SM, Cheng JD, Dozier A. Identification of a Neurologic Scale That Optimizes EMS Detection of Older Adult Traumatic Brain Injury Patients Who Require Transport to a Trauma Center. Prehosp Emerg Care. 2015; 19(2):202–212. [PubMed: 25290953]

58. Pillemer K, Finkelhor D. The prevalence of elder abuse: a random sample survey. Gerontologist. 1988; 28(1):51–57. [PubMed: 3342992]

Table 1

Characteristics and Outcomes of Older Adult Assault Victims (aged ≥60) Treated at U.S. Trauma Centers from 2008–2012 in Comparison to Older Adult Unintentional Injury Victims and Younger Assault Victims (aged 18–59)

	Older Adult Assault (n=3,564)	**Older Adult Unintentional Injury (n=200,194)**	***P* value**	**Younger Adult Assault (n=94,511)**	***P* value**
Male gender	81%	47%	<0.001	88%	<0.001
Age (years), mean ± SD	67 ± 7	74 ± 9	0.002	33 ± 11	--
Race			<0.001		<0.001
White	52%	83%		35%	
Black or African	30%	6%		41%	
American					
Other race	18%	11%		24%	
Drug and/or alcohol use	30%	9%	<0.001	42%	<0.001
Any alcohol use	21%	5%	<0.001	31%	<0.001
Any drug use	13%	5%	<0.001	21%	<0.001
Functionally dependent	0.3%	2%	<0.001	0.1%	0.02
health status					
≥3 concomitant medical Conditions	11%	18%	<0.001	2%	<0.001
Injury severity score (ISS), median (IQR)	9 (4 – 16)	9 (4 – 16)	0.51	6 (2 – 13)	<0.001
Severe trauma (ISS≥16)	34%	29%	<0.001	25%	<0.001
In-hospital mortality	8%	7%	0.33	5%	<0.001
Hospital length of stay (days), median (IQR)	3 (2 – 8)	4 (3 – 8)	<0.001	2 (1 – 5)	<0.001
ICU stay	39%	34%	<0.001	28%	<0.001
ICU length of stay (days), median (IQR)	3 (2 – 7)	3 (2 – 6)	0.09	2 (1 – 5)	<0.001
Number of injuries, median (IQR)	3 (2 – 5)	2 (1 – 4)	<0.001	3 (2 – 4)	<0.001
Surgeries performed					
Laparotomy	6%	1%	<0.001	10%	<0.001

	Older Adult Assault (n=3,564)	Older Adult Unintentional Injury (n=200,194)	*P* value	Younger Adult Assault (n=94,511)	*P* value
Thoracotomy	1%	0.3%	<0.001	2%	0.01
Craniotomy	0.6%	0.2%	<0.001	0.4%	0.09
Type of injury			<0.001		<0.001
Blunt	51%	96%		36%	
Burn	0.3%	1%		0.3%	
Penetrating	32%	0.7%		56%	
Other/unspecified	15%	2%		8%	
Traumatic brain injury	34%	34%	0.57	20%	<0.001
Body region(s) injured			<0.001		<0.001
Head	27%	25%		19%	
Face	30%	12%		24%	
Neck	2%	0.3%		2%	
Thorax	11%	12%		14%	
Abdomen	7%	3%		13%	
Spine	3%	11%		2%	
Upper extremity	11%	14%		11%	
Lower extremity	6%	19%		9%	
Unspecified	3%	3%		3%	
≥3 body regions injured	60%	46%	<0.001	53%	<0.001
Trauma-associated diagnosis(es)			<0.001		<0.001
Fractures	37%	53%		30%	
Internal organ	28%	26%		28%	
Open wounds	28%	13%		34%	

SD denotes standard deviation; IQR, interquartile range; ICU, intensive care unit.

Table 2

Characteristics and Outcomes of Older Adult Assault Victims (aged ≥60) Treated at U.S. Trauma Centers from 2008–2012, Stratified by Age Category

	Age 60–64 (n=1,671)	**Age 65–74 (n=1,185)**	**Age 75–84 (n=458)**	**Age 85+ (n=250)**	***P* value**
Male gender	88%	80%	66%	63%	<0.001
Age (years), mean ± SD	62 ± 1	68 ± 3	79 ± 3	87 ±1	--
Race					<0.001
White	47%	55%	64%	48%	
Black or African	35%	29%	20%	26%	
American					
Other race	18%	16%	16%	25%	
Drug and/or alcohol use	37%	26%	12%	25%	<0.001
Any alcohol use	28%	18%	9%	17%	<0.001
Any drug use	17%	11%	5%	13%	<0.001
Functionally dependent health status	0.2%	0.5%	0.3%	0.7%	0.58
≥3 concomitant medical conditions	10%	13%	12%	8%	0.03
Injury severity score (ISS), median (IQR)	9 (4 – 16)	9 (4 – 17)	9 (4 – 17)	9 (4 – 16)	0.35
Severe trauma (ISS≥16)	33%	35%	35%	30%	0.27
In-hospital mortality	6%	7%	12%	15%	<0.001
Hospital length of stay (days), median (IQR)	3 (2 – 7)	4 (2 – 8)	4 (2 – 8)	4 (1 – 7)	<0.001
ICU stay	37%	42%	40%	39%	0.03
ICU length of stay (days), median (IQR)	3 (2 – 7)	3 (2 – 8)	3 (2 – 7)	3 (1 – 8)	0.59
Number of injuries, median (IQR)	3 (2 – 5)	3 (2 – 5)	3 (2 – 5)	3 (2 – 5)	0.31
Surgeries performed					
Laparotomy	6%	7%	2%	9%	0.001
Thoracotomy	1%	2%	0.5%	2%	0.07
Craniotomy	1%	0.4%	0.2%	0%	0.11

	Age 60–64 (n=1,671)	Age 65–74 (n=1,185)	Age 75–84 (n=458)	Age 85+ (n=250)	*P* value
Type of injury					<0.001
Blunt	54%	51%	51%	41%	
Burn	0.3%	0.5%	0.2%	0%	
Penetrating	34%	34%	28%	22%	
Other/unspecified	13%	15%	21%	37%	
Traumatic brain injury	32%	35%	40%	37%	0.008
Body region(s) injured					<0.001
Head	26%	27%	30%	26%	
Face	33%	29%	27%	24%	
Neck	2%	2%	2%	2%	
Thorax	11%	11%	9%	12%	
Abdomen	7%	8%	6%	10%	
Spine	2%	3%	4%	3%	
Upper extremity	10%	10%	12%	15%	
Lower extremity	6%	7%	6%	5%	
Unspecified	3%	3%	3%	2%	
≥3 body regions injured	59%	59%	59%	67%	0.19
Trauma-associated diagnosis(es)					0.002
Fractures	39%	37%	36%	31%	
Internal organ	27%	29%	29%	31%	
Open wounds	28%	28%	29%	31%	

SD denotes standard deviation; IQR, interquartile range; ICU, intensive care unit.

Table 3

Characteristics and Outcomes of Older Adult Assault Victims (aged ≥60) with Blunt vs. Penetrating Injuries Treated at U.S. Trauma Centers from 2008–2012

	Blunt Injuries (n=1,832)	Penetrating Injuries (n=1,180)	*P* value
Male gender	83%	84%	0.70
Age (years), mean ±SD	67 ± 7	67 ± 7	0.23
Race			<0.001
White	54%	46%	
Black or African American	27%	38%	
Other race	19%	16%	
Drug and/or alcohol use	31%	29%	0.38
Any alcohol use	22%	22%	0.89
Any drug use	13%	13%	0.40
Functionally dependent health status	0.4%	0%	0.06
≥3 concomitant medical conditions	12%	9%	0.007
Injury severity score (ISS), median (IQR)	9 (5 – 17)	9 (2 – 14)	<0.001
Severe trauma (ISS≥16)	35%	31%	0.02
In-hospital mortality	5%	14%	<0.001
Hospital length of stay (days), median (IQR)	4 (2 – 7)	3 (1 – 7)	<0.001
ICU stay	40%	36%	0.04
ICU length of stay (days), median (IQR)	3 (2 – 6)	3 (2 – 8)	0.005
Number of injuries, median (IQR)	3 (2 – 5)	3 (1 – 4)	<0.001
Surgeries performed			
Laparotomy	0.7%	17%	<0.001
Thoracotomy	0.3%	4%	<0.001
Craniotomy	1%	0.2%	0.01
Traumatic brain injury	50%	6%	<0.001
Body region(s) injured			<0.001
Head	34%	9%	
Face	39%	11%	
Neck	0.6%	6%	
Thorax	6%	22%	
Abdomen	1%	20%	
Spine	3%	2%	
Upper extremity	8%	15%	
Lower extremity	4%	10%	
Unspecified	2%	3%	
≥3 body regions injured	64%	52%	<0.001

	Blunt Injuries (n=1,832)	Penetrating Injuries (n=1,180)	*P* value
Trauma-associated diagnosis(es)			<0.001
Fractures	47%	18%	
Internal organ	27%	31%	
Open wounds	22%	41%	

SD denotes standard deviation; IQR, interquartile range; ICU, intensive care unit.

Table 4

Characteristics and Outcomes of Older Adult Assault Victims (aged ≥60) Suffering Traumatic Brain Injury Treated at U.S. Trauma Centers from 2008–2012

	TBI n=1,227	No TBI n=2,337	*P* value
Male gender	81%	80%	0.62
Age (years), mean ± SD	68 ± 7	67 ± 7	0.001
Race			<0.001
White	56%	50%	
Black or African American	23%	34%	
Other race	21%	16%	
Drug and/or alcohol use	31%	29%	0.07
Any alcohol use	22%	21%	0.24
Any drug use	14%	13%	0.50
Functionally dependent health status	0.3%	0.3%	0.85
≥3 concomitant medical conditions	11%	11%	0.47
Injury severity score (ISS), median (IQR)	14 (9 – 20)	6 (4 – 13)	<0.001
Severe trauma (ISS≥16)	53%	24%	<0.001
In-hospital mortality	8%	8%	0.82
Hospital length of stay (days), median (IQR)	4 (2 – 9)	3 (1 – 7)	<0.001
ICU stay	56%	30%	<0.001
ICU length of stay (days), median (IQR)	3 (2 – 7)	3 (2 – 8)	0.007
Number of injuries, median (IQR)	4 (2 – 6)	3 (2 – 4)	<0.001
Surgeries performed			
Laparotomy	1%	9%	<0.001
Thoracotomy	0.3%	2%	<0.001
Craniotomy	1%	0.1%	<0.001
Type of injury			<0.001
Blunt	74%	40%	
Burn	0%	0.5%	
Penetrating	6%	47%	
Other/unspecified	20%	13%	
Body region(s) injured			<0.001
Head	48%	12%	
Face	33%	28%	
Neck	1%	3%	
Thorax	4%	16%	
Abdomen	1%	12%	
Spine	2%	3%	
Upper extremity	7%	13%	
Lower extremity	3%	9%	

	TBI n=1,227	No TBI n=2,337	*P* value
Unspecified	2%	3%	
≥3 body regions injured	72%	53%	<0.001
Trauma-associated diagnosis(es)			<0.001
Fractures	33%	40%	
Internal organ	44%	18%	
Open wounds	21%	33%	

TBI denotes traumatic brain injury; SD, standard deviation; IQR, interquartile range; ICU, intensive care unit.