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ORIGINAL SCIENTIFIC REPORT

Trauma in the Elderly: Demographic Trends (1995–2014) in a Major New Zealand Trauma Centre

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Abstract

Background Population studies have confirmed an increase in the proportion of elderly patients (≥65 years of age), and this could be expected to be reflected in trauma admissions and outcomes. This study aims to investigate the demographic trends for elderly patients admitted following trauma to Auckland City Hospital (ACH) and their outcomes.

Materials and methods The ACH Trauma Database was searched from 1995 to 2014, and data including date of admission, injury cause, age, sex, mortality, Injury Severity Score (ISS), Intensive Care Unit (ICU) stay and length of stay (LOS) were extracted.

Results A total of 26,882 patients were identified, with 4428 patients ≥65 years of age admitted following trauma. In the mid-1990s between 200 and 250 trauma patients ≥65 years were admitted to ACH annually. This has increased to >400 in 2014 and now represents >20% of all admissions. Females are over represented (61.7%) in those ≥65 years (vs. 29.4% in < 65 years, $p < 0.001$), and falls are the greatest cause of admission for trauma in those ≥65 years at 72% (vs. 36.9% in those < 65 years, $p < 0.001$). Elderly trauma patients are more than twice as likely to die (5.6% vs. 2.3%, $p < 0.001$) compared with trauma patients < 65 years despite an identical median ISS of 4 ($p = 0.86$). Furthermore, of those ≥65 years, 2.2% died of minor/moderate trauma (ISS ≤ 15) versus only 0.12% for those < 65 years confirming the complexities of ageing physiology in a trauma setting. Until 2003, mortality from trauma in elderly patients closely paralleled the rate of severe trauma admissions (ISS ≥ 16), but after 2003, despite a steady increase in severe trauma in this cohort, mortality rates have fallen.

Conclusions Elderly patients bring with them a greater burden of co-morbidities, and trauma admission of elderly patients has almost doubled over 20 years, including severe trauma (ISS ≥ 16), but despite this mortality has decreased. Integration of services into the new ACH in 2003 as well as improving trauma and medical care may be possible explanations. Further resources will be required to meet service demand, along with consideration of strategies to integrate multi-disciplinary care and consolidate trauma management for this vulnerable patient group.

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Introduction

The world is currently in the midst of an unprecedented shift in demographics with a rapidly ageing population [1]. As life expectancy continues to increase, it is estimated that the proportion of those defined as elderly (≥65 years) in New Zealand (NZ) will rise from 15% currently to 22–25% by 2041 with similar projections for Australia, the USA and UK; moreover, this phenomenon is not limited to developed nations [1–4]. By extrapolation the proportion of elderly patients presenting to hospital following trauma should also increase.

Elderly trauma patients face an increased risk for adverse outcomes, the ageing process impacting physiological responses to injury, this being further complicated by concomitant co-morbidities and by associated pharmacological treatments [5–11]. Furthermore, these patients consume a disproportionate share of health resources through longer hospital stay, involvement of multi-disciplinary teams and increased utilisation of rehabilitation services and assisted care facilities [12, 13]. Comprehensive clinical databases allow for longitudinal assessment of hospital admissions, discharges and outcomes in order to aid in health planning and service provision.

Objectives

This retrospective database analysis was performed to assess if the expected demographic change in the proportion of individuals ≥65 years was reflected in trauma admissions to Auckland City Hospital (ACH). ACH serves the Auckland District Health Board (ADHB) catchment and also receives major trauma from further afield. NZ offers universal and free public hospital trauma care which extends to foreign nationals through government funding from the Accident Compensation Corporation (ACC). Elderly trauma patients have been shown to fare worse after trauma than their younger counterparts, and the database analysis assessed this phenomenon at NZ's busiest level 1 trauma centre. It was expected that significant differences would be found between the ≥65 years and < 65 years cohorts with respect to the causes of admissions for trauma, length of hospital stay and mortality with further subgroup analysis being performed where appropriate. Finally, the longitudinal data were utilised in order to highlight trends and outcomes measures in the ≥65-year-old patient group.

Materials and methods

A retrospective database study was conducted according to the STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) statement guidelines [14]. The ACH Trauma Services Database was utilised, comprising a registry of all trauma patients admitted to ACH from December 1994 onwards, and is the third longest running trauma registry in Australasia. Patients presenting from 1 January 1995 to 31 December 2014 were analysed; those with isolated hip fractures, pathological/age-related degeneration, injuries occurring >1 week prior to admission and incomplete records were excluded. Protocols governing 'Trauma Calls', Trauma Service and Intensive Care Unit (ICU) admissions did not vary over the study period. Data were extracted from Collector (Digital Innovations, Inc.) using a dedicated search string and manipulated in Microsoft Excel (Microsoft Corporation).

Analyses were performed to categorise trauma patients according to their age (< 65 or ≥65 years), sex, injury cause (fall, motor vehicle crash (MVC), motorbike crash (MBC), pedestrian accident, stabbing, gunshot wound (GSW), other and unknown), injury severity score (ISS) (calculated from the 1998 revision of the Abbreviated Injury Score, AIS98), ICU stay, length of stay (LOS), destination at discharge and in hospital mortality [15]. Longitudinal analyses were performed to ascertain if there had been a trend in the proportion of admissions of those ≥65 years in keeping with demographic change. Longitudinal data were also utilised to assess for trends in mortality and admissions of patients ≥65 years with severe trauma (ISS ≥ 16). Subgroup analysis of the injury mechanism of 'falls' was undertaken, and regression analyses were implemented where indicated. Parametric demographic and injury characteristics were compared between groups using the 2-sample t test. To test for differences in nonparametric data, the Wilcoxon–Mann–Whiney and Mood's median tests were used. Proportional variables were analysed by the Fisher's exact test and Tukey's honest significant difference test. Statistical analysis was performed using Minitab 17 and 18 (Minitab, Inc. 2015, 2017).

Results

The database yielded a total of 26885 patients admitted to the hospital following trauma from 1995 to 2014; 26882 records were included in the analysis with 4428 patients ≥65 years admitted with trauma. Analysis of the annual number of admissions in this cohort confirms that both the number and proportion of patients ≥65 years admitted

following trauma have increased from around 15% in the mid-1990s to now >20% of total admissions (Figs. 1, 2).

Comparison of the ≥65 year cohort with the < 65 year cohort reveals that the 2 population groups are distinct with respect to demographics, injury mechanism and clinical outcomes (see Table 1). Trauma patients ≥65 years were less likely to be male ($p < 0.001$) and were less likely to present with severe trauma (ISS ≥ 16) than those < 65 years ($p < 0.001$). Almost 3/4 s of trauma patients ≥65 years were admitted because of falls and were more likely to be admitted due to a pedestrian accident, but statistically less likely to be admitted due to a MVC, MBC, stabbing, GSW or 'other' (assault/struck by object) causes (see Table 1). Patients ≥65 years had a significantly increased hospital stay, by 1.9 days (9 days vs. 7.1 days, $p < 0.001$), than < 65 years, but were less likely to be admitted to the ICU (6.4% vs. 11.9%), although the length of ICU stay was not statistically different between the 2 groups (4.65 days vs. 4.5 days, $p = 0.7$, see Table 1). Despite a statistically similar median ISS of 4 ($p = 0.86$) and suffering a smaller proportion of severe trauma (ISS ≥ 16) as a cohort (14.8% vs. 17.8%, $p < 0.001$), patients ≥65 years admitted with trauma had a greater than twofold increase in mortality (5.55% vs. 2.34%, $p < 0.001$, see Table 1). This was evident for both minor trauma (ISS < 16) and major trauma (2.2% vs. 0.12% $p < 0.001$, 28% vs. 12.6% $p < 0.001$) (see Table 1). On discharge, elderly trauma patients were more likely to be transferred to a rehabilitation/skilled care facility or require assistance at home ($p < 0.001$, see Table 1).

Within the elderly trauma cohort, significant differences were seen with respect to demographics, injury mechanism and patient outcomes when males and females are compared. Elderly female trauma patients admitted to ACH were significantly older (77.3 years vs. 74.4 years, $p < 0.001$) and more likely to be admitted following falls (77.1% vs. 63.4%, $p < 0.001$), with males being significantly more likely to be admitted with all other categories of traumatic injury (see Table 2). When compared to female patients ≥65 years, male patients ≥65 years admitted with trauma were more likely to be severely injured (23% vs. 9.7%, $p < 0.001$), with a higher median ISS (8 vs. 4, $p < 0.001$). Further significant differences were also seen with respect to falls (median ISS 5 vs. 4, $p < 0.001$), MVCs (median ISS 9 vs. 8, $p = 0.046$), stabbings (median ISS 4 vs. 1, $p = 0.002$) and 'other' (median ISS 8 vs. 4, $p = 0.0004$); there was no significant different in median ISS between sexes seen in MBCs ($p = 0.55$) or pedestrian accidents ($p = 0.34$, see Table 2). Despite the significant differences in the median ISS both overall and within the before mentioned injury groups, there was no significant increase in length of stay for male patients, except for those involve in MBCs (10.5 days vs. 2.3 days, $p = 0.002$, see Table 2). Elderly male patients were more likely to be admitted to the ICU than female patients ≥65 years (11.3% vs. 3.3%, $p < 0.001$) but when admitted, did not stay as long (4.5 days vs. 5.0 days, $p = 0.007$). In this analysis, mortality for male patients ≥65 years admitted for trauma was more than double that for females (8.7% vs. 3.6%, $p < 0.001$), significant increased mortality was seen in falls (6.9% vs. 2.0%, $p < 0.001$) and MVCs (14.6 vs. 6.6%, $p = 0.006$, see Table 2). Further subgroup analysis of those admitted for falls supported the significance of age as a risk factor for increased mortality with regression analysis demonstrating a strong correlation between these factors despite an identical ISS ($S = 0.21$, $R^2 = 98\%$, see Table 3). In patients ≥ 65 years, there was a preponderance for men to be admitted with other/multi-levels falls and were more severely injured when admitted with this diagnosis [ISS 9(4–13.5) vs. 4(4–9), $p < 0.001$] with an increased mortality (8.9% vs. 3.6%, $p < 0.001$) when compared with women ≥ 65 years (see Table 3). Men ≥ 65 years were also more likely to die from same level falls (4.5% vs. 1.1%, $p = 0.001$) and when compared with women ≥ 65 years admitted with the same level falls, had an identical median ISS (4(4-9)), but when statistically evaluated, it was evident that the male cohort was more substantially injured ($p = 0.001$, see Table 3). Male patients were less likely to be transferred to a rehabilitation/skilled care facility or require assistance at home (21.4% vs. 29.2%, $p < 0.001$).

Statistical analysis demonstrated significant differences between injury mechanism with respect to injury severity, length of stay and mortality in the admitted trauma patient ≥65 years. Unsurprisingly, trauma mechanisms involving significant kinetic energy such as MVCs, pedestrian accidents and MBCs had a significantly higher median ISS compared with mechanisms such as falls, 'other' and stabbings; GSWs were only represented in this series by 2 patients. Pedestrian accidents had a significantly higher median ISS when compared with MVCs (9 vs. 8.5, $p = 0.0006$) but not when compared with MBCs (9 vs. 9, $p = 0.7$), and the median ISS was not significantly different between MBCs and MVCs (9 vs. 8.5, $p = 0.36$). Length of stay also varied significantly between injury mechanisms, again with the high kinetic energy mechanism of trauma showing a significantly increased duration of admission.

Significant differences in mortality were found between pedestrian accidents and falls (17% vs. 3.6%, $p < 0.001$), pedestrian accidents and 'other' (17% vs. 5.9%, < 0.001), pedestrian accidents and MVCs (17% vs. 10.3%, $p < 0.001$), pedestrian accidents and stabbings (17% vs. 4.5%, $p = 0.007$) and MVCs vs. falls (10.3% vs. 3.6%, $p < 0.001$). Gunshot injuries carried a 50% mortality, but was a mechanism of trauma in only 2 patients and thus was not included in the statistical analysis.

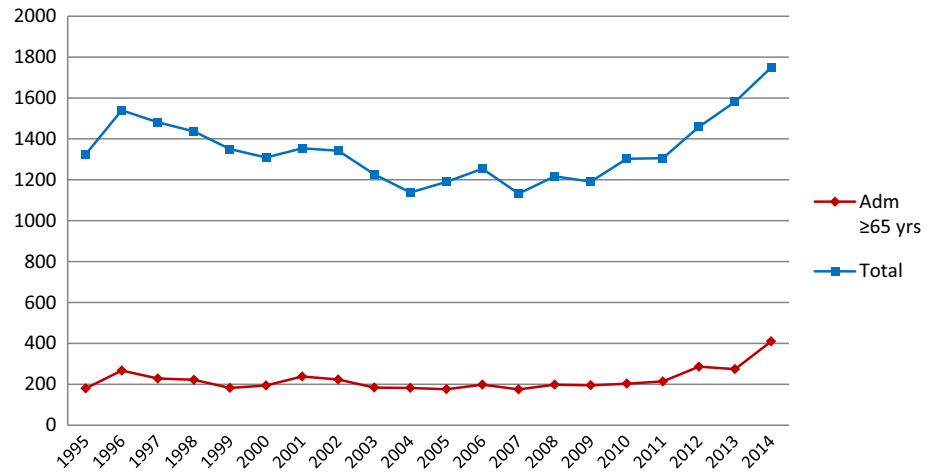

Fig. 1 Annual trauma admissions by year, total admission and admission of patients ≥65 years

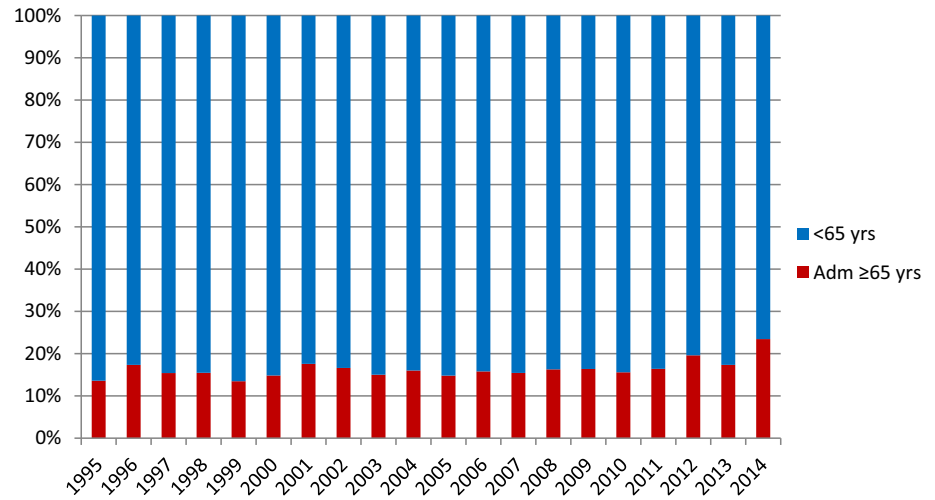

Fig. 2 Annual trauma admission by year, proportional

Analysis of trends for selected trauma mechanisms over the last 20 years demonstrated a dramatic increase in admissions for falls (see Fig. 3). In contrast, injuries requiring admission from pedestrian accidents have remained stable over this period, while admissions from injuries due to MVCs have fallen slightly (see Fig. 3). The last 20 years have also seen a marked increase in admissions of severely injured trauma patients ≥65 years, with a twofold increase since 1995 (see Fig. 4). Despite this increase in major trauma admissions, the overall mortality in the ≥65 years cohort has decreased over this time period (see Fig. 4).

The findings of this study confirm at the hospital level that the proportion of elderly patients admitted following trauma has increased over the past 20 years, and is now slightly above what would be expected by demographic change alone. In concordance with previous studies, the elderly trauma cohort at ACH is a distinctly different patient group from those that suffer trauma who are < 65 years of age [6, 7, 9–11]. They are more likely to have been admitted after a fall, be female, stay significantly longer in hospital, require rehabilitation services and are more likely to die as a result of their traumatic injuries [7, 9–12].

Proportionately, elderly trauma patients are more likely than younger patients to be admitted from 'low kinetic energy' trauma (such as falls); nevertheless, the mortality of the cohort is still significantly higher (see Table 1). Furthermore, male patients ≥65 years appear particularly vulnerable with a greater than twofold mortality compared with female trauma patient ≥65 years. This could be explained by an overall propensity for male patients to present with more severe injuries with a lower proportion injured by 'low kinetic energy' mechanisms of trauma (see Table 2). Further subgroup analysis of 'falls' (the predominant trauma admission diagnosis in those ≥65 years) demonstrated that men were less likely to be admitted with 'same level falls' compared to 'other/multi-level falls' (n = 488 vs. 587), whereas twice as many women ≥65 years were admitted with 'same level falls' compared to 'other/multi-level falls' over the same period (n = 1384

Table 1 Demographic, injury and hospital care characteristics

Characteristic	*n*	≥65 years	*n*	<65 years	*p*
Age mean (SD), years	4428	76.17 (7.84)	22,454	35.22 (14.07)	
Male sex, *n*(%)	1696	38.3	15,848	70.6	<0.001
ISS, median (IQR)	4428	4 (4–9)	22,454	4 (4–10)	0.86
ISS ≥ 16, *n*(%)	656	14.8	4003	17.8	<0.001
Mechanism of injury *n*(%), ISS median (IQR)					
Fall	3181	72	8278	36.9	<0.001
MVC	536	12	4434	19.7	<0.001
MBC	33	0.74	1638	7.3	<0.001
Pedestrian accident	289	6.5	868	3.9	<0.001
Stabbing	66	1.5	1582	7.0	<0.001
GSW	2	0.04	101	0.45	<0.001
'Other'[a]	320	7.2	5541	24.7	<0.001
Unknown	1	0.02	12	0.05	[b]
LOS, mean (SD), days	4428	9.0 (9.7)	22,454	7.1 (10.36)	<0.001
ICU adm (%), mean LOS (SD), days	283 (6.4)	4.65 (5.9)	2665 (11.9)	4.5 (5.9)	<0.001, 0.7
Mortality, *n*(%)	246	5.55	526	2.34	<0.001
ISS < 16	86	2.2	23	0.12	<0.001
ISS ≥ 16	184	28	503	12.6	<0.001
Discharge disposition, *n*(%)					
Home, no assistance	2683	60.6	18,543	82.6	<0.001
Rehab, skilled care facility, home with assistance	1160	26.2	1693	7.5	<0.001
Another hospital	239	5.4	1179	5.3	0.686
Other/unknown/morgue	346	7.8	1039	4.6	<0.001

[a]Struck by object/assault

[b]Insufficient data for analysis

vs. 722). Elderly men suffered a higher ISS from their 'other/multi-level fall' then the female cohort, and as expected, this translated into a higher mortality (see Table 3). Despite a significantly higher mortality for elderly men in the 'same level falls' group, the median ISS was identical (see Table 3). Further statistical analysis of this group does reveal that a greater proportion of male patients in the 'same level falls group' had a higher ISS, but this is not evident when only assessing the median ISS. Other reasons for this apparent discrepancy are unclear; however, variation in the causes of the falls, concomitant medical co-morbidities and overall frailty could be surmised.

Analysis of the cause of trauma does suggest that there is a difference in ISS between mechanisms, with the overall ISS for 'falls' being significantly less than 'MVC's, 'MBCs' and 'pedestrian accidents' (see Table 2). As expected by the differing ISS, the mortality associated with these mechanisms also differs (see Table 2). ISS has been shown to correlate most strongly with mortality in other studies, and in this study the correlation was moderate but significant, with those elderly trauma patients dying suffering a statistically more severe trauma (median ISS 21 vs. ISS 4, $p < 0.000$) that those who survive [5–8]. Interestingly, despite having a higher median ISS, elderly male trauma patient's LOS was not significantly longer and they were less likely to be transferred to a rehabilitation/skilled care facility or be discharged home with assistance (see Table 2). While the proportion of elderly male and female trauma patients discharged home is essentially identical, it is plausible that the more severely injured elderly male trauma patients are dying in hospital, and it is this cohort of patients that would likely make use of rehabilitation services had they survived their inpatient stay (see Table 2).

Injury trends demonstrate that the most significant contributor to the increasing proportion of elderly trauma admitted is falls, and the rate of total admissions tends to follow this closely [16]. Certainly, this is unsurprising as the frequency of falls increases with age, and thus, this trend is to be expected in a population in which the proportion of elderly also increasing. Another well-studied trend is that of road traffic crashes (RTCs), and New Zealand wide the number of injuries per 100,000 population has decreased from 463/100,000 in 1995 to

Table 2 Detailed characteristics and analysis of injury cause by sex, age ≥65 years

Characteristic	*n*	Male	*n*	Female	*p*
Age, mean (SD), years	1696	74.38 (7.36)	2732	77.28 (7.93)	<0.001
ISS, median (IQR)	1696	8 (4–13)	2732	4 (4–9)	<0.001
ISS ≥ 16, *n*(%)	390	23	266	9.7	<0.001
Mechanism of injury, *n*(%):					
Fall	1075	63.38	2106	77.09	<0.001
ISS, median (IQR)		5 (4–10)		4 (4–9)	<0.001
LOS, mean (SD), days		8.5 (7.9)		8.4 (8.4)	0.74
Mortality *n*(%)	74	6.9	42	2.0	<0.001
MVC	233	13.74	303	11.09	0.009
ISS, median (IQR)		9 (4–17)		8 (4–16)	0.046
LOS, mean (SD), days		12.1 (15.3)		10.7 (11.8)	0.25
Mortality *n*(%)	34	14.6	21	6.9	0.006
MBC	30	1.77	3	0.11	<0.001
ISS, median (IQR)		8.5 (4–22)		11 (1–12)	0.55
LOS, mean (SD), days		10.5 (12.9)		2.3 (0.58)	0.002
Mortality *n*(%)	3	10	0	0	1
Pedestrian accident	131	7.72	158	5.78	0.012
ISS, median (IQR)		10 (5–20)		9 (4-17)	0.34
LOS, mean (SD), days		11.5 (13.2)		12.8 (17.3)	0.47
Mortality *n*(%)	20	15.3	29	18.4	0.53
Stabbing	40	2.36	26	0.95	<0.001
ISS, median (IQR)		4 (1–9)		1 (1–4)	0.002
LOS, mean (SD), days		4.3 (4.6)		3.7 (3.2)	0.54
Mortality *n*(%)	2	5	1	3.8	1
'Other'[a]	184	10.85	136	4.98	<0.001
ISS, median (IQR)		8 (4–16)		4 (4–9)	0.0004
LOS, mean (SD), days		8.46 (7.6)		8.3 (10.5)	0.88
Mortality *n*(%)	13	7	6	4.4	0.35
GSW	2	0.12	0	0	[b]
ISS, median (IQR)		26 (26–26)			[b]
LOS, mean (SD), days		13.5 (14.8)			[b]
Mortality *n*(%)	1	50			[b]
Unknown	1	0.06	0	0	[b]
LOS, mean (SD), days	1696	9.08 (10.4)	2732	8.95 (9.2)	0.673
ICU adm (%), mean LOS (SD), days	192 (11.3)	4.5 (5.0)	91 (3.3)	5.0 (7.39)	<0.001, 0.007
Mortality, *n*(%)	147	8.7	99	3.6	<0.001
ISS < 16	34	23.1	28	28.3	0.37
ISS ≥ 16	113	76.9	61	71.7	0.015
Discharge disposition, *n*(%)					
Home, no assistance	1028	60.6	1655	60.6	1.0
Rehab, skilled care facility, home with assistance	362	21.4	798	29.2	<0.001
Another hospital	119	7.0	120	4.4	<0.001
Other/unknown/morgue	187	11.0	159	5.8	<0.001

[a]Struck by object/assault

[b]Insufficient data for analysis

Table 3 Subgroup analysis of 'falls'

Age (years)	Mortality (%)	ISS, median (IQR)
Mortality from 'falls', all ages		
<25	1.9	4 (4–9)
25–34	1.3	4 (4–9)
35–44	1.4	4 (4–9)
45–54	1.9	4 (4–9)
55–64	2.0	4 (4–9)
65–74	3.1	4 (4–9)
74–84	3.6	4 (4–9)
≥85	5.0	4 (4–9)
Polynomial regression S, R^2 (%)	0.21, 98	

Characteristic	Male	Female
Mortality from 'falls', subgroup analysis, ≥65 years		
Fall on same level, *n*(%)	488 (45)	1384 (66)
Fall—Other/multi-level, *n*(%)	587 (55)	722 (34)
Fall on same level—mortality, *n* (%)	22 (4.5)	16 (1.1)
Fall—Other/multi-level—mortality, *n*(%)	52 (8.9)	26 (3.6)
Fall on same level—ISS, median (IQR)	4 (4-9)	4 (4–9)
Fall—Other/multi-level—ISS, median (IQR)	9 (4-13.5)	4 (4–9)

249/100,000 in 2014 and mortality has fallen from 16/100,000 to 6.5/100,000 over the same period. Of these road users that die approximately two-thirds are involved in MVCs, and while the greatest decline has been in the 15-24 age group, a noticeable decline has also been seen in those age 60 and over [17]. This decline in mortality in those >60 years has been mirrored by a decline in trauma admissions in those ≥65 years for MVCs at ACH over the past 20 years (see Fig. 3), the reason for this is likely multi-factorial from intensive public safety campaigns to safer vehicles and public roads [18].

Admissions of elderly patients with major trauma have increased over the 20 years of the study data, and while it could be hypothesised that this should lead to an increase in mortality given the relative sensitivity of the elderly to this significant physiological stress, this has been shown not to be the case with the overall mortality rate slowly decreasing over this time (from around 6.5% in 1995 to 5% in 2014, see Fig. 4). Advances in the efficiency of trauma systems, resuscitation protocols, non-surgical interventions and intensive care have contributed to improved outcomes [19–24]. Logically, these improvements should be demonstrable over the entire trauma cohort, and in the <65 year group, mortality fell from around 3.5% in 1995 to 1.5% in 2014. Thus, proportionally greater improvement was achieved in the younger cohort; however, when taking into account admission trends of patients with major trauma, these results are less clear. In the younger cohort, the admissions with major trauma (ISS ≥ 16) stayed relatively constant around 200 admissions per year, whereas there was an almost tripling in the major trauma admissions for those ≥65 years in the same time period (see Fig. 4). There is some evidence that the elderly patient cohort may be more 'robust' medically now than in the past which may mitigate the effects on mortality in this group [19]. It is

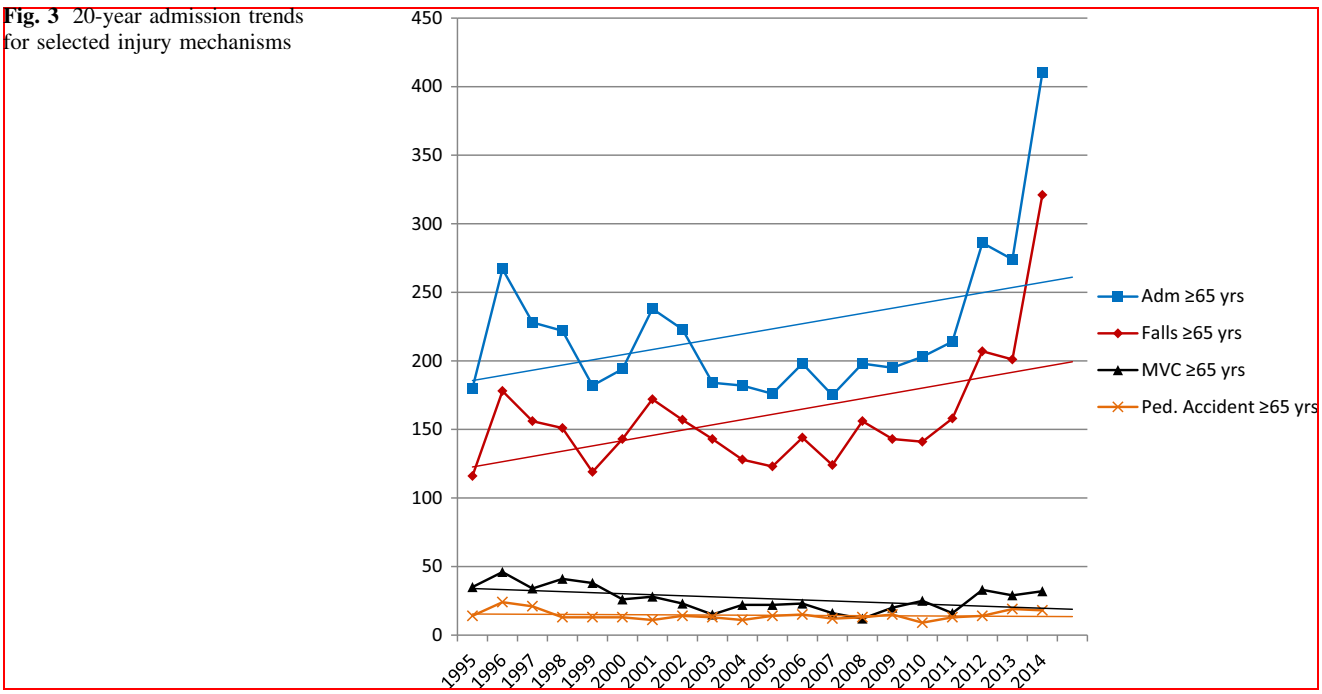

Fig. 3 20-year admission trends for selected injury mechanisms

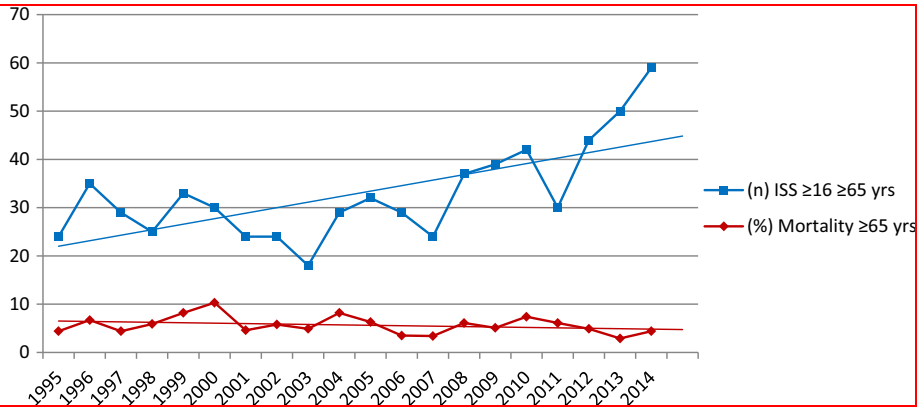

Fig. 4 20-year trend for severe trauma (ISS ≥ 16) admissions and mortality

likely that as the proportion of elderly patients increases in the trauma cohort, coupled with an increase in trauma severity, improvements in overall mortality will diminish, and certainly the gains already made are less pronounced in this cohort. It is important to note, however, that improvement is occurring.

Implications of the study findings have significant potential to direct and improve future health resource allocation and Trauma Service Development. During the period of this retrospective review, a number of changes have occurred both in the surrounding catchments and in the hospital itself. Over the 20 years of the analysis, the area served by the hospital has changed little; however, the opening of North Shore Hospital in the adjacent Waitemata District Health Board (WDHB) in 1999–2000, saw a drop in minor trauma presentations to ACH, although this did not affect major trauma presentations (see Fig. 1). In 2003, the redeveloped ACH opened in 2003 integrating services such as Cardio-Thoracic surgery, previously located on separate campuses, supplementing the ability to provide definitive care in one location. It is well published that the ability of a trauma centre to provide definitive care is important for patient outcomes, including the elderly [25].

It is evident that in the closing years of the analysis that there has been a marked increase in the admission of elderly trauma patients to ACH, although proportionally this increase is more linear due to the increase in total admissions. The proportion of elderly trauma patients is higher than what would be expected from demographic change in the ACH catchment alone, and this could potentially be explained by the transfer of elderly patients with major trauma from the adjacent WDHB. This is the largest Health Board in New Zealand by population, and demographic projections predict a doubling in number of those ≥65 years from 2014 to 2034, however it lacks a Level 1 Trauma Centre [26]. Given this trend, health economic projections can be calculated to ensure that funding and resources are provided to treat this resource intensive patient group.

Furthermore, there is increasing evidence that customised evaluation and management in the elderly trauma population may improve patient outcome, and that the proportional volume of elderly trauma seen in a particular trauma centre has effects on patient outcomes [10, 27–33]. This has been studied most extensively in the orthogeriatric cohort, and although the conclusion of some published studies is encouraging there is a lack of high quality evidence and further investigation is imperative [34]. Geriatricians at ACH have always worked closely with the Trauma Service, and an overall mortality of 5.6% with an elderly trauma cohort of around 20% of admissions is certainly comparable with other published data [33]. Thus, consideration of integration of an Older Person's Health team into the Trauma Service, as well as consolidation of elderly trauma patients to designated 'geriatric trauma' centres merits serious consideration.

The primary limitation of this study is that it is selective in both demographics and population; this can make generalisation problematic as populations can vary significantly. Despite this, the results are concordant with a number of other studies in highlighting the demographic differences between younger and older trauma patient cohorts and that clinical outcomes are also significantly different [6, 7, 9–11]. Furthermore, much has changed over the last 20 years in terms of treatment and management of elderly trauma patients, and while this could be cited as a confounding factor when comparing patients, the effects of these changes can be demonstrated by such a longitudinal study; however, the magnitude of these effects is difficult to quantify. Also difficult to quantify in such a longitudinal study are the subtle and individual patient factors that lead to the outcomes seen, such as those noted in patients admitted with falls. Further prospective studies aimed at specifically identifying at risk individuals in this cohort should be explored.

Conclusion

Population studies have confirmed an increase in the proportion of elderly patients (≥65 years of age); this demographic change has been demonstrated locally by the ACH Trauma Database and is above population estimates. In agreement with earlier studies, the elderly trauma cohort is significantly different from their younger counterparts with respect to injury presentation and clinical outcomes. The number of elderly patients admitted with major trauma has almost doubled over the past 20 years; however, overall mortality has fallen; possible explanations include improving trauma and medical care as well as service integration. Given the trends demonstrated, further resources will be required to meet service demand, along with consideration of strategies to integrate multi-disciplinary care and consolidate trauma management for this vulnerable patient group.

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