

Original Research

Trauma Recidivism in an Aging Population: Who Is Most at Risk?

Ryan Taylor, BS,¹ Austin McCrea, DO,² Nayda Parisio Poldiak, MSc, PhD,² Keely Muertos, MPH,³ Saptarshi Biswas, MD,² Christoph Kaufmann, MD, MPH²

Abstract

Background

Repeated episodes of trauma, particularly in older adults, result in increased morbidity and mortality. This study investigates trauma recidivism in our adult population to identify which patients in our region are more likely to become recidivists.

Materials and Methods

This 4 year retrospective study (2013 to 2017) examines all patients 18 years of age or older with multiple hospital admissions for trauma, comparing patients ages 65 and older (older adults) to those ages 18 to 64 (younger adults). Exclusion criteria consisted of those younger than 18 and/or had a home zip code outside of the study region. Data included admission demographics, injury characteristics and other clinical metrics.

Results

There were 240 younger adult and 182 older adult trauma recidivists included. In total, 4% of all patients were recidivists with significantly higher rates of recidivism among older adults (OR: 1.94 [1.59–2.36], $p < 0.001$). Older adult recidivists were more likely to be female (OR: 4.28 [2.82–6.51], $p < 0.001$) and suffer blunt trauma secondary to a fall (OR: 5.36 [3.91–7.35], $p < 0.001$). Trauma recidivism in older adults also correlated with a higher Injury Severity Score, longer length of stay and an increased proportion of patients requiring to be discharged home with organizational help or to a rehabilitation facility.

Conclusions

Trauma can be recurrent and associated with poor health outcomes, particularly in older adults. Recidivists in the studied region were significantly older with the most at-risk population consisting of females suffering blunt injury secondary to a fall. Improved prevention strategies are needed for this population.

Keywords

trauma; surgery; recidivism; older adults; aged; geriatrics; patient readmission; patient readmission/statistics & numerical data; wounds and injuries/epidemiology; Injury severity score; retrospective studies; South Carolina

Introduction

Older adults are the fastest growing segment of the population with approximately 42 million Americans over the age of 65. These numbers are estimated to double by 2030.^{1,2} In addition to an increased lifespan secondary to improved medical care, older adults are also more active, thereby increasing their risk for exposure to traumatic injuries.² Of greater concern are older trauma patients who suffer additional

traumatic injuries.

Such repeated traumatic events have been referred to as recidivism.³ While traditionally used in reference to criminal activity, recidivism is becoming an increasingly studied topic in the medical field.⁴ Trauma recidivism, particularly in this older population, has been strongly related to functional loss, increased socioeconomic challenges after initial injury, high mortality rates and increased health care expenses.^{2,5-7}

Author affiliations are listed at the end of this article.

Correspondence to:
Christoph Kaufmann, MD,
MPH
Grand Strand Medical
Center
Department of Surgery
809 82nd Parkway
Myrtle Beach, SC 29572
(Christoph.Kaufmann@hcahealthcare.com)

Prior studies have compared recidivism in urban versus rural populations and young versus old populations. There is limited research, however, on trauma recidivism, specifically in older adults—a group that contributes a significant amount to the population in our study region as well as others across the United States.

Our region, Horry County, is an underserved coastal community in South Carolina and is approximately 1,134 square miles in size.^{8,9} It is comprised of Myrtle Beach—a popular vacation destination with an estimated 14 million visitors each year—and several predominantly rural neighboring counties.⁹ In 2016, the total population was estimated to be 322,342 people. 22% of this population was older than 65 years of age, which was 1.3 times higher than the average for South Carolina and 1.5 times higher than the average for the United States.¹⁰ This diverse population consisting of rural and urban residents, vacationers and older adults are all

collectively served by the region’s only American College of Surgeons verified Level I Trauma Center.

We hypothesize there is a particular combination of patient demographics and injury characteristics that suggests an older adult patient in this region will be a recidivist. The goal is ultimately to better characterize this trauma population, identifying specific needs to help focus prevention efforts to reduce trauma and trauma recidivism in this population.

Materials and Methods

This 4 year retrospective study (2013 to 2017) examines all patients greater than 18 years of age with a history of trauma and trauma recidivism. For this study, a recidivist was defined as any patient with a recorded history of trauma who was evaluated following an additional traumatic injury at any time during the study period. Both admitted patients and those dis-

Table 1. ICD-10 Codes for Injury Location and Mechanism.

Injury Location	Code Range	Injury Mechanism	Code Range
Head	S00-S09	Transport Accidents	V00-V99
Neck	S10-S19	Falls	W00-W19
Thorax	S20-S29	Exposure to Inanimate Mechanical Forces (Struck, Caught, Crushed, Contact with, etc)	W20-W49
Abdomen, Lower Back, Lumbar Spine, Pelvis, & External Genitals	S30-S39	Accidental Drowning & Submersion	W65-W74
Shoulder & Upper Arm	S40-S49	Other Accidental Threats to Breathing	W75-W84
Elbow & Forearm	S50-S59	Exposure to Electric Current, Radiation, & Extreme Ambient Air Temp or Pressure	W85-W99
Wrist, Hand, & Fingers	S60-S69	Exposure to Smoke, Fire, Flames	X00-X09
Hip & Thigh	S70-S79	Contact with Heat & Hot Substances	X10-X19
Knee & Lower Leg	S80-S89	Contact with Venomous Plants & Animals	X20-X29
Ankle & Foot	S90-S99	Exposure to Forces of Nature	X30-X39
Injuries to Multi Body Regions (Inclusive of Burns)	T00-T98	Accidental Poisoning & Exposure to Noxious Substances	X40-X49
		Overexertion, Travel, & Privation	X50-X57
		Exposure to Other & Unspecified Accidental Factors	X58,X59
		Suicide and Self-Inflicted Injury	X60-X84
		Assault, Including Neglect & Other Maltreatment	X85-Y09
		Injury of Undetermined Intent	Y10-Y34

charged from the emergency department were included. Upon IRB approval, our institution's trauma registry was queried using ICD-10 diagnosis codes for various trauma mechanisms and anatomical regions. **Table 1** lists all ICD-10 codes used to capture patients for this study. A young adult and adult population (defined as age 18 to 64 years old) was compared to the target population of older adults (defined as age 65 years or older). Exclusion criteria consisted of those less than 18 years old, if the patient self-reported a home zip code outside of Horry County or surrounding communities (Georgetown, Marion, Dillion, Brunswick and Columbus Counties) and patients who expired with their first episode of trauma and were, therefore, unable to be a recidivist.

Recorded de-identified data for each patient included demographics, injury mechanism, Glasgow Coma Scale (GCS), Injury Severity Score (ISS), disposition, intensive care unit (ICU) admission, length of stay in number of

days (LOS) and other clinical data. For the recidivists, the same data as above was recorded for comparison. Descriptive statistics were used to evaluate demographic and clinical data, and continuous variables were compared using the Mann-Whitney-Wilcoxon rank sum test. The Chi-square test was used to compare categorical variables. Statistical significance was evaluated using $p < 0.05$.

Results

In total, 10,920 trauma patients were initially captured for this study. Of those patients, 240 younger adults (3.4%) and 182 older adults (6.3%) were identified as trauma recidivists with an overall recidivism rate of 4.2%. Recidivism was found to be significantly more likely in older adults overall (Odds Ratio (OR): 1.94 [1.59–2.36], $p < 0.001$).

Demographic and clinical data is summarized in **Table 2**. When comparing recidivism between the 2 age groups, older adults were more likely

Table 2. Demographics by Age Group, Trauma Recidivists, Ages 18 Years and Over.

	240 Patients Aged 18–64 years (Encounters = 541)	182 Patients Aged 65+ years (Encounters = 390)	P-value
Age, mean \pm SD (range)	44.3 \pm 13.2 (18–64)	79.9 \pm 8.3 (65–103)	–
*Male, N (%)	184 (76.7)	79 (43.4)	< 0.05
Blunt injury, N (%)	503 (93.0)	387 (99.2)	< 0.05
*ETOH \geq .08, N (%)	204 (48.1)	33 (16.4)	< 0.05
*Drug Use Indicated, N (%)	199 (76.2)	56 (44.1)	< 0.05
Arrival GCS, mean [median] \pm SD (range)	14.4 [15] \pm 2.2 (3–15)	14.5 [15] \pm 1.4 (3–15)	0.450
ISS, mean [median] \pm SD (range)	5.3 [4.0] \pm 6.0 (0–48)	6.6 [5.0] \pm 6.2 (0–29)	< 0.05
Hospital LOS, mean [median] \pm SD (range)	4.7 [2.0] \pm 8.3 (0–94)	5.3 [4.0] \pm 5.3 (0–43)	< 0.05
ICU Admission, N (%)	97 (17.9)	89 (22.8)	0.066
ICU LOS, mean [median] \pm SD (range)	5.4 [2.0] \pm 7.5 (1–48)	4.5 [3.0] \pm 5.2 (1–33)	0.318
Vent required, N (%)	30 (5.5)	19 (4.9)	0.650
Vent days, mean [median] \pm SD (range)	6.0 [3.0] \pm 9.1 (1–47)	8.2 [3.0] \pm 8.8 (1–32)	0.123

*Calculation uses the number of patients, all others calculated using number of encounters

*Percent out of those screened (ETOH: n=424 for recidivists 18–64 years, n=201 for recidivists 65+ years; recreational drug use: n=272 for recidivists 18–64 years, n=137 for recidivists 65+ years)

Abbreviations: ETOH=Alcohol; GCS=Glasgow Coma Scale; ISS=Injury Severity Score; LOS=length of stay; ICU=Intensive Care Unit; Vent=ventilator

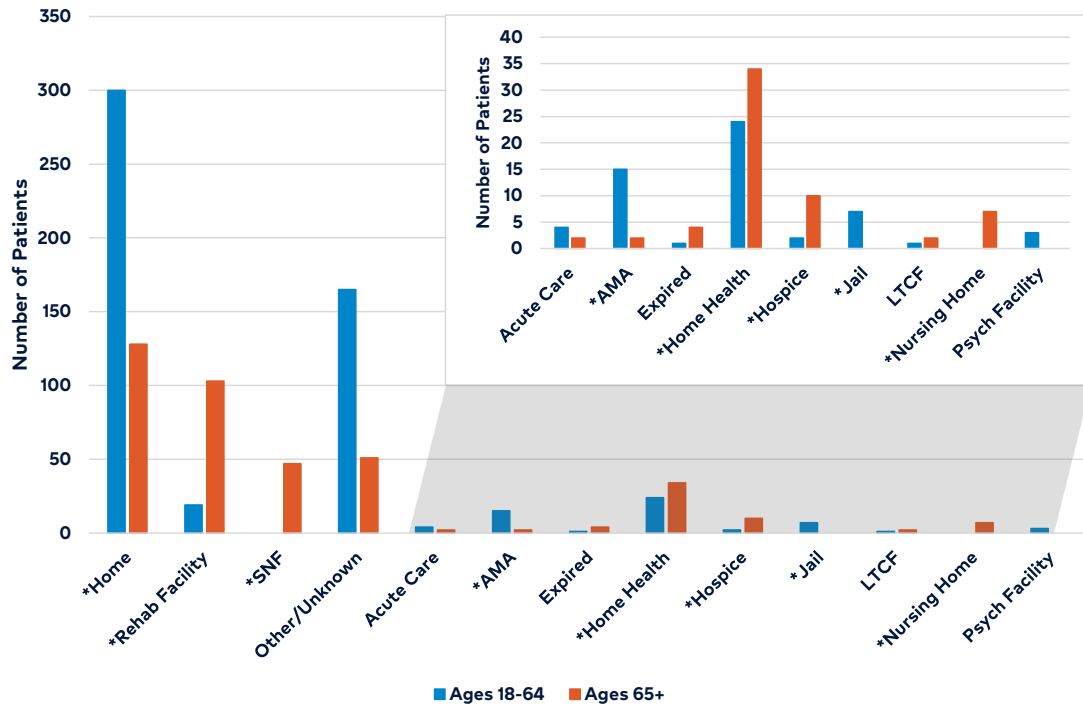


Figure 1. Discharge Disposition by Age Group, Trauma Recidivists, Ages 18 and Over

to be female compared to younger recidivists (OR: 4.28 [2.82–6.51], $p < 0.001$). Ninety-nine percent of older adult recidivist patients presented with blunt traumatic injuries compared to 93% adult recidivist patients (OR: 9.75 [2.99–31.81], $p < 0.001$). Specifically, older adults were more likely to suffer a fall (OR: 5.36 [3.91–7.35], $p < 0.001$) compared with an act of violence/assault (OR: 0.01 [0.00–0.07], $p < 0.001$) or vehicle-related incident (OR: 0.33 [0.23–0.50], $p < 0.001$). Older adult recidivists were also less likely to screen positive for alcohol and recreational drug use (OR 0.21 [0.14–0.32], OR: 0.26 [0.17–0.40], $p < 0.001$). While arrival GCS was similar between comparison groups, ISS was significantly higher among older adult recidivists (5.0 versus 4.0, $p < 0.001$) with longer LOS among this age group (4.0 days versus 2.0 days, $p < 0.001$). No differences were observed in ICU admission, ICU LOS, ventilator requirements or ventilator days between age groups. Discharge disposition was found to be related to age group among recidivist patients ($p < 0.05$) with older adults requiring more healthcare resources following their injuries. **Figure 1** illustrates the discharge dispositions between these two groups.

Comparing recidivism within the older adult age group, older adult recidivists were also

significantly older relative to their non-recidivist counterparts (81 versus 76 years, $p < 0.001$). Older adult recidivists were more likely to suffer a traumatic fall as well (OR: 4.31 [3.17–5.88], $p < 0.001$) and less likely to suffer a traffic related incident (OR: 0.318 [0.21–0.47], $p < 0.001$). There was no significant difference between other injury mechanisms in this age group. There were no differences in the gender of recidivists with females the most common for both groups. Additionally, alcohol and recreational drug use were similar among those screened, and there was no significant difference in GCS, ISS, LOS, ICU LOS or ventilator utilization. Older adult recidivists were less likely to expire (OR: 0.15 [0.05 – 0.47], $p < 0.001$). They were, however, more likely to require discharge to a rehabilitation or skilled nursing facility (SNF) (OR: 1.38 [1.08–1.77], $p = 0.010$; OR: 1.60 [1.14–2.23], $p = 0.06$) and less likely to be discharged home (OR: 0.63 [0.51 – 0.79], $p < 0.001$) compared to their non-recidivist counterparts. There were no other significant differences in discharge disposition for these 2 groups.

Discussion

Previous research has demonstrated that trauma recidivism is not a random isolated event but a predictable recurrent disease affecting

higher risk groups such as the young, males and substance abusers.⁴ Several similar studies have produced consistent results and advocate for improved prevention efforts.¹¹⁻¹⁵ Fewer studies have investigated this issue in older adults. However, recidivism appears to be prevalent in this population as well.^{5-7,16}

Results of our study show that trauma is also recurrent in our diverse adult population. In the current literature on older adults, rates of trauma recidivism range from 1.22% to over 5%.^{2,16} Older adult recidivists in our population suffered a particularly high rate of recidivism (6.3% of trauma patients in this age group) compared to both the control population in this study and other studies on trauma recidivism.

Our older adults most at risk were females who suffered blunt traumatic injuries—falls in particular. Unexpectedly, the results showed this population was less likely to expire as a result of their repeat injuries compared with younger patients. While the etiology of this result is unclear and likely multifactorial, these patients ultimately suffered more severe injuries, had longer recovery times and required utilization of significant health care resources overall. The considerable morbidity in this study can likely be attributed to a combination of diminished physiological reserve in such patients and a deficiency in targeted prevention strategies for an age group that is thought to be increasingly active.²

Other studies on older adults have similarly shown that females have the highest risk for recurrent falls secondary to blunt traumatic mechanisms. Gubler et al. conducted one of the first studies on trauma recidivism on a wide population base of older adults. They found that once injured, older adults, particularly women, are at significant risk for future injury. This risk only increased with age, injury severity and the presence of pre-existing comorbid conditions.⁷ A later study using nationwide data also found that women and those suffering from falls secondary to functional impairments related to their initial injury were at increased risk for recidivism.⁵ A third, more recent study similarly found that female gender and falls were significant risk factors for recidivism.¹⁶ A study investigating falls specifically found that even minor head trauma was associated

with high emergency department recidivism rates and that falls were the most common cause of trauma-related death in older adults as well.¹⁷ Results of these studies differ from the previously cited more generalized recidivism research, which consistently showed that younger males suffering penetrating injuries were more at risk.

Regarding urban populations, 2 studies were identified—both of which investigated rural recidivism relative to their urban counterparts—and found that they are also quite different. Both studies demonstrated lower rates of recidivism in rural populations.^{18,19} Toschlog et al. found rural recidivists were predominately white females. They also reported that these patients were significantly older (55.9 versus 39.7 years) and suffered from blunt trauma secondary to falls. They did not, however, comment on recidivism rates, specifically for rural patients older than 65 years of age, nor did they find any significance relating to intentional/violent injuries or injury severity in their rural population.¹⁸ Rogers et al. did comment on older rural adults and reported that falls and violent injuries were associated with recidivism in both demographics, but age—specifically 65 or older—was a risk factor for recidivism in rural patients only. They also reported that gender was not a significant factor—a distinct difference from the previous study—and noted that rural victims of violence were more likely to suffer from self-inflicted injuries.¹⁹ These studies as well as ours further support recognizing elderly rural patients as a high-risk population compared to their younger and more urban counterparts.

Interestingly, one study specifically investigating substance abuse in elderly trauma patients found that drug and alcohol abuse in patients 65 or older was a significant issue.²⁰ While results of our study were not as conclusive, we argue that such risk factors should still be considered for such an at-risk population.

Prevention strategies should be targeted to the specific population. To help with this strategy implementation, our institution has incorporated a Trauma Prevention Specialist and the Screening, Brief Intervention and Referral to Treatment (SBIRT) model into the multidisciplinary trauma team. The authors recommend

immediate and long-term interventions directed at reducing the recurrence of trauma, including risk-factor screening, gait and balance testing, medication review, regular vision and driving examinations as well as thorough patient and family education.

Results should be viewed in light of their limitations, including potential missed patients and the clinical impact of statistically significant data. This was a 4 year retrospective study using our institution's trauma registry. As such, there were a number of potential patients that could have been missed for various reasons. The study region also has a level 3 trauma center and 2 other local hospitals where potential recidivist patients could have been evaluated. Furthermore, patients who travel could potentially be a recidivist at a trauma center in an outside region. Despite this factor, all measures were taken to capture as many patients as possible and to maximize the applicability of this study.

Conclusion

Our results ultimately demonstrate that trauma can be recurrent and associated with significant morbidity, particularly in older adults living in communities such as the one described. In this study, older females who suffer fall-related injuries were identified as being the most at-risk population for recidivism. These patients had a higher ISS, longer LOS and were more likely to require discharge to a rehab or nursing facility. Results of this study complement other recidivism research, helping demonstrate that older adults in a diverse region like ours are predisposed to such repeated traumatic events. While recidivism has traditionally been viewed as a disease of urban youths, appropriate prevention should also include older patients, as shown in this study. Future areas of research include a larger multi-institutional review of this population with increased sample size. We also suggest a further subgroup analysis of various age ranges and recidivism time frames as well as prospective prevention studies targeted at this population.

Conflicts of Interest

The authors declare they have no conflicts of interest.

Drs. Biswas, Kaufmann, McCrea and Parisio Poldiak are employees of Grand Strand Medical Center, a hospital affiliated with the journal's publisher.

This research was supported (in whole or in part) by HCA Healthcare and/or an HCA Healthcare affiliated entity. The views expressed in this publication represent those of the author(s) and do not necessarily represent the official views of HCA Healthcare or any of its affiliated entities.

Author Affiliations

1. University of South Carolina School of Medicine, Columbia, SC
2. Grand Strand Medical Center, Myrtle Beach, SC
3. Precision Point Specialty (PPS) Analytics

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