Original Article

The Changing Epidemiology of Serious Trauma in the Elderly Population: An Increasing Concern of a Tertiary Hospital in Singapore

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Abstract

Introduction: Although trauma is often seen in the young, there is a recent shift in this trend as more elderly patients are hospitalised for traumatic injuries. This study examined serious trauma in young and elderly patients and hypothesised that the increase in incidence of elderly serious trauma has led to greater burden of care in hospitals and health services. Materials and Methods: Details of trauma patients admitted with an Injury Severity Score ≥9 or to the intensive care unit or high dependency unit of a tertiary acute hospital between 2004 and 2015 were retrospectively reviewed. Patients ≥65 years old who sustained low-impact trauma that resulted from same-level falls with isolated hip fractures or compression fractures of the vertebral column were excluded. Patients were classified as either elderly (≥65 years old, n = 5074) or young (<65 years old, n = 9088) and their baseline characteristics, complications rate and length of hospital stay were evaluated. Results: Elderly patients ≥65 years old accounted for 51.2% of seriously injured patients after 2014 and their numbers are increasing at an annual rate of 16.5%. They also experienced longer hospital stay in the general ward than younger patients. Conclusion: The number of elderly trauma patients were thrice that of all trauma patients seen and they also required longer hospitalisation. This trend has led to greater burden of care in hospitals and health services in Singapore.

Ann Acad Med Singapore 2019;48:354–62

Key words: Burden of care, Length of stay, Resource utilisation, Trend

Introduction

The burden of care for an ageing population on health services is a growing concern in developed countries.[1,2] In Singapore, the life expectancy of its residents has risen from 79.1 years in 2003 to 82.4 years in 2013.[3] Trauma is often seen in those ≤45 years old.[4] However, recent studies in developed countries have shown a shift in this trend as their elderly population increases.[5,6] Similar to young children, low energy transfers such as a simple slip or fall from the same level in the elderly may cause significant injuries. In the aged population, difficulties in early diagnosis are further complicated when they have pre-existing medical conditions and altered physiological response to trauma.[7]

In Singapore, the incidence of elderly patients admitted to hospitals as a result of trauma is rising and the impact and significance of this growing trend on hospitals and health services—in terms of burden of care, patient outcomes and resource utilisation—are not known. However, several studies have shown that there is a correlation between age, mortality and utilisation of health services.[8–10]

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This study aimed to compare and describe serious trauma in elderly and young patients in an acute tertiary hospital over a 12-year period. It also investigated rates of adverse complications and length of stay (LOS) in both groups of patients.

Materials and Methods

Retrospective data from the trauma registry of Tan Tock Seng Hospital (TTSH)—an acute tertiary hospital in Singapore with a high patient load of adult trauma and the elderly[11]—between 1 January 2004 and 31 December 2015 were retrieved for analysis. The details included demographics, injury epidemiology and treatment outcomes in patients.

Patients were classified as either elderly (≥65 years old, n = 5074) or young (<65 years old, n = 9088). Adult trauma patients with serious injuries graded ≥9 on the Injury Severity Score (ISS),[12] admitted to the High Dependency Unit (HDU) or Intensive Care Unit (ICU) were included. Patients with isolated hip fractures or compression fractures of the vertebral column sustained in low-impact, same-level falls were excluded since these injuries were not available in the database.

The variables examined included comorbidities (existing medical conditions or prior surgical history), injury data according to ISS and Revised Trauma Score, Glasgow Coma Scale (GCS) result, heart rate (HR), mechanism of injury (MOI), probability of survival (PS), surgical requirements and complications, systolic blood pressure (SBP) and outcome data including LOS in Acute Care Unit (ACU), General Ward (GW), HDU, ICU and mortality. Data were analysed using SPSS Statistics for Windows version 19.0 (IBM Corp., Armonk, NY, USA).

For continuous data, histograms and Q-Q plots were used to examine its distribution and the results were shown as median and interquartile range (IQR). For non-parametric data, Mann-Whitney U test was used to compare both groups of patients. Kruskal-Wallis test was used to test for significance between both groups over the study period. Aggregates were shown in percentage values and analysed using chi-square test. Data in 2004 and 2015 were compared to test for temporal changes and differences in epidemiology and trauma outcomes. LOS analysis included only survivors from this study. A value of P <0.05 was considered statistically significant.

This study (REF2016/00689) was approved by the Domain Specific Review Board of the National Healthcare Group, Singapore.

Results

A total of 14,162 patients were included in the study. Between 2004 and 2015, annual mean rate of increase in total patient volume and elderly patients was 5.4% (Fig. 1) and 16.5% (Table 1), respectively. Median age of female (69 years old) patients was higher than male (47 years old) patients. Compared to young patients, elderly patients with severe injuries increased threefold from 17.5% to 51.9% over the same period (Table 1).

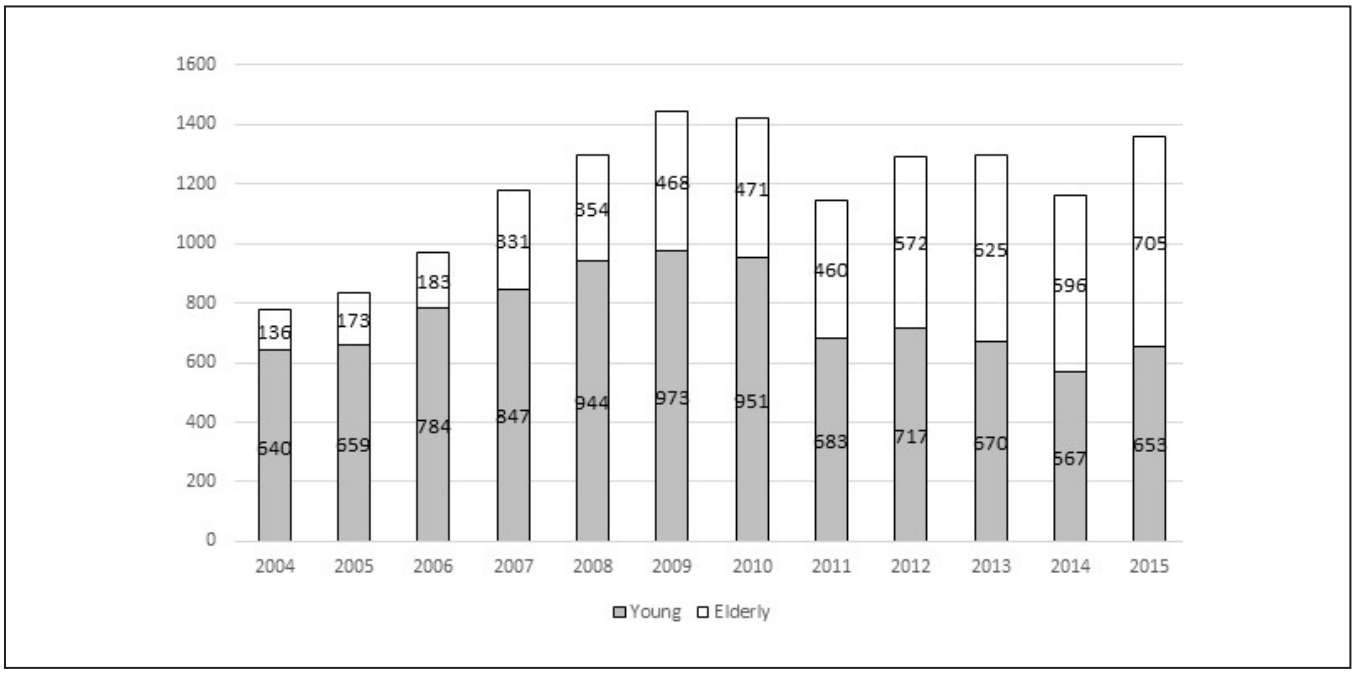


Fig. 1. Growing trend of elderly and young trauma patients with Injury Severity Score ≥9 from 2004 to 2015.

Table 1. Baseline Characteristics of Elderly (≥65 Years Old) and Young (≥65 Years Old) Trauma Patients from 2004 to 2015

Variable	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Elderly*	136 (17.5)	173 (20.8)	183 (18.9)	331 (28.1)	354 (27.3)	468 (32.5)	471 (33.1)	460 (40.2)	572 (44.4)	625 (48.3)	596 (51.2)	705 (51.9)
Young*	640 (82.5)	659 (79.2)	784 (81.1)	847 (71.9)	944 (72.7)	973 (67.5)	951 (66.9)	683 (59.8)	717 (55.6)	670 (51.7)	567 (48.8)	653 (48.1)
Age (years)*												
Women	54 (36 – 69)†	54 (30 – 74)†	51 (36 – 69)†	61 (41 – 77)†	62 (42 – 77)†	68 (50 – 78)†	65 (50.5 – 79)†	72 (55 – 82)†	72 (57 – 83)†	76 (61 – 85)†	74 (61 – 84)†	77 (63 – 86)†
Men	39 (27 – 53)	38 (28 – 54)	42 (29 – 55)	41 (29 – 59)	42 (29 – 59)	44 (29 – 61)	46 (32 – 64)	51 (32 – 68)	57 (37 – 72)	57 (38 – 71)	57 (38 – 74)	59 (40 – 73)
GCS												
Elderly*	15 (14 – 15)	15 (10 – 15)†	15 (15 – 15)	15 (14 – 15)	15 (15 – 15)	15 (15 – 15)	15 (15 – 15)	15 (15 – 15)	15 (15 – 15)†	15 (15 – 15)	15 (15 – 15)	15 (15 – 15)†
Young	15 (14 – 15)	15 (14 – 15)	15 (14 – 15)	15 (15 – 15)	15 (15 – 15)	15 (15 – 15)	15 (15 – 15)	15 (15 – 15)	15 (15 – 15)	15 (15 – 15)	15 (15 – 15)	15 (15 – 15)
HR (bpm)												
Elderly	78 (67 – 91)†	78 (68 – 91)†	81 (70 – 94)	83 (69 – 93)†	80 (69 – 93)†	80 (70 – 92)†	78 (70 – 93)†	80 (70 – 91)†	81 (70 – 92)†	80 (71 – 92)†	78 (67 – 91)†	78 (68 – 91)†
Young	83 (72 – 96)	84 (72 – 96)	83 (72 – 96)	83 (73 – 94)	83 (72 – 96)	83 (73 – 96)	84 (72 – 96)	85.5 (74 – 98)	87 (75 – 98)	86 (75 – 97)	83 (72 – 96)	84 (72 – 96)
SBP (mm Hg)												
Elderly*	159 (136 – 182)†	153 (134 – 174)†	150 (129 – 171)†	149 (131 – 171)†	147 (128 – 168)†	146 (130 – 165)†	146 (133 – 164)†	146 (130 – 166)†	145 (128 – 164)†	146 (129 – 165)†	159 (136 – 182)†	153 (134 – 174)†
Young	78 (67 – 91)	78 (68 – 91)	82 (70 – 94)	83 (69 – 93)	80 (69 – 93)	80 (70 – 92)	78 (70 – 93)	80 (70 – 91)	81 (70 – 92)	80 (71 – 92)	78 (67 – 91)	78 (68 – 91)
RTS*												
Elderly	7.8 (7.8 – 7.8)	7.8 (6.9 – 7.8)†	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)†	7.8 (7.8 – 7.8)†	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)†	7.8 (7.8 – 7.8)†
Young	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)	7.8 (7.8 – 7.8)
PS*												
Elderly	95.7 (90.4 – 97.4)†	95.7 (83.4 – 97.4)†	97.2 (91.8 – 97.4)†	95.7 (93.5 – 97.4)†	95.7 (91.8 – 97.4)†	96.6 (94.2 – 97.4)†	97.2 (95.0 – 97.4)†	96.5 (92.8 – 96.8)†	96.5 (93.4 – 96.8)†	96.5 (93.1 – 96.8)†	96.5 (92.8 – 96.8)†	96.5 (93.9 – 96.8)†
Young	99.5 (97.4 – 99.6)	99.4 (97.4 – 99.6)	99.5 (97.4 – 99.6)	99.4 (97.4 – 99.6)	99.4 (97.4 – 99.6)	99.5 (97.4 – 99.6)	99.34 (97.4 – 99.6)	98.7 (96.5 – 99.4)	98.3 (96.5 – 99.4)	98.7 (96.5 – 99.4)	97.9 (96.5 – 99.4)	98.3 (96.2 – 99.4)
ISS												
Elderly	16 (9 – 25)†	16 (9 – 25)†	10 (9 – 17)	12 (9 – 17)†	16 (9 – 20)†	10 (9 – 17)	10 (9 – 17)†	10 (9 – 17)	10 (9 – 17)	10 (9 – 17)	10 (9 – 17)	10 (9 – 17)
Young	10 (9 – 18)	10 (9 – 18)	9 (9 – 17)	10 (9 – 17)	10 (9 – 19)	10 (9 – 17)	10 (9 – 17)	10 (9 – 17)	10 (9 – 17)	10 (9 – 17)	10 (9 – 17)	10 (9 – 17)
Comorbidities*												
Elderly	112 (82.4)†	138 (79.8)†	156 (85.2)†	277 (83.7)†	305 (86.2)†	411 (87.8)†	423 (89.8)†	425 (92.4)†	543 (94.9)†	587 (93.9)†	570 (95.6)†	675 (95.7)†
Young	190 (29.7)	170 (25.8)	244 (31.1)	242 (28.6)	312 (33.1)	365 (37.5)	404 (42.5)	331 (48.5)	376 (52.4)	337 (50.3)	296 (52.2)	371 (56.8)

GCS: Glasgow Coma Scale; HR: Heart rate; ISS: Injury Severity Score; PS: Probability of survival; RTS: Revised Trauma Score; SBP: Systolic blood pressure
Data are presented as median (interquartile range) or aggregate (%).
*P <0.05 when comparing data between elderly and young patients, and between men and women from 2004 to 2015.
†P <0.05 when comparing data between elderly and young patients in each year.

Although elderly patients had higher ISS from 2004 to 2010, it was comparable to that in younger patients from 2011 to 2015 (Table 1). PS in elderly patients increased from 95.7% (range, 90.4–97.4%) in 2004 to 96.5% (range, 93.9–96.8%; $P = 0.016$) in 2015; however, over the same period it declined from 99.5% (range, 97.4–99.6%) to 98.3% (96.2–99.4%; $P < 0.000$) in young patients.

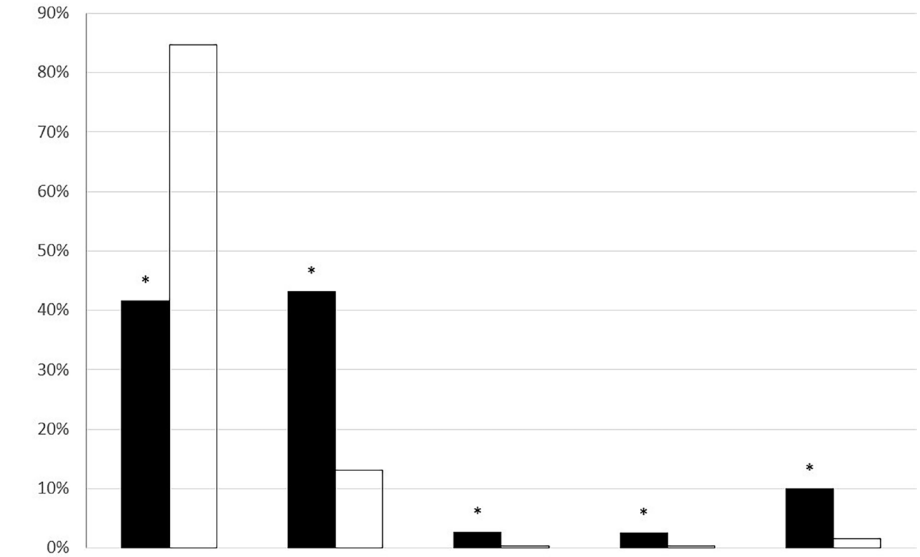
Elderly patients had significantly more comorbidities than young patients. However, there was a significant increase in comorbidities between 2004 and 2015 in elderly patients (82.4% vs 95.7%, respectively; $P < 0.000$) and young patients (29.7% vs 56.8%, respectively; $P < 0.000$).

Falls, especially those that involved low-impact falls ≤2 m, were the most prevalent MOI in elderly patients followed by motor vehicular accidents (MVAs). The reverse was true in young patients (Fig. 2). Falls were the only MOI in which the elderly surpassed the young. In elderly patients, the most common cause of MVAs involved getting hit by a vehicle; in young patients, they were mostly motorcyclists or drivers (Fig. 3). A difference in the distribution of MVAs between elderly and young patients ($P < 0.00$) was noted, except for back ($P = 0.16$) and front ($P = 0.46$) motor vehicular passengers.

Unlike young patients, injury to head and neck were the most common injury sites in elderly patients followed by the extremities (Table 2). Young patients also had higher surgical rates compared to elderly patients (Fig. 4). There was a strong correlation between age and surgery, and the likelihood of surgery being performed in young patients upon admission was greater compared to elderly patients. Between 2004 and 2015, there was a significant decline in surgical rate in elderly (47.1% vs 33.4%, respectively; $P = 0.002$) and young (71.6% vs 54.8%, respectively; $P < 0.000$) patients (Fig. 4).

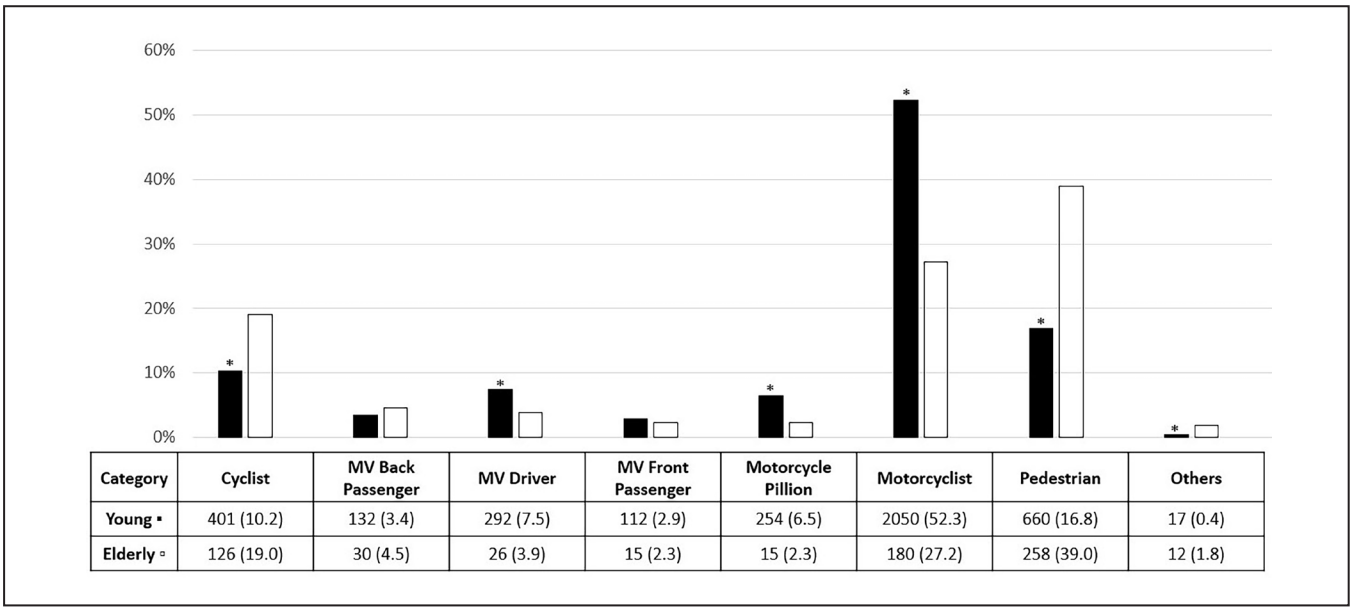
In both groups, crude mortality rate declined over the study period (Table 3). In 2004, it was 22.8% and 11.7% in elderly and young patients ($P < 0.001$), respectively; by 2015, it was 9.5% and 7%, respectively ($P = 0.12$). An increase in the incidence of complications was, however, observed in both groups (Table 3). In 2004, it was 21.3% and 10.8% in elderly and young patients ($P < 0.001$), respectively; by 2015, it was 43.5% and 25.9%, respectively ($P < 0.000$).

Data on LOS in ACU, GW, HDU and ICU and total LOS for elderly (n = 5007) and young (n = 8821) patients are shown in Table 3. In younger patients, median LOS in ICU decreased from 3 days (IQR, 1–8 days) in 2004 to 3 days (IQR, 1–6 days) in 2015 ($P = 0.022$). In elderly patients, it increased from 2.5 days (IQR, 1–7 days) to 3 days (IQR, 1–9.5 days) over the same period ($P < 0.000$). The same trend was seen in LOS in GW. Although elderly



Category	Fall	MVA	Falling Object	Interpersonal Violence	Others
Young ■	3785 (41.6)	3918 (43.1)	244 (2.7)	231 (2.5)	910 (10.0)
Elderly □	4300 (84.7)	662 (13.0)	15 (0.3)	16 (0.3)	82 (1.6)

Fig. 2. Distribution of injury mechanisms in elderly and young trauma patients. The category "Others" includes injuries sustained from bites, foreign bodies, handling of tools and machinery and other unspecified mechanisms of injury. MVA: Motor vehicular accident
*$P < 0.05$.



Category	Cyclist	MV Back Passenger	MV Driver	MV Front Passenger	Motorcycle Pillion	Motorcyclist	Pedestrian	Others
Young ▪	401 (10.2)	132 (3.4)	292 (7.5)	112 (2.9)	254 (6.5)	2050 (52.3)	660 (16.8)	17 (0.4)
Elderly ▫	126 (19.0)	30 (4.5)	26 (3.9)	15 (2.3)	15 (2.3)	180 (27.2)	258 (39.0)	12 (1.8)

Fig. 3. Distribution of motor vehicular (MV) accidents in elderly and young trauma patients.
*P <0.05.

patients had longer LOS in HDU from 2009 to 2015 than young patients, it decreased from 2 days (IQR, 1–4.8 days) in 2004 to 2 days (1–3 days) in 2015 (P <0.000). In elderly patients, median LOS in ACU declined from 2 days (IQR, 1.3–20 days) in 2011 to 2 days (IQR, 1–5 days) in 2015 (P = 0.001); in young patients, however, it increased from 1 day (IQR, 1–2.25 days) to 2 days (IQR, 1–4) over the same period (P <0.000). Finally, elderly patients had longer total LOS than young patients from 2004 to 2015, but the difference between both groups was not statistically significant (Table 3).

Table 2. Injury Distribution and Rankings on the Abbreviated Injury Scale in Elderly and Young Trauma Patients

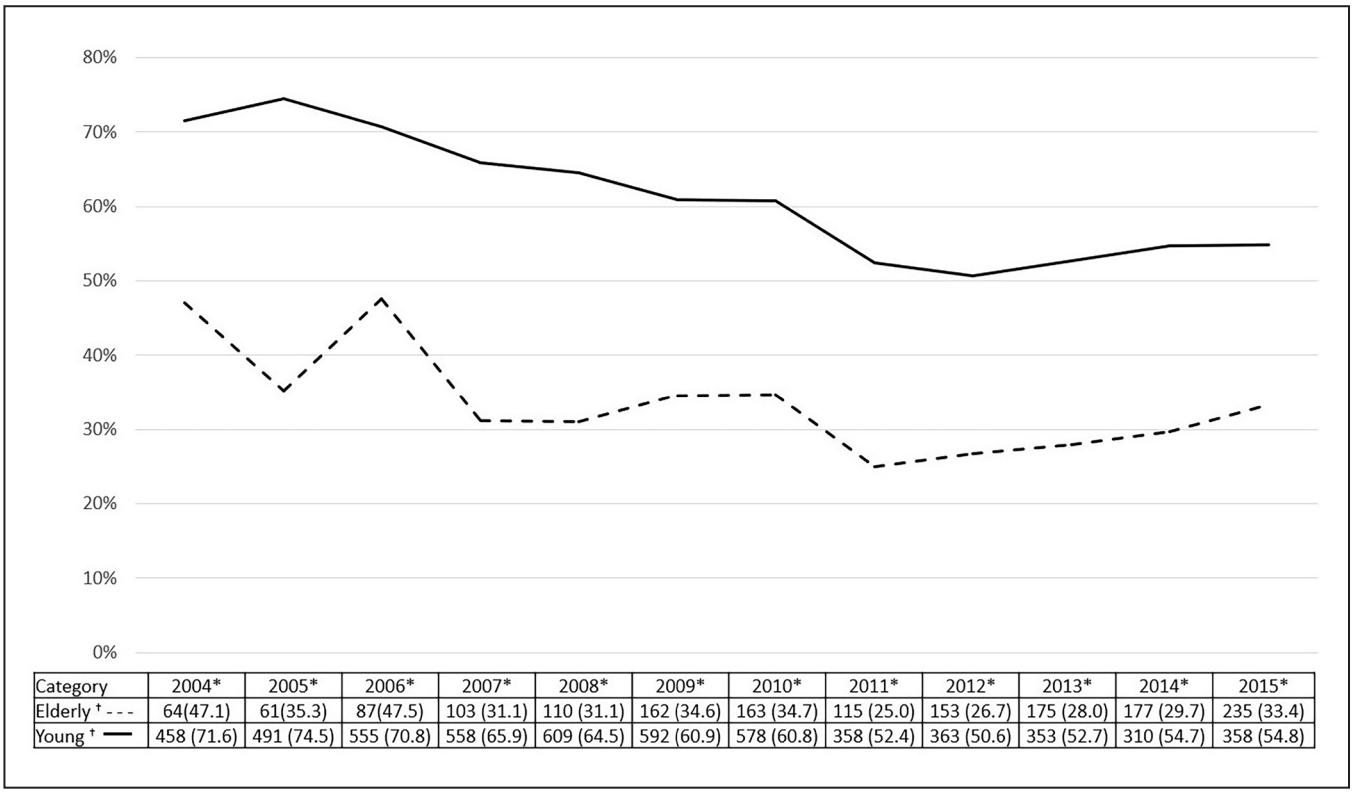
Body/Region	Rank	Aggregate (%)
Elderly (≥65 years old)		
Head/neck	1	2815 (30.5)
External	2	2437 (26.4)
Extremity/pelvic girdle	3	2051 (22.2)
Chest	4	949 (10.3)
Abdomen/pelvic contents	5	517 (5.6)
Face	6	457 (5.0)
Young (≥65 years old)		
Extremity/pelvic girdle	1	5510 (30.4)
External	2	4304 (23.8)
Head/neck	3	3432 (19.0)
Chest	4	2183 (12.1)
Abdomen/pelvic contents	5	1401 (7.4)
Face	6	1269 (7.0)

Discussion

This study has shown that the rapid increase in elderly trauma patients from 2004 to 2015 was associated with adverse outcomes and greater utilisation of hospital and health resources. Over the years, the median age of trauma patients had increased steadily, especially in female patients. This observation is consistent with the longer life expectancy of women in Singapore.[3] Although data from the National Trauma Data Bank in America showed an increase of 15% in 2004 to 30% in 2015 in the incidence of elderly admitted for trauma injuries,[13] in our study the figure accelerated from 17% to 50% over the same period.

Although the elderly population was growing at about 1% annually in Singapore,[14] the number of seriously injured elderly patients seen in TTSH had increased at a rate of 16.5% every year. This was a threefold increase compared to the annual growth rate of 5.4% in the trauma load in TTSH from 2004 to 2015. Elderly patients seen in TTSH also comprised a third of the elderly population in Singapore.[11]

While injury severity was similar in elderly and young trauma patients, physiological differences were noted between them. Elderly patients had higher SBP that might be attributed to more comorbidities such as hypertension[15] and had greater likelihood of head and neck



Category	2004*	2005*	2006*	2007*	2008*	2009*	2010*	2011*	2012*	2013*	2014*	2015*
Elderly † - - -	64(47.1)	61(35.3)	87(47.5)	103 (31.1)	110 (31.1)	162 (34.6)	163 (34.7)	115 (25.0)	153 (26.7)	175 (28.0)	177 (29.7)	235 (33.4)
Young † ——	458 (71.6)	491 (74.5)	555 (70.8)	558 (65.9)	609 (64.5)	592 (60.9)	578 (60.8)	358 (52.4)	363 (50.6)	353 (52.7)	310 (54.7)	358 (54.8)

Fig. 4. Incidence of elderly and young trauma patients who underwent surgery.
*P <0.05 when comparing data between elderly and young patients in each year.
†P <0.05 when comparing data between elderly and young patients between 2004 and 2015.

injury. HR was also lower, which was not unexpected since elderly patients typically have more comorbidities and medications such as beta blockers could lower HR.[7,16] Studies had shown that HR and SBP are not good predictors of injury severity in the elderly.[17,18] Therefore, one must exercise vigilance when resuscitating elderly patients since normal HR and SBP readings in this group of patients may lead to inaccurate assessment of their injury severity and result in under-triaging.[7,16]

In elderly patients, the cause of low PS could be multi-factorial since the score is based on several parameters and there are no significant differences in some of the parameters in our study. Some studies have suggested age as an independent factor that can be used to predict outcomes.[19–21]

Similar to findings in other studies, elderly patients in our study had more comorbidities than young patients.[22,23] The increase in comorbidities in young and elderly patients between 2004 and 2015 might be attributed to the promotion of health screening by the authorities and cheaper screening tests that were made widely available to residents in Singapore.[24]

Our finding that falls and MVAs were the most common MOI in elderly and young patients, respectively, corroborated the findings of an earlier local study.[25,26] As the elderly become more frail when they age, this frailty phenotype increases their risk of falls.[27] Comorbidities that result in syncope may also increase the likelihood of falls.[15,28] A recent study had found that the home is the most "dangerous" place since most falls in elderly were reported to have taken place in their own homes.[29] Since a decline in falls in elderly was not documented in our study, this finding could be used to formulate outreach programmes that engage and encourage stakeholders such as the elderly and social support groups to promote falls prevention.

Compared to young patients, the lower rate of surgery in elderly patients echoed the findings of other studies[5] where there is a tendency to adopt a more conservative approach to surgical management in this group of patients. This could be due to higher operative risks associated with surgical intervention that result from age and more existing comorbidities.[30] Further investigation is required on decision-making in surgical intervention in the elderly.

Decline in mortality in the elderly trauma population in our study could be attributed to the experience of the medical team that had been treating elderly patients for several years to improve survivability. With a growing incidence

Table 3. Complications, LOS and Mortality in Elderly (≥65 Years Old) and Young (≥65 Years Old) Trauma Patients from 2004 to 2015

Variable	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Mortality*												
Elderly	31 (22.8)†	40 (23.1)†	27 (14.8)†	48 (14.5)†	54 (15.3)†	51 (10.9)†	53 (11.3)†	48 (10.4)	59 (10.3)†	52 (8.3)†	59 (9.9)	67 (9.5)
Young	75 (11.7)	73 (11.1)	52 (6.6)	49 (5.8)	72 (7.6)	48 (4.9)	41 (4.3)	50 (7.3)	47 (6.6)	31 (4.6)	44 (7.8)	46 (7.0)
Complications*												
Elderly	29 (21.3)†	39 (22.5)†	25 (13.7)†	32 (9.7)	47 (13.3)	60 (12.8)	128 (27.2)†	155 (33.7)†	237 (41.4)†	285 (45.6)†	225 (37.8)†	307 (43.5)†
Young	69 (10.8)	93 (14.1)	59 (7.5)	56 (6.6)	77 (8.2)	94 (9.7)	158 (16.6)	134 (19.6)	172 (24.0)	182 (27.2)	126 (22.2)	169 (25.9)
ICU stay (days)*												
Elderly	2.5 (1 – 7)	2 (1 – 8.5)	2 (1 – 6)†	3 (1 – 6.5)	3.5 (1 – 6)	2 (1 – 7)	2 (1 – 8)	2 (1 – 6.5)	3 (1 – 6)†	2 (1 – 7)†	3 (1 – 7.5)†	3 (1 – 9.5)†
Young	3 (1 – 8)	3 (1 – 9)	3 (1 – 7)	3 (1 – 8)	3 (2 – 7.75)	3 (1 – 7)	3 (2 – 6.5)	4 (2 – 8)	3 (1 – 7)	3 (1 – 8)	3 (2 – 6)	3 (1 – 6)
HDU stay (days)												
Elderly*	2 (1 – 4.8)	2 (1 – 4.8)	2 (1 – 3)	2 (1 – 3)	2 (1 – 5)	2 (1 – 3)†	2 (1 – 3.25)†	2 (1 – 4)†	2 (1 – 3)†	2 (1 – 3)†	2 (1 – 3)†	2 (1 – 3)†
Young	2 (1 – 4)	2 (1 – 4)	2 (1 – 3)	2 (1 – 4)	2 (1 – 3)	2 (1 – 3)	2 (1 – 3)	2 (1 – 3)	1 (1 – 2)	1 (1 – 2)	1 (1 – 3)	1 (1 – 3)
ACU stay (days)*												
Elderly	–	–	–	–	–	–	–	2 (1.3 – 20)	2 (1 – 14)	2 (2 – 5)	2 (1 – 3)	2 (1 – 5)
Young	–	–	–	–	–	–	–	1 (1 – 2.25)	3 (1 – 4)	2 (1 – 2)	2 (1 – 3)	2 (1 – 4)
GW stay (days)*												
Elderly	6 (3 – 15)	6.5 (3 – 17.8)	6 (4 – 15)	7 (4 – 14)†	7 (3 – 15)†	7 (3 – 14)†	7 (3 – 14)†	8 (3 – 16)†	7 (2 – 16)†	8 (3 – 17)†	7 (3 – 16)†	8 (3.8 – 15)†
Young	5 (3 – 10)	5 (3 – 11)	5 (3 – 10)	5 (3 – 10)	5 (3 – 10)	4 (2 – 9)	4 (2 – 9)	5 (2 – 10)	5 (2 – 10)	5(2 – 11)	4 (2 – 11)	4 (2 – 9)
Total LOS (days)												
Elderly	6 (3 – 15)	6 (3 – 17.3)	6 (4 – 16)†	8 (4 – 15)†	7 (3 – 16)†	7 (3 – 14)†	7 (3 – 14)†	8 (3 – 16)†	7 (2 – 17)†	8 (4 – 18)†	7 (3 – 17)†	8 (4 – 16)†
Young	5 (3 – 12)	5 (3 – 12)	6 (3 – 11)	5 (3 – 11)	5 (3 – 10)	5 (3 – 10)	5 (2 – 11)	5 (2 – 11)	5 (2 – 11)	6 (2 – 12)	4.5(2 – 11)	5 (2 – 10)

ACU: Acute Care Unit; GW: General Ward; HDU: High Dependency Unit; ICU: Intensive Care Unit; LOS: Length of stay
Data are presented as median (interquartile range) or aggregate (%).
*P <0.05 when comparing data between elderly and young patients between 2004 and 2015.
†P <0.05 when comparing data between elderly and young patients in each year.

of elderly trauma patients, existing trauma management systems and care pathways were also improved and modified to meet the challenge posed by this demographic change.[31,32] The challenge ahead is to rehabilitate elderly patients to their premorbid state to lessen the burden of care on their families and society.

After 2006, elderly patients were observed to have longer total LOS. An increase in their LOS in GW and ICU was seen between 2004 and 2015. Increased LOS in ICU might be attributed to the need for higher levels of intensive support in elderly trauma patients.[33] Longer LOS in GW might be due to the inability and lack of different stepdown care facilities—such as community hospitals, day care centres, nursing homes and rehabilitation centres—to accommodate more elderly patients who were discharged from our institution and to match a growing demand for such services from an ageing population, respectively.[34] These findings could be used to support efforts to boost the capabilities of stepdown care facilities and to increase their numbers.

A limitation of our study was that the findings may have limited generalisability since it was a single-centre study. A common caveat of retrospective studies such as ours was that the data might not have captured the details of all trauma patients who were admitted to our institution. More details on comorbidities and complications were also lacking in the retrospective data set, including a classification of comorbidities that would have given us more insight into patients' behaviour. Although patients ≥65 years old with isolated hip fractures and compression fractures of the vertebral column sustained in low-impact falls were excluded from our study, these aetiologies could be causative factors of morbidity and mortality in them. Further studies could include this group of patients to accurately quantify the burden of elderly trauma in Singapore.

Conclusion

The incidence of elderly trauma has vastly outpaced the growth of the ageing population in Singapore, and is thrice that of the trauma load seen in our institution. Since elderly patients have longer LOS, it has led to greater burden of care in acute care hospitals throughout the country. There is a need to deploy more resources to boost the numbers and capabilities of stepdown care facilities to improve treatment outcomes in elderly trauma patients.

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