Changing Injury Pattern in Geriatric Admissions in a Level-1 Trauma Center

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ABSTRACT

OBJECTIVE: The COVID-19 pandemic affected driving and activity, and therefore risk for trauma. We describe the most common injuries, falls and motor vehicle injuries (MVA), admitted to our Level-1 Trauma Center before and during the pandemic.

METHOD: We retrospectively evaluated pre-pandemic with pandemic trauma admissions from January 2017 to February 2023, for patients 65 years and older, following falls and MVAs.

RESULTS: Of 12,098 falls and MVAs, falls occurred similarly frequently before and during the pandemic while MVA admissions declined from the pre-pandemic period. Odds for pandemic surgical and infectious complications increased 1.77 [1.11–2.80] vs 1.62 [1.02–2.59] as did LOS and 30-day mortality (mean 6.6±6.4 vs 6.2±5.8, adjusted p-value=0.0432, and 1.27[1.03–1.56] respectively). Thirty-day readmission (0.79[0.66–0.94]) decreased.

CONCLUSION: Injuries from falls and MVAs remain the commonest cause for trauma admission in older adults, with declining MVA. This informs resource utilization, and clinical focus, including fall-risk evaluation and driving assessment for older adults.

KEYWORDS: Older adults; falls; motor vehicle injury; mortality

INTRODUCTION

Unintentional injury rose from the fourth to the third leading cause of death in the United States between 2021 and 2022, surpassed only by heart disease and cancer.[1] Falls (56.1%) and motor vehicle injuries (12.5%) remain the primary causes of unintentional injury deaths, causing the majority of traumatic brain injury-related hospitalizations and deaths among older adults.[2,3] Nearly one million older adults require hospitalization each year after falls, most often due to head injuries or hip fractures.[4] Compared to younger individuals who tend to die at the scene of their traumatic injuries, older adults die from complications that develop from their injuries after hospitalization.[5,6]

With the increase in average life expectancy (77.5 years for both sexes) in the country, hospitals face an increasing volume of geriatric trauma admissions.[7,8] The CDC reports that in 2020, falls among geriatric patients led to nearly three million emergency department visits, over 36,000 deaths, costing $50 billion. Similarly, injuries, both fatal and nonfatal, to people riding in cars and light trucks, cost $70 billion a year. While driving helps older adults maintain mobility and independence, age increases the risk of motor vehicle-related injuries and deaths. The number of older adult drivers has grown by 40% in the past decade, leading to an increase in deaths, hospitalizations, and ED visits.[2,4]

Health and well-being of older adults, and the hospital system, witnessed multiple changes in the year 2020 with the COVID-19 pandemic. Although the initial period of lockdown and healthcare protocols resulted in an abrupt decrease in trauma admission volume and fall-related ED visits and hospitalizations, they are increasing to pre-pandemic levels.[9,10] Motor vehicle-related injuries decreased in 2020 but mortality rates significantly increased with hip fractures.[11,12] Injuries within home became more prevalent and alcohol use increased after the pandemic onset.[13]

Noting these trends reported in other regions, we aimed to identify local patterns in trauma admissions of older adults. This may guide triage criteria and resource allocation in the state that serves a population of which almost 20 percent are 65 years of age or older, above the national average of 17.3 percent.[14]

METHOD

Study design and setting

This was a retrospective cohort study performed at a 719-bed academic tertiary care hospital, a certified Level 1 Trauma Center in Rhode Island (RI). The study received formal Institutional Review Board (IRB) approval. We adhered to the IRB-approved guidelines.

Patient selection

We included patients, 65 years and above, admitted to the trauma service with any trauma diagnosis on admission from January 1, 2017 to February 28, 2023 (**Figure 1**). Patients admitted from prison were excluded. This time frame included the period of 2020, which was affected significantly by COVID-19.

Study procedure and data collection

We obtained the data from the Trauma registry at our Level 1 trauma center. International Statistical Classification of Disease and related health problems: tenth edition codes were used to define mechanisms of injury.

We evaluated baseline demographics, which included injury mechanism, injury severity [abbreviated injury scale (AIS) scores, mean new injury severity scale (ISS) scores and Apache score], and medical comorbidities.

We defined our comparison periods as pre-pandemic (Jan. 1, 2017–Feb. 28, 2020) and pandemic (March 1, 2020–Feb. 28, 2023).

Primary outcome

We defined our primary outcome as the relative incidence of falls and MVAs between the pre-pandemic and pandemic periods.

Secondary outcome

We looked at hospital length-of-stay (LOS), discharge disposition, 30-day mortality, hospital mortality, medical complication and 30-day readmission

Statistical analysis

Multivariate linear or logistic regression analysis via SAS software version 9.4 to compare LOS, discharge disposition, complications, location or mechanism of the injury, readmission, and mortality between admissions from pre-pandemic with pandemic periods. Bivariate analyses were also conducted, where chi-square and Student's t-tests were performed to compare the study periods characteristics. When applicable, the analysis was adjusted for age, race, ethnicity, gender, body mass index (BMI), Charles comorbidity score (CCI), new injury Severity Score (ISS), max-abbreviated injury scale (AIS), admitted to intensive care unit (ICU), or during weekend or after hours, complications, and location or mechanism of the injury.

RESULTS

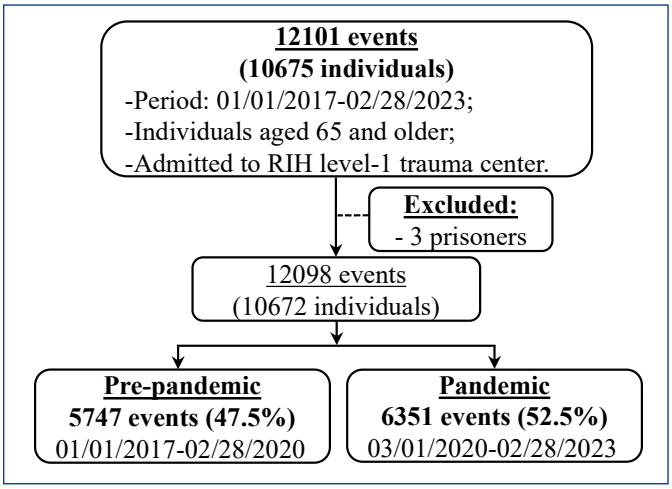
Baseline characteristics

The pre-pandemic group represented 5,747 (47.5%) of trauma admission (**Figure 1**). They were younger (79.9±9.0 years), more male (43.0%), less Caucasian (91.3%), and more likely to reside in the state (82%) than the pre-pandemic cohort (80.3±9.1,40.9%, 92.7%, and 77.4%, p-value 0.0253,0.0195, 0.0044 and <0.0001 respectively) (**Table 1**).

Pandemic individuals were sicker (mean CCI:6.5±3.8) or used more alcohol (58.6%) compared with pre-pandemic period (5.7±3.2 or 56.6%, both p-values ≤ 0.05).

New ISS or max AIS scores were equal independent of the study periods (12.6±10.2 or 2.8±0.9, p-value=0.4861 or 0.4376, respectively).

Figure 1. Flow chart of study groups of individuals admitted to Rhode Island Hospital level-1 trauma center, 2017 to February 2020, compared with March 2020 to 2023.



Primary Outcomes

Falls remained the leading cause of trauma admissions between the two comparison periods (pre-pandemic 85.7% vs pandemic 86.1%, (1.02 [CI 0.91–1.15]) (**Figure 2**). There was a decrease in MVAs in the pandemic period (6.2%) compared to pre-pandemic period (7.8%), (0.80 [CI 0.69–0.93].

Pedestrian accidents in the pandemic period declined compared to the pre-pandemic period (1.5% vs 2.1%, 0.34[0.20–0.64]). In the pandemic period, although the rate of injuries on the road decreased (8.2 vs 9.6%, 0.78[CI 0.68–0.88]), the injuries at home increased to 20.3% compared to 18.4% in the pre-pandemic period (1.18[CI 1.07–1.29]).

Secondary Outcomes

Pandemic trauma admissions had higher odds of surgical or infectious complications, 1.77 [1.11–2.80] or 1.62 [1.02–2.59] respectively. Pandemic individuals were 1.40 [1.26–1.51], 1.29 [1.05–1.59], or 1.59 [1.31–1.93], or more likely to be discharged to home, hospice, inpatient rehab, but 0.76 [0.70-0.82] times less likely to go to a skilled nursing facility. While LOS (**Figure 3)** and the odds of 30-day mortality increased during the pandemic (mean 6.6±6.4vs6.2±5.8, adjusted p-value=0.0432, and 1.27[1.03–1.56] respectively), the odds of in-hospital mortality (0.81[0.69–0.96]) or 30-day readmission (0.79[0.66–0.94]) decreased.

DISCUSSION

By 2030, demographers estimate that one in four Rhode Islanders (25%) will be 65 or older.[15] Projections indicate that by 2025, almost 9% of RI's residents will be 75 years or older. This proportion is anticipated to rise further, reaching 14% by 2040.[16] These figures indicate that Rhode Island has

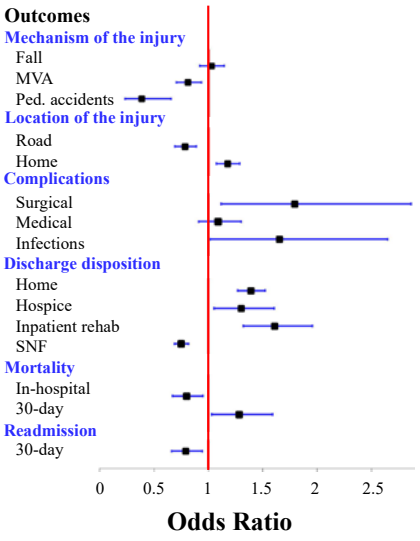
Table 1. Baseline characteristics of individuals admitted to Rhode Island Hospital level-1 trauma center, 2017 to February 2020, compared with March 2020 to 2023.

	Total	Study Group		
Variable	**N=12098 (100%)**	**Pre-pandemic N=5747 (47.5%)**	**Pandemic N=6351 (52.5%)**	**P-value**
Age, mean (SD)	80.1 (±9.0)	80.3 (±9.1)	79.9 (±9.0)	**0.0253**
65–74, **n (%)**	3803 (31.4)	1787 (31.1)	2016 (31.7)	0.4429
75–84, **n (%)**	4110 (34.0)	1890 (32.9)	2220 (35.0)	**0.0164**
85–94, **n (%)**	3567 (29.5)	1758 (30.6)	1809 (28.5)	**0.0112**
>95, **n (%)**	618 (5.1)	312 (5.4)	306 (4.8)	0.1276
Gender (male), n (%)	5082 (42.0)	2351 (40.9)	2731 (43.0)	**0.0195**
Race and ethnicity, n (%)				
White/Caucasian	11122 (90.9)	5326 (92.7)	5796 (91.3)	**0.0044**
Black	265 (2.2)	123 (2.1)	142 (2.2)	0.7197
Hispanic/Latino	471 (3.9)	201 (3.5)	270 (4.3)	**0.0242**
Other	656 (5.4)	297 (5.2)	359 (5.7)	0.2397
State of residency, n (%)				
Rhode Island	9697 (80.2)	4446 (77.4)	5251 (82.7)	**<0.0001**
Massachusetts	2085 (17.2)	1122 (19.5)	963 (15.2)	**<0.0001**
CT/NY/FL	106 (0.9)	45 (0.8)	61 (1.0)	0.2956
Other states	206 (1.7)	132 (2.3)	74 (1.2)	**<0.0001**
Body mass Index, mean (SD)	27.5 (±44.9)	28.3 (±64.3)	26.7 (±6.6)	**0.0873**
Underweight < 18.5, **n (%)**	1763 (14.6)	725 (12.6)	1038 (16.3)	**<0.0001**
Normal 18.5 to 24.9, **n (%)**	4199 (34.7)	2028 (35.3)	2171 (34.2)	0.2026
Overweight 25.0 to 29.9, **n (%)**	3519 (29.1)	1741 (30.3)	1778 (28.0)	**0.0054**
Obesity class I 30.0 to 34.9, **n (%)**	1586 (13.1)	796 (13.9)	790 (12.4)	**0.0216**
Obesity class II 35.0 to 39.9, **n (%)**	608 (5.0)	259 (4.5)	349 (5.5)	**0.0129**
Obesity class III > 40, **n (%)**	423 (3.5)	198 (3.5)	225 (3.5)	0.7707
Weekend of after hours, n (%)	7150 (59.1%)	3451 (60.1)	3699 (58.2)	0.0436
Admitted from, n (%)				
Home	4883 (40.4)	2201 (38.3)	2682 (42.2)	**<0.0001**
Nursing home	813 (6.7)	369 (6.4)	444 (7.0)	0.2109
ALF	246 (2.0)	40 (0.7)	206 (3.2)	**<0.0001**
Other location	220 (1.8)	108 (1.9)	112 (1.8)	0.6342
New ISS, mean (SD)	12.5 (±10.0)	12.6 (±10.2)	12.5 (±9.8)	0.4861
Max AIS, mean (SD)	2.8 (±0.9)	2.8 (±0.9)	2.8 (±0.9)	0.4376
Anticoagulants, n (%)	2923 (32.5)	1766 (30.8)	2157 (34.0)	**0.0002**
Alcohol use indicator, n (%)	6969 (57.7)	3249 (56.6)	3720 (58.6)	**0.0310**
CCI, mean (SD)	6.1 (±3.5)	5.7 (±3.2)	6.5 (±3.8)	**<0.0001**
CCI >2, n (%)	11213 (92.8)	5281 (91.9)	5932 (93.4)	**0.0014**

Abbreviations: AIS – max abbreviated injury scale; CCI – Charles comorbidity score; ISS – new injury Severity Score; SD – standard deviation.

Notes: CCI was defined as in Deyo et al (1992) and Quan et al (2005). Condition Points in Charlson Comorbidities Index: Myocardial Infarction 1; CHF 1; Peripheral Vascular Disease 1; Cerebrovascular Disease 1; COPD 1; Dementia 1; Paralysis 1; Diabetes 1; Diabetes with Sequelae 2; Chronic Renal Failure 2; Various Cirrhosis 1; Moderate-Severe Liver Disease 3; Ulcers 1; Rheumatism 1; AIDS 6; Any Malignancy 2; Metastatic Solid Tumor 6.

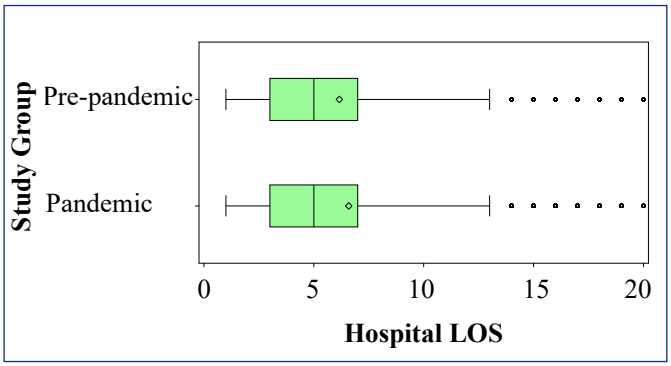
Figure 2: Mechanism and location of the injury, complications, discharge disposition, mortality, and readmission of individuals admitted to Rhode Island Hospital level-1 trauma center, 2017 to February 2020, compared with March 2020 to 2023.



Abbreviations: AIS – max abbreviated injury scale; BMI – body max index; CCI – Charles comorbidity score; ICU – admitted to intensive care unit; ISS – new injury Severity Score; LOS – Length of stay.

Notes: The multivariate logistic regression models were adjusted by: a) mechanism or type of injury: age, gender, race, CCI, ISS, AIS or during weekend or after hours, and alcohol use indicator; b) complications: age, gender, race, ethnicity, BMI, CCI, ISS, AIS, ICU or during weekend or after hours and location or mechanism of the injury; except CCI for infections c) discharge disposition: age, gender, race, ethnicity, BMI, CCI, ISS, AIS, ICU or during weekend or after hours, medical or surgical complications, and location or mechanism of the injury; d) Mortality: age, gender, race, ethnicity, admission during weekend or after hours, LOS and alcohol use indicator; e) readmission: age, gender, race, ethnicity, BMI, CCI, ISS, AIS, ICU, LOS or admission during weekend or after hours, medical or surgical complications, and location or mechanism of the injury. CCI was defined as in Deyo et al (1992) and Quan et al (2005). Condition Points in Charlson Comorbidities Index: Myocardial Infarction 1; CHF 1; Peripheral Vascular Disease 1; Cerebrovascular Disease 1; COPD 1; Dementia 1; Paralysis 1; Diabetes 1; Diabetes with Sequelae 2; Chronic Renal Failure 2; Various Cirrhosis 1; Moderate-Severe Liver Disease 3; Ulcers 1; Rheumatism 1; AIDS 6; Any Malignancy 2; Metastatic Solid Tumor 6.

Figure 3: Length-of-stay of individuals admitted to Rhode Island Hospital level-1 trauma center, 2017 to February 2020, compared with March 2020 to 2023.



Abbreviations: AIS – max abbreviated injury scale; BMI – body max index; CCI – Charles comorbidity score; ICU – admitted to intensive care unit; ISS – new injury Severity Score; LOS – Length of stay; SD – standard deviation.

Notes: There was an increase in LOS for the Pandemic period (mean 6.6± SD 6.4), compared with (6.2±5.8, adjusted* p-value=0.0432). * – The multivariate linear regression model was adjusted by age, gender, BMI, CCI, ISS, AIS, ICU or during weekend or after hours, medical or surgical complications, and location or mechanism of the injury. CCI was defined as in Deyo et al (1992) and Quan et al (2005). Condition Points in Charlson Comorbidities Index: Myocardial Infarction 1; CHF 1; Peripheral Vascular Disease 1; Cerebrovascular Disease 1; COPD 1; Dementia 1; Paralysis 1; Diabetes 1; Diabetes with Sequelae 2; Chronic Renal Failure 2; Various Cirrhosis 1; Moderate-Severe Liver Disease 3; Ulcers 1; Rheumatism 1; AIDS 6; Any Malignancy 2; Metastatic Solid Tumor 6.

a higher proportion of older adults compared to the national average, and this trend is expected to continue growing in the coming years.

In 2020, RI witnessed the impact of COVID-19, which disrupted the access to routine and preventive healthcare for many older adults. Many delayed or avoided seeking medical care due to fears of virus exposure or overwhelmed healthcare systems, which led to: postponed screenings, tests, and preventive care appointments, worsening of existing chronic health conditions and delayed diagnoses of new health issues.[17] Reluctance to approach healthcare providers from fear (anxiety) of COVID-19 could have contributed initially during the pandemic but this pattern persisted over the period.[18] With multiple strategies, including telehealth and vaccinations, the intensity of COVID-19 currently is unlike how it was in 2020, but it continues to impact the well-being of older adults due to changes in practice secondary to the pandemic.

We noted that pandemic trauma admissions represented relatively younger patients and more males. The state is also seeing growing communities of non-Caucasian populations which is likely reflected in fewer admissions of Caucasian race when compared to the pre-pandemic period.[19]

We were struck by the pandemic group being sicker compared to pre-pandemic individuals. One explanation could be that reluctance to approach healthcare services due to fear of COVID-19; this made vulnerable adults wait until their conditions worsened, thus the hospital admissions were sicker.[20] Also, barriers to access including limited in-person office visits, and access to nursing and therapies could have also led to missed opportunities to prevent medical and surgical complications.

Higher rates of injuries within the home were seen in the pandemic period due to multiple possible endogenous and exogenous factors. Endogenous factors include deconditioning, delay in access to healthcare, cognitive evaluation and adaptive devices (such as hearing aids, walking aides, and eyewear). Exogenous factors include environmental (weather), alcohol or substance abuse-associated injuries. Complications during admissions for geriatric trauma patients generally occur at higher rates than their younger counterparts.[21] The above-mentioned factors likely contributed to our pandemic trauma patients having more surgical, medical or infectious complications, respectively.

While our study showed increased rates of alcohol use in admitted patients after pandemic onset, the literature is mixed. A recent national behavioral risk surveillance study showed an increase in deaths related to alcohol in all age groups, but a slight decrease in alcohol consumption among those greater than 65 years.[22] Alcohol consumption in older adults in the country has been increasing and the trend of increases in consumption that are faster for women than for men appears to continue into older adult years (60 and older) across several studies.[23]

Consistent with prior studies, our review showed falls and MVAs to be the leading mechanisms of trauma admissions among older adults both before the pandemic and after its onset. Overall numbers of MVAs and pedestrian accidents declined though in the pandemic period. This could be the direct effect of limited driving associated with less social interaction and commerce, initially due to COVID protocols but later due to longer term changes in habits. The AUTO study reflected a significant decrease in rates of driving, highlighting reasons including COVID protocols and avoidance of exposures, but also a realization among several respondents that they could "get along driving less" and "less need to go places."[24]

Pandemic individuals were more likely to be discharged to home, hospice, inpatient rehab, or skilled nursing facility, respectively. LOS and 30-day mortality increased during the pandemic, which is reflected by sicker patients in the pandemic period. However, this group had less in-hospital mortality or 30-day readmission, which is likely contributed by the excellent care these patients received.

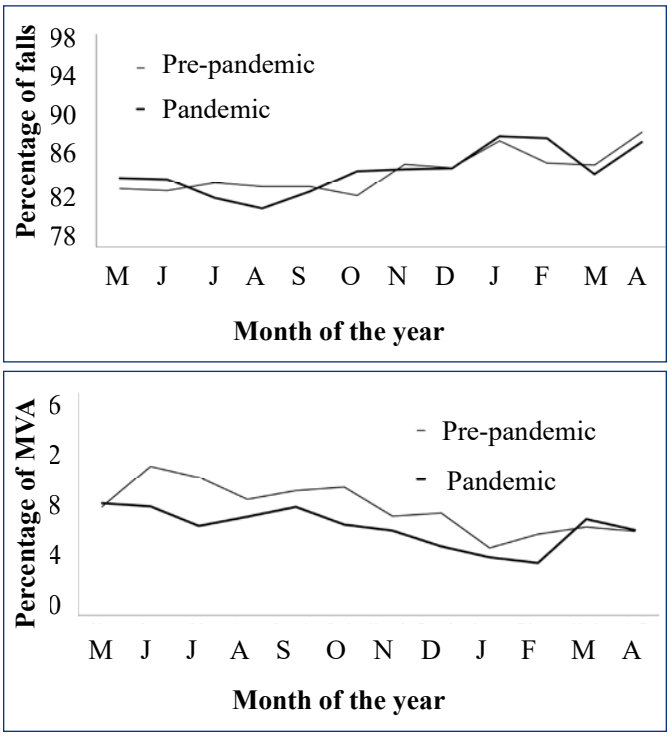
Trauma centers also need to likely be repurposed and adapted to the current needs of their local populations. Geriatric-age groups benefit when the trauma centers handle higher volume of older patients, have more experience at managing geriatric trauma and have a wider hospital network.[25-27] One study reported a decrease in hospital LOS with implementation of geriatric co-management in a level one trauma center.[28] Although COVID-19 impacted healthcare workers, which disrupted available trauma resources, our hospital was able to implement some strategies to mitigate

these limitations.[29] Multidisciplinary trauma services with integration of geriatricians in orthopedic care and on the trauma service has shown benefit in reducing hospital LOS and mortality in our institution.[30] Geriatrician participation in trauma committees allows advocacy on policy-making. Resident and Advanced Practice Provider education on "The 4M Model" as per the recommendation from the Institute for Healthcare Improvement can also improve with a multidisciplinary service.

Our descriptive study can help us further develop better programs to address fall evaluation, such as addressing reversible factors (e.g., Vitamin B12, Vitamin D deficiency, thyroid disorders) and modifiable factors (e.g., blood pressure, hypoglycemia, medication side effects and secondary prevention of osteoporosis). Driving discussions, cognition evaluations, alcohol use assessments during the hospitalization can help mitigate long-term outcomes for older adults by initiating appropriate services and consults. As a community, the state of RI can help these older adults by improving traffic safety, such as crosswalk signs for older adults, driving simulation referrals/centers, and educating them to avoid highways, unfamiliar roads and night-time driving. We noted how cold weather in RI could have impacted more falls in the winter months when slipping on ice and falling is more common (**Figure 4A,B**). On the other hand, warmer months lead to more older drivers and passengers on the road, reflecting higher MVA during that time. This highlights the need for supplementing resources in the community and hospitals during the peak of the seasons (e.g., elderly transportation programs for non-emergency appointments) and hospitals to be more vigilant in the high-volume seasons, given the demographics, incorporating resources accordingly.[31] Training older adults to use technology on the phones or devices for automatic medication refill and delivery, grocery delivery and ride services can help maintain independence while avoiding driving-related risks.

Our study is not without limitations. Being a single-center study, its result cannot be generalized to other centers. The retrospective design has selection bias. Our data from the registry relies heavily on accurate documentation. In addition, we are unable to represent those who presented to other non-trauma center hospitals in RI. We also note that we do not report on which of our patients had COVID, had received a COVID vaccine, and therefore cannot determine the contribution of current or recent infection to our outcomes. Thus, the differences we report may derive from non-behavioral factors related to infection, rather than changes in driving or physical activity, or other factors.

Figure 4A,B. [**A**] Trend in falls and [**B**] motor vehicle injury of individuals admitted to Rhode Island Hospital level-1 trauma center, May to April, 2017 to February 2020, compared with 2020 to 2023.



CONCLUSION

As the population distribution continues to shift, it is necessary to constantly evaluate and reassess hospital policies and resource allocation to reduce injury risk and improve treatment after a trauma admission. More research is needed to better understand demographics, injury patterns and outcomes of injured older adults. We also need to disentangle behavioral changes that a pandemic might drive from those potentially caused by infection, and follow our populations as we return to post-pandemic utilization.

References

1. Common Injuries as We Age | Still Going Strong | CDC
2. Centers for Disease Control and Prevention. National Center for Health Statistics: Mortality Data on CDC Wide-ranging Online Data for Epidemiologic Research (WONDER).
3. Centers for Disease Control and Prevention (2022). Surveillance Report of Traumatic Brain Injury-related Deaths by Age Group, Sex, and Mechanism of Injury—United States, 2018 and 2019. Centers for Disease Control and Prevention. U.S. Department of Health and Human Services.
4. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Web-based Injury Statistics Query and Reporting System (WISQARS). Atlanta, GA: CDC; 2021
5. Keller JM, Sciadini MF, Sinclair E, O'Toole RV. Geriatric trauma: demographics, injuries, and mortality. J Orthop Trauma. 2012 Sep;26(9):e161-5. doi: 10.1097/BOT. 0b013e3182324460. PMID: 22377505
6. Clement ND, Tennant C, Muwanga C. Polytrauma in the elderly: predictors of the cause and time of death. Scand J Trauma Resusc Emerg Med. 2010 May 13;18:26. doi: 10.1186/1757-7241-18-26. PMID: 20465806; PMCID: PMC2880283
7. https://www.cdc.gov/nchs/fastats/life-expectancy
8. Jiang L, Zheng Z, Zhang M. The incidence of geriatric trauma is increasing and comparison of different scoring tools for the prediction of in-hospital mortality in geriatric trauma patients. World J Emerg Surg. 2020 Oct 19;15(1):59. doi: 10.1186/s13017-020-00340-1. PMID: 33076958; PMCID: PMC7574576
9. Xu B, Radojčić MR, Anderson DB, Shi B, Yao L, Chen Y, Feng S, Lee JH, Chen L. Trends in prevalence of fractures among adults in the

United States, 1999-2020: a population-based study. Int J Surg. 2024 Feb 1;110(2):721-732. doi: 10.1097/JS9.0000000000000883. PMID: 37921645; PMCID: PMC10871608.
10. Weerasinghe A, Thielman J, Li Y, Doguparty VB, Medeiros A, Keller-Olaman S, Carsley S, Richmond SA. Trends in falls among older adults before and during the COVID-19 pandemic in Ontario, Canada: A retrospective observational study. BMC Geriatr. 2024 May 11;24(1):418. doi: 10.1186/s12877-024-05032-y. PMID: 38730402; PMCID: PMC11088052.
11. Ghafil C, Matsushima K, Ding L, Henry R, Inaba K. Trends in Trauma Admissions During the COVID-19 Pandemic in Los Angeles County, California. JAMA Netw Open. 2021 Feb 1;4(2):e211320. doi: 10.1001/jamanetworkopen.2021.1320. PMID: 33616667; PMCID: PMC7900857
12. Sutherland M, McKenney M, Elkbuli A. Vehicle related injury patterns during the COVID-19 pandemic: What has changed? Am J Emerg Med. 2020 Sep;38(9):1710-1714. doi: 10.1016/j.ajem.2020.06.006. Epub 2020 Jun 6. PMID: 32721782.
13. Obamiro E, Trivedi R, Ahmed N. Changes in trends of orthopedic services due to the COVID-19 pandemic: A review. World J Orthop. 2022 Nov 18;13(11):955-968. doi: 10.5312/wjo.v13.i11.955. PMID: 36439371; PMCID: PMC9685630.)
14. Sohi I, Chrystoja BR, Rehm J, Wells S, Monteiro M, Ali S, Shield KD. Changes in alcohol use during the COVID-19 pandemic and previous pandemics: A systematic review. Alcohol Clin Exp Res. 2022 Apr;46(4):498-513. doi: 10.1111/acer.14792. Epub 2022 Apr 12. PMID: 35412673; PMCID: PMC9111333
15. https://www.americashealthrankings.org/explore/measures/pct_65plus/RI
16. https://oha.ri.gov/who-we-are/key-facts
17. https://planning.ri.gov/planning-areas/data-center/ri-data-center-census-data/population-projections
18. Cocuzzo B, Wrench A, O'Malley C. Effects of COVID-19 on Older Adults: Physical, Mental, Emotional, Social, and Financial Problems Seen and Unseen. Cureus. 2022 Sep 23;14(9):e29493. doi: 10.7759/cureus.29493. PMID: 36299954; PMCID: PMC9588279
19. Sun C, Dyer S, Salvia J, Segal L, Levi R. Worse Cardiac Arrest Outcomes During The COVID-19 Pandemic In Boston Can Be Attributed To Patient Reluctance To Seek Care. Health Aff (Millwood). 2021 Jun;40(6):886-895. doi: 10.1377/hlthaff.2021.00250. Epub 2021 May 26. PMID: 34038193.
20. US department of health and human services, overview of state RI. 2022.
21. Keyes KM, Jager J, Mal-Sarkar T, Patrick ME, Rutherford C, Hasin D. Is There a Recent Epidemic of Women's Drinking? A Critical Review of National Studies. Alcohol Clin Exp Res. 2019 Jul;43(7):1344-1359. doi: 10.1111/acer.14082. Epub 2019 Jun 5. Erratum in: Alcohol Clin Exp Res. 2020 Feb;44(2):579. doi: 10.1111/acer.14276. PMID: 31074877; PMCID: PMC6602861.
22. Spencer MR, Curtin SC, Garnett MF. Alcohol-induced Death Rates in the United States, 2019-2020. NCHS Data Brief. 2022 Nov;(448):1-8. PMID: 36342847.
23. Haight M, Smith P, Bray N, Nolan D, Hartwell M. Alcohol consumption among older adults in the United States amidst the COVID-19 pandemic: an analysis of the 2017-2021 Behavioral Risk Factor Surveillance System. J Osteopath Med. 2024 Jul 30. doi: 10.1515/jom-2024-0054. Epub ahead of print. PMID: 39072478.
24. Keyes KM, Jager J, Mal-Sarkar T, Patrick ME, Rutherford C, Hasin D. Is There a Recent Epidemic of Women's Drinking? A Critical Review of National Studies. Alcohol Clin Exp Res. 2019 Jul;43(7):1344-1359. doi: 10.1111/acer.14082. Epub 2019 Jun 5. Erratum in: Alcohol Clin Exp Res. 2020 Feb;44(2):579. doi: 10.1111/acer.14276. PMID: 31074877; PMCID: PMC6602861.
25. Zafar SN, Obirieze A, Schneider EB, Hashmi ZG, Scott VK, Greene WR, Efron DT, MacKenzie EJ, Cornwell EE 3rd, Haider AH. Outcomes of trauma care at centers treating a higher proportion of older patients: the case for geriatric trauma centers. J Trauma Acute Care Surg. 2015 Apr;78(4):852-9. doi: 10.1097/TA.0000000000000557. PMID: 25742246
26. Ang D, Norwood S, Barquist E, McKenney M, Kurek S, Kimbrell B, Garcia A, Walsh CB, Liu H, Ziglar M, Hurst J. Geriatric outcomes for trauma patients in the state of Florida after the advent of a large trauma network. J Trauma Acute Care Surg. 2014 Jul;77(1):155-60; discussion 160. doi: 10.1097/TA.0000000000000272. PMID: 24977771.
27. Zafar SN, Shah AA, Zogg CK, Hashmi ZG, Greene WR, Haut ER, Cornwell EE 3rd, Haider AH. Morbidity or mortality? Variations in trauma centres in the rescue of older injured patients. Injury. 2016 May;47(5):1091-7. doi: 10.1016/j.injury.2015.11.044. Epub 2015 Dec 17. PMID: 26724172.
28. Halvachizadeh S, Gröbli L, Berk T, Jensen KO, Hierholzer C, Bischoff-Ferrari HA, Pfeifer R, Pape HC. The effect of geriatric co-management (GC) in geriatric trauma patients treated in a level 1 trauma setting: A comparison of data before and after the implementation of a certified geriatric trauma center. PLoS One. 2021 Jan.
29. Sheehan O, Sheehan M, Rau RI, Sullivan IO, McMahon G, Payne A. Burnout on the frontline: the impact of COVID-19 on emergency department staff wellbeing. Ir J Med Sci. 2022 Oct;191(5):2325-2333. doi: 10.1007/s11845-021-02795-w. Epub 2021 Oct 9. PMID: 34628589; PMCID: PMC8502087.
30. Neupane I, Mujahid N, Zhou EP, Monteiro JFM, Lueckel S, Cizginer S, Yildiz F, Raza S, Singh M, Gravenstein S, McNicoll L. A Model of Care to Improve Survival of Older Trauma Patients: Geriatrics Co-management. J Gerontol A Biol Sci Med Sci. 2023 Jul 8;78(7):1212-1218. doi: 10.1093/gerona/glac146. PMID: 35868000.
31. Esper GW, Meltzer-Bruhn AT, Ganta A, Egol KA, Konda SR. Seasonality Affects Elderly Hip Fracture Mortality Risk During the COVID-19 Pandemic. Cureus. 2022 Jul 3;14(7):e26530. doi: 10.7759/cureus.26530. PMID: 35928394; PMCID: PMC9345382.

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