Elderly Females Fall More From Heights but Males Survive Less: Insights from an American Level 1 Trauma Center

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Abstract

Background Approximately one third of subjects ≥65 year old and half of subjects ≥80 years old sustain a fall injury each year. We aimed to study the outcomes of fall from a height (FFH) among elderly. We hypothesized that in an elderly population, fall-related injury and mortality are the same in both genders. Methods A retrospective analysis was conducted between January 2012 and December 2016 in patients who sustained fall injury at age of at least 60 years and were admitted into a Level 1 Trauma center. Patients were divided into 3 groups: Gp-I: 60-69, Gp-II: 70-79 and Gp-III: ≥80 years old. Data were analyzed and compared using Chi-square, one-way analysis of variance (ANOVA) and logistic regression analysis tests. Results Forty-three percent (3665/8528) of adult trauma patients had FFH and 2181 (59.5%) were ≥ 60 years old and 52% were women. The risk of fall increased with age with an Odd ratio (OR) 1.52 for age 70-79 and an OR 3.40 for ≥80. Females fell 1.2 times more (age-adjusted OR 1.24; 95% CI 1.05-1.45) and 47% of ≥80 years old suffered FFH. Two-thirds of FFH occurred at a height ≤1 meter. Injury severity (ISS, NISS and GCS) were worse in Gp-II, lower extremities max Abbreviated Injury score (max AIS) was higher in Gp-III. Overall mortality was 8.7% (Gp-I 3.6% vs. 11.3% in Gp-II and 14% in Gp- III). Males showed higher mortality than females in the entire age groups (Gp-I: 4.6% vs 1%, Gp-II: 12.9% vs 4.2% and Gp-III: 17.3% vs 6.9% respectively). On multivariate analysis, shock index (OR 3.80; 95% CI 1.27-11.33) and male gender (OR 2.70; 95% CI 1.69-4.16) were independent predictors of mortality. Conclusions Fall from a height is more common in elderly female patients, but male patients have worse outcomes. Preventive measures for falls at home still are needed for the elderly of both genders.

Introduction

Adults age 60 and older are the fastest growing segment of the population in the world. In the USA the number of the elderly is expected to reach 89 million by 2050, while globally from 2025 to 2050, the older population is projected to reach 1.6 billion. Each year, 3 million elderly people are treated in the emergency department for fall-related injuries which are always associated with catastrophic functional outcomes [1-3]. Over 800,000 patients per year are hospitalized for a fall related injury, most commonly, head injuries or hip fractures [1]. Falls are one of the most common causes of traumatic brain injuries [2]. In the year of 2015, the total medical costs for fall-related injuries accounted for more than $50 billion [3]. Falls are the leading cause of injury and death among the elderly [1-3]. Approximately every third person (30%) of the population over the age of 65 and every other one (50%) over the age of 80 sustain falls each year [4, 5]. Recent estimates indicated that the incidence of falls leading to emergency admissions and mortality have been increasing over the past few years [6-9].

It has been estimated that one in four of people in the Western countries will be at geriatric age by the year 2030, therefore fall-related injuries and hospitalization will pose a burden on the community in the near future [10]. It can be concluded that health care costs for fall-related injuries will be a major issue in the geriatric population [11].

Morbidity and mortality are more common in elderly trauma patients compared to younger patients [12-14]. Age is an independent predictor of survival following trauma. In addition, elderly trauma patients have distinct patterns of injuries because of their unique physiologic, behavioral, and anatomical characteristics, thus, trauma is expected to dramatically affect the elderly quality of life [15].

Several prediction scores are used to manage trauma patients, including Injury Severity Score (ISS), Trauma Injury Severity Score (TRISS), Revised Trauma Score (RTS), New Injury Severity Score (NISS) and Shock Index (SI) [16, 17]. There is limited information available about clinical characteristics and outcomes of fall related injuries among the geriatric populations in the state of New York (NY) and its counties. The purpose of this study is to find out clinical characteristics, patterns, and outcomes of fall related injuries in elderly patients admitted to a Level I regional trauma center. We hypothesized that in elderly, fall-related injury and mortality are the same in both genders.

Material And Methods

This retrospective study was conducted at the Westchester Medical Center, Valhalla, NY, a 895 bed facility and a Level I regional trauma center that provides care to > 3.5 million people in New York's Hudson Valley region and beyond. The medical center covers a population across 6,200 square miles.

We retrieved data from the Trauma Registry System of our institution for all adult trauma patients ≥18 years old between January 2012 and December 2016. The registry follows the American College of Surgeons guidelines for data acquisition and storage in a Level I trauma center registry. Data were analyzed and compared on an annual basis across the last 6 years. Inclusion criteria included all men and women who sustained fall from height at age 60 years old and above. We excluded patients who died at the scene or lack relevant information (i.e., other mechanism of injury or incomplete fall-related data). Patients were divided into 3 groups based on their age: Group-I: 60-69, Group-II: 70-79 and Group-III: ≥80 years old.

Variables used in the data analysis for this study included demographics, age, gender, mechanism of injury (MOI), vital signs on arrival, the first Glasgow Coma Scale (GCS) score in the emergency department, height of fall (<1m, 1-3m, 3-6m, >6m), alcohol use, Abbreviated Injury Scale (AIS) scores for each body region, ISS, NISS, TRISS, blood transfusion, length of hospital stay (HLOS), in-hospital mortality, and diabetes

mellitus and alcoholism. In brief, AIS, ISS, and NISS are anatomical, GCS is a physiological scoring system, and TRISS is a combined scoring system for survival prediction. Shock index (SI) was defined as admission heart rate divided by the systolic blood pressure [18,19]. This study follows STROBE checklist (Supplementary Table).

This study granted ethical approval from the Westchester Medical Center, and New York Medical College, Valhalla, NY, USA (IRB approval number, L-12,432).

Statistical analysis: Descriptive and inferential statistics were applied for data analysis. Data were presented as mean (standard deviation), median (range), median (interquartile range; IQR) or number (%) as appropriate. Data were analyzed and compared using Chi-square and one-way analysis of variance (ANOVA) tests. The Post Hoc Bonferroni test was used for the pairwise comparison. We compared patients' characteristics and outcomes in each gender, age groups (60-69, 70-79 vs ≥80 years) and within each gender (< vs > 65 years old) and different heights. The association between age, gender and falls was assessed by logistic regression. The association between the fall height and other variables were assessed by ANOVA. For predictors of mortality among patients with fall-related injury, multivariable logistic regression analysis was conducted after adjustment for the potential relevant variables such as age, gender, diabetes mellitus, fall height, SI, ISS, GCS and need for blood transfusion. Data were expressed with odds ratio (OR) and 95% confidence intervals (CI). Statistical significance was defined as a p-value < 0.05. Data were analyzed using Statistical Package for the Social Sciences (SPSS) for Windows Version 21.0 (SPSS Inc; Chicago, IL, USA).

Results

Out of 8528 adult trauma patients, 3665 (43%) had fall related injuries, of them 2181 (59.5%) were ≥ 60 years old and 1132 (52%) were females. Figure 1 shows the study design and breakdown of Fall-related injury population. While the risk of fall increased with age with an OR 1.52 (95% CI 1.25-1.84) for patients between ages 70 and 79, the probability of fall was 3.4 times greater for patients' age ≥ 80 (an OR 3.40; 95% CI 2.76-4.08). Female gender was associated with increased risk of fall by 1.2 times (age-adjusted OR 1.24; 95% CI 1.05-1.45).

Table 1 shows the demographics, characteristics and outcomes in patients with fall-related injury based on the age group. There were no significant differences for the proportions of falls across the years among age groups; however, almost half of elderly adults (47%) sustained fall-related injury at age ≥80 years old. Whites were the most common to experience falls in all age groups. The majority of elderly sustained a home related fall (72.9%).

Injury severity in terms of ISS, NISS, TRISS and GCS were worse in group II in comparison to group I and III (p<0.001). Shock index was greater in group 1 in comparison to the other groups (p<0.001). Lower extremities max AIS was higher in group III (p<0.001) whereas upper extremities max AIS and rib fractures were greater in group I (p<0.001). Head and spine injuries were comparable among all the groups. Alcohol consumption and diabetes mellitus were reported in 11% and 25% of the study cohort, respectively. Alcohol consumption was more frequent in group I (6.5%) and II (6%) whereas diabetes mellitus was more prevalent in group II (30.2%) and group I (24.1%). Blood transfusion was required in 6.3% of the cohort; particularly in group III (19.3%) in comparison to the other groups (p<0.001). The mean hospital length of stay was greater in group II (p<0.001). In Table 2, patients with fall-related injury were stratified according to the height of fall. The proportions of fall from a height less than 3 meter were more frequent in females whereas fall from 3 meters or higher was more in males. Two-thirds of fall-related injury occurred at a height ≤1 meter. Although statistically it was not significant, the mortality was higher in those who fell down from < 1 meter (8.8%) and those who fell down from >6 meter distance (8.7%) in comparison to other heights. Figures 1 also shows the proportion of falls and mortality in each age group. Overall mortality was 8.7% (group I 3.6%, 11.3%, and 14% in group I-III, respectively). Mortality was significantly higher among males in comparison to females in all the age groups (group I: 4.6% *vs* 1%, group II: 12.9% *vs* 4.2% and group III: 17.3% vs 6.9% respectively) (p<0.003). Table 3 shows differences between elderly females and males. The mortality was 2-fold higher in males. Males had higher fall heights, ISS and NISS, fewer GCS, higher proportion of rib fractures, diabetes and smoking in comparison to females. A subanalysis within each gender, shows patients' characteristics and outcomes based on age < 65 years vs > 65 years old (Table 4) . It shows that in females, the fall was more frequent in those who were of age 65 and above whereas in males the majority of fall was in the younger age. However, the severity of injury, rib fractures, diabetes mellitus, blood transfusion and mortality were more frequent in males aged 65 and above. Of note, females were 4 years younger than males in those who in the age group of <65 whereas females were 3 years older than males in those who in the age group of 65 and above. Table 5 shows fall-related injury and mortality by year (2012-2016).

Multivariable logistic regression analysis (Table 6) showed that SI (OR 3.80;95% CI 1.27-11.33) and male gender (OR 2.70; 95% CI 1.69-4.16) were independent predictors of mortality among elder patients who fell down after adjustment for age, diabetes mellitus , GCS, ISS, height of fall and need for blood transfusion.

Discussion

This study analyzed the demographics and clinical characteristics of fall related injuries observed in a geriatric population presented to a Level I trauma center in Westchester County, New York. Although our trauma center draws patients from many other counties in New York state (over

3.5 million population), the largest portion come from Westchester county, which is just north of New York City, and had a population estimate of approximately 980,000 in 2017, according to U.S. Census [16]. The county covers an area of 450 square miles and includes six cities, 19 towns, and 23 villages [16]. The county is racially diverse with an estimate of 73.5% (White alone) and 24.9% (Hispanic or Latino). Twenty-two percent of the population is under the age of 18 and 16.6% is aged 65 years or older and 51.5% of the population is female gender [16].

This study shows that fall-related injuries represent 43% of the total trauma admissions and nearly 60% of them are of age 60 and above. Almost half of elderly adults sustained fall-related injury at age ≥80 years old. Approximately three-quarter of elderly sustained a home related fall. Across the study period from 2012 to 2016, there were no significant changes in the proportions of falls among different age groups; however, mortality decreased from 10% to 5.6% (Table 5). This drop in mortality could be in part explained by the higher mean ISS in 2012 (13±8) in comparison to 10±7.6 in 2016; in addition to the improvement in the health care system. Of note, mortality in females decreased from 7.5% in 2012 to 1.2% in 2016 (p=0.02), whereas it varied in males from 12.4% in 2012 to 11.1 in 2016 with a peak in 2014 (14.4%). The mean age, ISS and GCS did not show significant changes per year in female gender and therefore it could not explain the drop in mortality between 2012 and 2016. The risk of fall increases significantly with the increase in age with an OR of 3.4 in patients aged 80 and above. Furthermore, our study shows that female gender is associated with increased risk of fall regardless of the age. The mortality was greater in males by 2 times, which could be related to the higher ISS, head AIS , height of fall and NISS and lower GCS in addition to the greater frequency of having DM, alcohol consumption, smoking habit, and rib fractures.

Prior data reported that almost one third of the elderly population fall at least once per year [21-24], however, our study reported one fifth of elderly falls once per year.

Our data shows that women between 60 and 79 years old sustain more fall injury, however, at age of 80 and above, men fell more than women. Prior reports conducted on emergency department visits showed that women experienced fall-related injury more than men [17,25-28]. In contrary, two studies reported that men comprised a more proportion of fall-related emergency visits [29-30]. Recently, Galet et al [24] evaluated WHO mortality and readmission database between 2010 and 2014 among elderly. The authors observed 1.4 and 2% increase in the fall-related mortality and readmission for a subsequent fall, respectively. Fall was the most common mechanism of injuries in women who required hospitalization and the majority of fall patients readmitted within 30 days were also women [24].

It is difficult to establish the factors affecting mortality in falls [23]. The WHO database showed that elderly with uncomplicated and complicated diabetes mellitus were at 16% and 31% increased risk of being admitted for fall injury, respectively [24]. Also it was observed that anemic patients had a 21% increased risk of being admitted for a fall injury. Alcohol consumption and diabetes mellitus were reported in 11% and 25% of our study cohort, respectively.

In the present study, shock index and male gender were independent predictors of mortality among elder patients who fell down after adjustment for age, diabetes mellitus, GCS, ISS, height of fall and need for blood transfusion.

In 2010, Bennett et al [32] studied the outcomes in 422 patients ≥80 years old vs 898 patients aged 60-79 years old after traumatic injury. The first group had significantly higher risk-adjusted in-hospital mortality (OR 1.94; 95% CI 1.14, 3.31). In our study this elderly group who sustained fall injury after adjustment for gender and GCS had a higher mortality with OR 2.871;95% CI 1.97-4.19).

In the United States, falls from the standing height are considered the second cause of death due to unintentional injuries in the elderly [33]. Based on the present study; home related falls were the most common falls in elderly. In 2011 Rapp et al [34] analyzed nearly 70,000 elderly for falls that occurred in residences in Germany and observed a higher frequency of falls among male patients, and approximately 75% of the events occurred in the bedroom or bathroom. A previous study with a small sample size showed that elderly who sustained falls-related injury at bathroom were significantly associated with the female gender and high mortality rate [35].

Limitations: The limitations of this study include the use of a retrospective design and the lack of availability of data regarding the risk factors, other than diabetes and alcoholism, such as pulmonary, cardiac and stroke in addition to the circumstances of the mechanism of injury and readmissions. Although we intended to include all fall-related injuries in elderly, selection bias cannot be ignored. There is a significant number of patients with missing information regarding the location of fall (home, workplace or public). Additionally, our single center study is not a representative of the entire population of United States and our results may therefore not be generalizable. When comparing census data of Westchester County to the U.S. in general, there is a higher percentage of Hispanic or Latino, in Westchester County. The U.S. has an average of 18.1% versus 24.9% in Westchester County. Westchester County is slightly more racially diverse than that of the rest of the United States, on average. Additionally, Westchester has slightly more elderly adults than the average of the United States, where Westchester had 16.6% over aged 65, the U.S. in general has 15.6%. However, we do not have data of county origin of patients. Another major limitation of our study is the lack of data on anticoagulants, antihypertensive, hypoglycemic agents and polymedications. Most recently, the frailty index has become a popular tool in predicting outcomes in elderly trauma patients, however it was lacking in our data [36].

Conclusions: Falls from height among the elderly is a major public health concern, and increases with age, particularly among females. However, males have worse outcomes. Preventive measures for falls at home among elderly should have a priority in the major healthcare action plans

List Of Abbreviations

ISS: injury severity score

AIS: abbreviated injury scale

GCS: Glasgow coma scale

FFH: fall from hieght

TRISS: Trauma ISS

NISS: new ISS

Declarations

Ethics approval and consent to participate: This study granted ethical approval from the Westchester Medical Center, and New York Medical College, Valhalla, NY, USA (IRB approval number, L-12,432).

Consent for publication: This study granted ethical approval from the Westchester Medical Center

Availability of data and material: N/A

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References

1. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Web–based Injury Statistics Query and Reporting System (WISQARS) [online]. Accessed November 1, 2018.

2. Jager TE, Weiss HB, Coben JH, Pepe PE. Traumatic brain injuries evaluated in U.S. emergency departments, 1992–1994. Academic Emergency Medicine 2000&359;7(2):134–40.

3. Florence CS, Bergen G, Atherly A, Burns ER, Stevens JA, Drake C. Medical Costs of Fatal and Nonfatal Falls in Older Adults. Journal of the American Geriatrics Society, 2018 March, DOI:10.1111/jgs.15304

4. Hausdorff JM, Rios DA, Edelberg HK: Gait variability and fall risk in community-living older adults: a 1-year prospective study. Arch Phys Med Rehabil 2001, 82(8):1050–1056.

5. Inouye SK, Brown CJ, Tinetti ME: Medicare nonpayment, hospital falls, and unintended consequences. N Engl J Med 2009, 360(23):2390–2393.

6. Meschial WC, Soares DF, Oliveira NL, Nespollo AM, Silva WA, Santil FL: Elderly victims of falls seen by prehospital care: gender differences. Rev Bras Epidemiol 2014, 17(1):3–16.

7. Wendelboe AM, Landen MG: Increased fall-related mortality rates in New Mexico, 1999-2005. Public Health Rep (Washington, DC: 1974) 2011, 126(6):861–867.

8. Rockett IR, Regier MD, Kapusta ND, Coben JH, Miller TR, Hanzlick RL, Todd KH, Sattin RW, Kennedy LW, Kleinig J, Smith GS: Leading causes of unintentional and intentional injury mortality: United States, 2000-2009. Am J Public Health 2012, 102(11):e84–e92.

9. Hartholt KA, Polinder S, van Beeck EF, van der Velde N, van Lieshout EM, Patka P, van der Cammen TJ: End of the spectacular decrease in fall-related mortality rate: men are catching up. Am J Public Health 2012, 102(Suppl 2):S207–S211.

10. Bergeron E, Clement J, Lavoie A, Ratte S, Bamvita JM, Aumont F, Clas D: A simple fall in the elderly: not so simple. J Trauma 2006, 60(2):268–273.

11. Labib N, Nouh T, Winocour S, Deckelbaum D, Banici L, Fata P, Razek T, Khwaja K: Severely injured geriatric population: morbidity, mortality, and risk factors. J Trauma 2011, 71(6):1908–1914.

12. Pandya SR, Yelon JA, Sullivan TS, Risucci DA: Geriatric motor vehicle collision survival: the role of institutional trauma volume. J Trauma 2011, 70(6):1326–1330.

13. Caterino JM, Valasek T, Werman HA: Identification of an age cutoff for increased mortality in patients with elderly trauma. Am J Emerg Med 2010, 28(2):151–158.

14. Min L, Ubhayakar N, Saliba D, Kelley-Quon L, Morley E, Hiatt J, Cryer H, Tillou A: The vulnerable elders survey-13 predicts hospital complications and mortality in older adults with traumatic injury: a pilot study. J Am Geriatr Soc 2011, 59(8):1471–1476.

15. Taylor MD, Tracy JK, Meyer W, Pasquale M, Napolitano LM: Trauma in the elderly: intensive care unit resource use and outcome. J Trauma 2002, 53(3):407–414.

16. Data for U.S. Census, Westchester County. Retrieved from https://www.census.gov/quickfacts/fact/table/westchestercountynewyork,mamaronecktownwestchestercountynewyork/AGE775217#viewtop. Accessed on 24 November 2018.

17. Rau CS, Lin TS, Wu SC, Yang JC, Hsu SY, Cho TY, Hsieh CH. Geriatric hospitalizations in fall-related injuries. Scand J Trauma Resusc Emerg Med. 2014 Nov 12;22:63. doi: 10.1186/s13049-014-0063-1.

18.El-Menyar A, Mekkodathil A, Abdelrahman H, Latifi R, Galwankar S, Al-Thani H,

Rizoli S. Review of Existing Scoring Systems For Massive Blood Transfusion in

Trauma Patients: Where Do We Stand? Shock. 2019 Apr 16. doi:

10.1097/SHK.0000000000001359

19. El-Menyar A, Goyal P, Tilley E, Latifi R. The clinical utility of shock index to predict the need for blood transfusion and outcomes in trauma. J Surg Res. 2018 Jul;227:52-59. doi: 10.1016/j.jss.2018.02.013. Epub 2018 Mar 12.

20. Greenberg MR, Moore EC, Nguyen MC, Stello B, Goldberg A, Barraco RD et al. Perceived Fall Risk and Functional Decline: Gender Differences in Patient's Willingness to Discuss Fall Risk, Fall History, or to Have a Home Safety Evaluation.Yale J Biol Med. *2016 Jun 27;89(2):261-7*

21. Gates S, Smith LA, Fisher JD, Lamb SE. Systematic review of accuracy

of screening instruments for predicting fall risk among independently living older adults. J Rehabil Res Dev. 2008;45(8):1105–1116.

22. Stel VS, Smit JH, Pluijm SM, Lips P. Balance and mobility performance as treatable risk factors for recurrent falling in older persons. J Clin

Epidemiol. 2003;56(7):659–668.

23. O'Loughlin JL, Robitaille Y, Boivin JF, Suissa S. Incidence of and risk factors for falls and injurious falls among the community-dwelling

elderly. Am J Epidemiol. 1993;137(3):342–354

24. Galet C, Zhou Y, Eyck PT, Romanowski KS. Fall injuries, associated deaths, and 30-day readmission for subsequent falls are increasing in the elderly US population: a query of the WHO mortality database and National Readmission Database from 2010 to 2014. Clin Epidemiol. 2018 Nov 8;10:1627-1637

25. Wu MY, Chen YL, Yiang GT, Li CJ, Lin AS. Clinical Outcome and Management for Geriatric Traumatic Injury: Analysis of 2688 Cases in the Emergency Department of a Teaching Hospital in Taiwan. J Clin Med. 2018 Sep 4;7(9). pii: E255. doi: 10.3390/jcm7090255.

26. Hartholt KA, Polinder S, Van der Cammen TJ, Panneman MJ, Van der Velde N, Van Lieshout EM, Patka P, Van Beeck EF: Costs of falls in an ageing population: a nationwide study from the Netherlands (2007-2009). Injury. 2012, 43 (7): 1199-1203.

27. Mathers LJ, Weiss HB: Incidence and characteristics of fall-related emergency department visits. Acad Emerg Med. 1998, 5 (11): 1064-1070.
28. Rosen T, Mack KA, Noonan RK. Slipping and tripping: fall injuries in adults associated with rugs and carpets. J Inj Violence Res. 2013;5(1):61–69

29. Gelbard R, Inaba K, Okoye OT, Morrell M, Saadi Z, Lam L, Talving P, Demetriades D: Falls in the elderly: a modern look at an old problem. Am J Surg. 2014, 208 (2): 249-253. 10.1016/j.amjsurg.2013.12.034.

30. Kara H, Bayir A, Ak A, Akinci M, Tufekci N, Degirmenci S, Azap M: Trauma in elderly patients evaluated in a hospital emergency department in Konya, Turkey: a retrospective study. Clin Interv Aging. 2014, 9: 17-21.

31. Icer M, Guloglu C, Orak M, Ustundag M: Factors affecting mortality caused by falls from height. Ulus Travma Acil Cerrahi Derg. 2013, 19 (6): 529-535. 10.5505/tjtes.2013.77535.

32. Bennett KM, Scarborough JE, Vaslef S. Outcomes and health care resource utilization in super-elderly trauma patients. J Surg Res. 2010;163(1):127-31.

33. Bergeron E, Clement J, Lavoie A, Ratte S, Bamvita JM, Aumont F, et al. A simple fall in the elderly: not so simple. J Trauma. 2006;60(2):268-73.

34. Rapp K, Becker C, Cameron ID, König HH, Büchele G. Epidemiology of falls in residential aged care: analysis of more than 70,000 falls from residents of bavarian nursing homes. J Am Med Dir Assoc. 2012;13(2):187.

35. Abdelrahman H, Almadani A, El-Menyar A, Shunni A, Consunji R, Al-Thani H. Home-related falls: An underestimated mechanism of injury. J Fam Community Med 2018;25:48-51

36. Joseph B, Pandit V, Rhee P, Aziz H, Sadoun M, Wynne J, Tang A, Kulvatunyou N, O'Keeffe T, Fain MJ, Friese RS. Predicting hospital discharge disposition in geriatric trauma patients: is frailty the answer? J Trauma Acute Care Surg. 2014 Jan;76(1):196-200. doi: 10.1097/TA.0b013e3182a833ac

Tables

Table 1: Demographics, characteristics and outcomes based on age group in fall-related injured patients

Variable	Age 60 – 69	Age 70 – 79	Age ≥80	P
Total (N = 2181)	584(27%)	570(26%)	1027(47%)	
White (N =1826)	450 (77.1%)	456 (80.0%)	920 (89.6%)	0.001
Black (N =93)	43 (7.4%)	28 (4.9%)	22 (2.1%)	
Hispanic (N=116)	48 (8.4%)	29 (5.1%)	39 (3.8%)	
Alcohol consumption (N =231, 10.6%)	38 (6.5%)	34 (6.0%)	43 (4.2%)	0.001
NISS*	14.43, 12.0 (1-75)	15.93, 12.0 (1-75)	14.96, 12.0 (1-75)	0.001
ISS*	10.82, 9.0, (1-75)	11.99, 9.0, (1-75)	11.73, 9.0, (1-50)	0.001
Shock index**	0.62±0.16	0.61±0.19	0.60±0.16	0.001
TRISS**	0.9258 ±0.139	0.9085± 0.162	0.920± 0.141	0.001
Year				
2012 (N=438, 20.1%)	114 (19.5%)	127 (22.3%)	197 (19.2%)	0.372
2013 (N=448, 20.5%)	119 (20.4%)	115 (20.2%)	214 (20.8%)	
2014 (N=430, 19.7%)	125 (21.4%)	114 (20.0%)	191 (18.6%)	
2015 (N=417, 19.1%)	115 (19.7%)	97 (17.0%)	205 (20.0%)	
2016 (N=448, 20.5%)	111 (19.0%)	117 (20.5%)	220 (21.4%)	
Place of trauma				0.001
Public (N=156)(27.1%)	32 (33.3%)	15 (14.9%)	16 (8.05)	
Residence (N=420) (72.9%)	64 (66.7%)	86 (85.1%)	185 (92.0%)	
Fall Height *	8.67, 8.0, (1-40)	7.69, 6.0, (1-30)	5.45, 3.0, (1-40)	0.001
Glasgow coma scale				
Mild (> 12),N=1957	531 (91.2%)	506 (88.9%)	920 (90.1%)	0.243
Moderate (8-12),N=76	17 (2.9%)	19 (3.3%)	40 (3.9%)	
Severe (< 8), N=139	34 (5.8%)	44 (7.7%)	61 (6.0%)	
Max AIS**				
Head	3.03 (1.18)	3.2 (1.22)	3.06 (1.25)	0.199
Upper extremities	1.89 (.56)	1.87 (.54)	1.77 (.57)	0.040
Lower extremities	2.16 (.65)	2.34 (.75)	2.46 (.75)	0.001
Spine	2.39 (.80)	2.5 (.77)	2.4 (.64)	0.508
Diabetes mellitus (N = 536)(25%)	141 (24.1%)	172 (30.2%)	223 (21.7%)	0.001
Rib injury (N = 369) (16.9%)	104 (17.8%)	88 (15.4%)	177 17.2%)	0.001
Blood Transfusion (N=321) (6.3%)	71 (13.5%)	70 (13.6%)	180 (19.3%)	0.003
Hospital stay, days*	8.10, 5.0, (1-95)	9.8, 6.0, (1-302)	7.95, 6.0, (1-96)	0.001
Mortality (N=28 (8.7%)	5 (3.6%)	11 (11.3%)	12 (14%)	0.001

*=mean, median and range. **=mean and standard deviation

able 2: patients characteristics based on the height of fall (n=2181)

ariables	<1m (n=1438; 66%)	1-3m (n=292, 13%)	>3-6m (n=130, 6%)	>6m (n=321, 15%)	P
emale N(%)	811 (56.4)	171 (58.6)	58 (44.6)	92 (28.7)	0.001
ale N(%)	627 (43.6)	121 (41.4)	72 (55.4)	229 (71.3)	0.001
ge (years) **	79(60-103)	81(60-102)*	74 (60-99)*	71 (60-98)*	0.001
S**	10 (9.7-10.3)	10.7 (9.9-11.5)*	12.1 (10.9-13.3)*	13.4 (12.8-14.1)*	0.001
ISS**	13.2 (12.8-13.7)	13.7 (12.7-14.8)*	16.7 (15.1-18.3)*	17.8 (16.9-18.7)*	0.001
bdomen AIS**	2.4 (2.2-2.6)	2.1 (1.7-2.5)	2.6 (2-3.2)	2.2 (1.9-2.4)*	0.235
ead AIS**	3.2 (3.1-3.3)	3.1 (2.9-3.3)	2.9 (2.7-3.1)	2.8 (2.7-3)*	0.001
horax AIS**	2.7 (2.6-2.8)	2.6 (2.4-2.9)	2.7 (2.5-3)	2.7 (2.6-2.8)	0.968
pper extremity AIS**	1.8 (1.8-1.9)	1.9 (1.7-2)	2 (1.8-2.1)	1.9 (1.9-2)	0.044
pine AIS**	2.5 (2.4-2.6)	2.5 (2.3-2.6)	2.5 (2.2-2.7)	2.3 (2.3-2.4)*	0.013
ower extremity AIS**	2.4 (2.3-2.4)	2.5 (2.4-2.6)	2 (1.9-2.2)*	2 (1.9-2.1)*	0.001
robability of survival (TRISS)	0.94 (0.93-0.94)	0.94 (0.92-0.95)	0.93 (0.91-0.95)	0.93 (0.92-0.94)	0.069
ospital stay, days	7.7 (7.2-8.1)	7.9 (7-8.8)	7.8 (6.6-9)	8.1 (7.5-8.7)	0.800
ortality	127 (8.8%)	18 (6.2%)	9 (6.9%)	28 (8.7%)	0.44

Post hoc Bonferroni test significant (p<0.05) and reference group is <1m height of fall,**= median ,range. IS=abbreviated injury score , ISS: injury severity score , NISS=new ISS

Table 3 : comparison between females and males aged > 60 years old			
	Females	**Males**	**P**
Age > 80 years	4.8%	7.2%	0.37
NISS	13.5±10	16.7±12.6	0.001
ISS 16-24 >24	 16% 6%	 20% 13%	0.001for all
GCS 8-12 <8	 2.6% 4.7%	 4.5% 8.4%	0.002 for all
Max AIS head >2	67%	73%	0.09
Alcohol consumption	4.2%	6.2%	0.02
Smoking	4%	8.7%	0.001
Diabetes mellitus	22.8%	26.4%	0.05
Rib fractures	13%	21%	0.001
Fall heights median(IQR)	<1(<1-3)	3(<1-6)	0.02
Mortality	5.2%	12.4%	0.001

Table 4: patients characteristics and outcomes within each gender based on the age groups (< vs > 65 years)						
	Females (n=1510; 41.2%)			Males (n=2155; 58.8%)		
	<65 yrs	>65 yrs	p	<65 yrs	>65 yrs	p
Patients number	488(32.3%)	1022(67.7%)	0.001	1300(60.3%)	855(39.7%)	0.001
Mean age ±SD	27±22	81±9.0	0.001	31±20	78±8.0	0.001
ISS*	5(4-9)	9(5-14)	0.001	9(4-13)	10(8-17)	0.001
NISS*	8(4-12)	10(9-17)	0.001	9(4-17)	13(9-22)	0.001
TRISS*	0.994(0.983-0.996)	0.968(0.943-0.975)	0.001	0.994(0.983-0.996)	0.965(0.933-0.970)	0.001
Fall height*	4(3-9.5)	3(3-8)	0.004	8(4-15)	6(3-11)	0.001
Diabetes mellitus	6.3%	23.3%	0.001	6.9%	26.8%	0.001
Rib fractures	4.2%	13.5%	0.001	11%	20%	0.001
GCS≤8	4.3%	5.6%	0.17	5.7%	8.9%	0.002
Blood transfusion	4.1%	15.6%	0.001	5.2%	18.1%	0.001
Mortality N(%)	8(1.6%)	56(5.5%)	0.001	32(2.5%)	116(13.6%)	0.001
*Data presented as median (interquartile range).						

le 5: fall-related injury and mortality by year					
	2012	2013	2014	2015	2016
-related injury in WCMC ≥ 60 yrs	20%	20.5%	19.7%	19%	20.5%
-related mortality in WCMC	5.1%	5.1%	4.4%	3.8%	3.1%
-related Mortality WCMC≥ 60 yrs	10%	9.6%	9.3%	7.2	5.6%
-related mortality in WCMC-Females ≥60 yrs	7.5%	6.5%	4.8%	6.3	1.2%
-related mortality-WCMC-Males ≥ 60 yrs	12.4%	12.5%	14.4%	8.3%	11.1%
MC= patients attending Westchester medical center, Valhalla, NY					

Table 6: predictors of mortality in patients with fall-related injury				
Variable	Odd ratio	95% CI		P
Age	1.059	1.035	1.085	0.001
Fall height	0.924	0.877	0.973	0.003
Injury Severity Score	1.123	1.094	1.153	0.001
Sex (male)	2.70	1.69	4.16	0.001
Diabetes mellitus	1.253	0.769	2.041	0.366
Blood Transfusion	1.455	0.915	2.314	0.113
Glasgow Coma scale	0.814	0.772	0.858	0.001
Shock Index	3.796	1.271	11.331	0.017

Figures

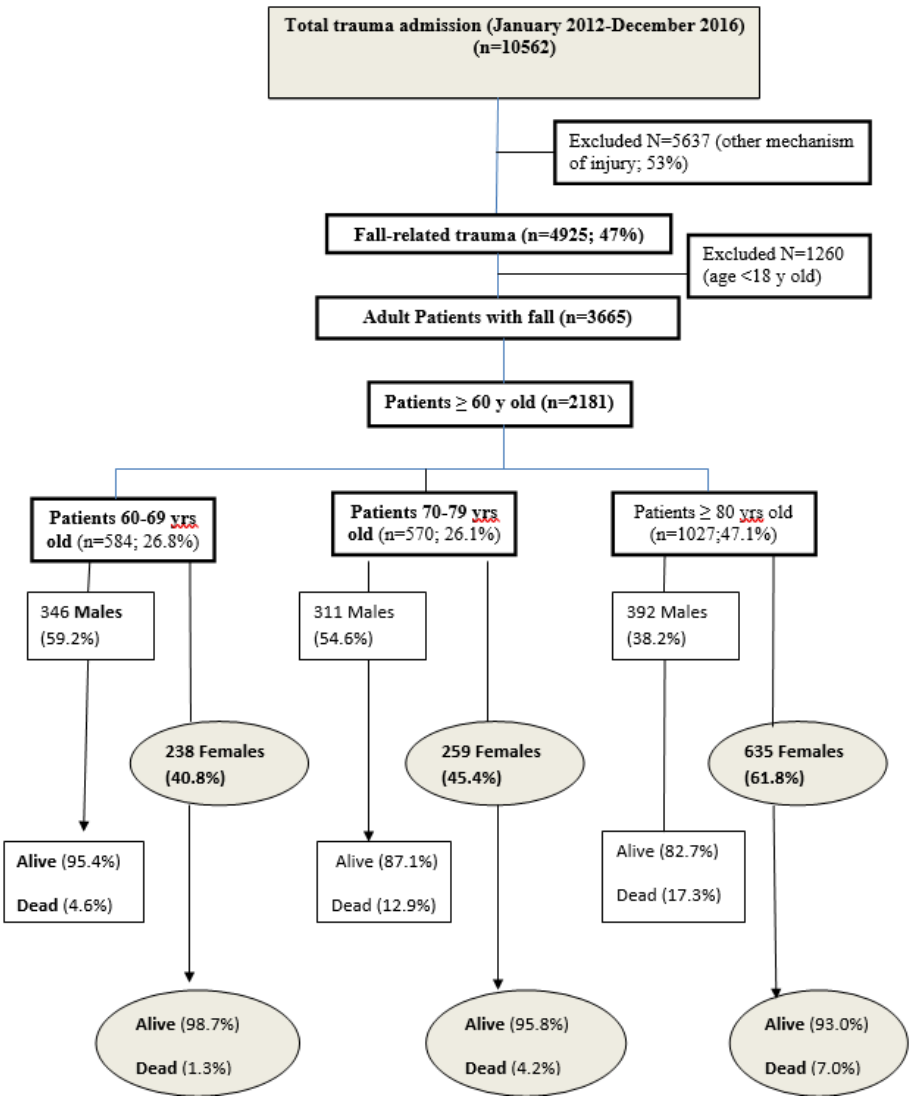

Figure 1

Flow diagram showing study design and proportions of injury and mortality by gender.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- supplement1.doc