

# ORIGINAL ARTICLE

## Characteristics of elderly patients presenting to the emergency department with injury

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**Abstract.** <Background> In Japan, emergency departments (ED) receive a large proportion of elderly patients each year. As such, injuries in the elderly are a common reason for presentation to the ED. Knowledge about the characteristics of injuries presenting to the ED would be invaluable in devising strategies to prevent injury in the elderly. <Objective> To analyze the characteristics of injuries in the elderly presenting to the ED and compare them with those of the younger population. <Setting> The ED at Keio University Hospital, a large inner city teaching hospital located in Tokyo. <Method> A retrospective analysis of data extracted from the ED database of the Keio University Hospital. Information regarding patients aged 65 years or above presenting with injury was analyzed and compared with those aged less than 65 years. Prehospital triage by emergency personnel was adopted as the severity of patients, namely “life-threatening” or “non life-threatening”. <Results> 20% of all ED presentations of elderly patients were injury related compared to 39% of non-elderly. Compared to the non-elderly, elderly patients presenting to the ED with injury were more likely to be female, sustained injury from trauma unrelated to motor vehicle accidents (MVA) and requiring hospital admission as a result of “non life-threatening” injuries. They were less likely to have injuries from MVA or burns. The number of “life-threatening” injury cases and mortality in both groups were similar. There was evidence that the number of ED presentations relating to injury is increasing in the elderly population. <Conclusion> Elderly injury patients are a distinct group with distinctive demographics, mechanism of injury and outcomes. This information would be useful in the planning of injury prevention programs, with particular emphasis on elderly females and MVA-unrelated trauma. (Keio J Med 51 (1): 11–16, March 2002)

**Key words:** elderly, injury, prevention, emergency department

### Introduction

The growing elderly population will have a significant impact on the health care sector world-wide. It is estimated that by the year 2050, the population above 60 years in developed nations will double, whereas in underdeveloped nations this figure will triple.<sup>1</sup> In Japan, whose citizens enjoy a relatively high life expectancy, the ratio of elderly people is expected to reach the highest level in the world.<sup>2</sup>

Injuries are a serious health problem for elderly people. They represent the seventh leading cause of death in patients over 65 years.<sup>3</sup> Although injury is

often regarded as a disease of the young, the repercussions of injury are much more significant in the elderly. Injuries in the elderly result in an increased rate of hospital admission,<sup>4</sup> greater length of stay,<sup>5</sup> as well as a higher mortality and morbidity rate compared to younger age groups.<sup>6,7</sup> Whilst the elderly only constitute 14% of the population in the United States, they utilize one-third of all trauma healthcare resources.<sup>3</sup> The magnitude of this problem is expected to increase as the aging population continues to grow.

Injury is a common reason for presentation to the ED. However, little is known about the epidemiology of injuries in older people that present to the ED.

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Studies on the characteristics of injuries in the elderly would be invaluable in identifying priorities for further research and intervention. Here, we present our findings of the pattern of injuries in elderly patients that presented to the ED of a large urban teaching hospital in Tokyo.

### Method

Keio University Hospital is a major private teaching hospital located in inner Tokyo. As a tertiary referral center, it receives a wide variety of emergency cases by ambulance each year. As such, Keio University Hospital provides an appropriate setting to examine the demographics and statistical information regarding injuries sustained by elderly patients.

To facilitate research purposes, an ongoing computerized database has been established since 1988 to collect information on ED admissions to the hospital. The database holds individual records of each patient that presented to the ED. For each patient presenting to the ED, a predetermined dataset was recorded from the medical record. This includes demographic information such as name, age and gender, as well as the presenting complaint, mode of arrival, triage, diagnosis and outcome. The data entry is completed by the consulting doctor responsible for the patient. Thus, the database is a rich source of information with respect to injury epidemiology and surveillance.

A retrospective analysis was performed using the above-mentioned ED database of the Keio University Hospital. Analysis was conducted on five years of data: January 1996 to December 2000. For purposes of comparison, "elderly" persons were defined as those aged 65 or above, whilst patients less than 65 years were referred as "non-elderly". Injuries were arbitrarily divided into those arising from motor vehicle accident (MVA), those not related to MVA, burns and self-inflicted injuries.

In this study, elderly and non-elderly patients presenting with injury were compared using different parameters. These include the number of injury presentations in each group over the five-year study period, gender distribution, nature of injury, severity of injury determined by prehospital personnel and short term outcomes of these patients. Data were analyzed by a Chi-square test. Significance was accepted at  $p < 0.05$ .

### Results

During the five-year period from 1996 to 2000, a total of 17,578 patients presented to the ED at Keio University Hospital (Table 1). Just over one-third of these presentations (35.5%) were injury-related. In total, there were 3,968 patients aged 65 years or above,

**Table 1** Comparison of the Number of Elderly and Non-elderly Patients Presenting with Injury

Year	1996	1997	1998	1999	2000	Total
Total patients	3,373	3,364	3,487	3,563	3,791	17,578
(%)	(100)	(100)	(100)	(100)	(100)	(100)
Total injuries	1164	1219	1208	1265	1349	6,205
(%)	(34.5)	(36.2)	(34.6)	(35.5)	(35.6)	(35.3)
Elderly*	787	759	776	776	870	3,968
(%)	(23.3)	(22.6)	(22.3)	(21.8)	(22.9)	(22.6)
With injury	125	148	180	163	197	813 <sup>†</sup>
(%)	(3.7)	(4.4)	(5.2)	(4.6)	(5.2)	(4.6)
Non-elderly <sup>†</sup>	2,586	2,605	2,711	2,787	2,921	13,610
(%)	(76.7)	(77.4)	(77.7)	(78.2)	(77.1)	(77.4)
With injury	1,036	1,070	1,021	1,066	1,141	5,334
(%)	(30.7)	(31.8)	(29.3)	(29.9)	(30.1)	(30.3)

\* Elderly: Persons aged 65 or above. <sup>†</sup> Non-elderly: Persons aged less than 65. <sup>†</sup> Incidence of injury in the elderly was significantly less in the elderly compared to the non-elderly (813 injury cases among 3,968 elderly patients = 20%, 5,334 injury cases among 13,610 non-elderly patients = 39%, odds ratio 0.40 [95% CI 0.37–0.43]).

**Table 2** Comparison of Injury and Non-injury Related Presentations to the ED between 1996–1997 and 1999–2000

	No. in 1999–2000 (%)	No. in 1996–1997 (%)	Odds ratio (95% CI, $p$ value)
Elderly	1,646 (100)	1,546 (100)	
Injury related presentation	360 (21.9)	273 (17.7)	<b>1.31</b> <b>(1.10–1.56, <math>p = 0.003</math>)</b>
Non-elderly	5,708 (100)	5,191 (100)	
Injury related presentation	2,207 (38.7)	2,106 (40.6)	<b>0.92</b> <b>(0.85–0.997, <math>p = 0.04</math>)</b>

comprising approximately 23% of all patients presenting to the ED during the study period. Of these 3,986 elderly patients, 813 (4.6%) presented to the ED with injury. Thus, it can be seen that around 20% of all ED presentations of elderly patients were injury related. With respect to non-elderly patients, i.e. those aged less than 65 years, there were 13,610 presentations to the ED in the five-year period with 5,334 (30.3%) cases of injury recorded. Thus, injury represented 39.2% of all emergency presentations in the non-elderly group. It was found that the occurrence of injury was significantly less in the elderly than the non-elderly (odds ratio; 0.40, 95% CI; 0.37–0.43).

Trends in the number of injury-related presentations were examined for the study period (Table 2). In the interval between 1996 and 1997, there were 273 cases of injury-related presentations in the elderly group, making up approximately 17.7% of all elderly ED

**Table 3** Gender Distribution of Elderly and Non-elderly Patients Presenting with Injury to the ED

	Injury-related	Not injury-related	Odds ratio (95% CI, <i>p</i> value)
Elderly (%)	813 (100)	3,155 (100)	
Male (%)	376 (46.2)	1,749 (55.4)	<b>0.69 (0.59–0.81, <i>p</i> &lt; 0.0001)</b>
Non-elderly (%)	5,334 (100)	8,276 (100)	
Male (%)	3,610 (67.7)	4,425 (53.5)	<b>1.82 (1.69–1.95, <i>p</i> &lt; 0.0001)</b>

presentations in the two-year period. In comparison, 360 cases of injury were documented in the interval between 1999 and 2000, accounting for 21.9% of all elderly ED presentations. This represented a statistically significant increase in the number of injury-related presentations to the ED in the elderly (odds ratio; 1.31, 95% CI; 1.10–1.56). Subsequent analysis of the non-elderly group revealed a decrease in the number of injury-related presentations to the ED (odds ratio; 0.92, 95% CI; 0.85–0.997) between the periods 1996–1997 and 1999–2000.

The gender distribution of injury-related presentations was also examined (Table 3). Of the 813 elderly patients who presented with injury during the five-year study period, 437 (57.8%) patients were women compared with 376 (42.2%) men. This represented a significant difference in the proportion of female and male elderly patients presenting with injury (odds ratio; 0.69, 95% CI; 0.59–0.81). In the non-elderly group, 3,610 (67.7%) men and 1,724 women (32.3%) were recorded in the study period, out of a total of 5,334 injury-related presentations. Thus, there were a significantly greater proportion of males than females presenting with injury in the non-elderly population (odds ratio; 1.82, 95% CI; 1.69–1.95).

The nature of the injuries sustained was subsequently analyzed with respect to the two study groups (Table 4). In the elderly group, MVA-unrelated trauma was the main cause of injury, with a total of 587 cases during the five-year period (72% of all injuries in the elderly). MVA was responsible for 172 cases of injury, making up 21% of injuries in the elderly. Deliberate self-injury contributed to 39 injury-related presentations, whilst 15 cases of burns were recorded. These modes of injury represented approximately 5% and 2% of all cases of injury in the elderly respectively.

In comparison, the principal reason for injury presentation to the ED in the non-elderly group was MVA. There were 3,015 cases of MVA, accounting for approximately 57% of all injuries sustained by non-elderly patients. MVA-unrelated trauma contributed to 2,106 cases of injury (39% of all injuries). Deliberate self-

**Table 4** Nature of Injury Presentations to the ED in the Elderly and Non-elderly Populations

	Elderly* No. (%)	Non-elderly† No. (%)	Statistics Odds ratio (95% CI, <i>p</i> value)
No. of patients (%)	3,968 (100)	13,610 (100)	
Total no. of injuries	813 (20.5)	5,334 (39.2)	<b>0.40 (0.37–0.43, <i>p</i> &lt; 0.0001)</b>
MVA*	172 (4.4)	3,015 (22.2)	<b>0.16 (0.14–0.18, <i>p</i> &lt; 0.0001)</b>
MVA-unrelated	587 (14.8)	2,061 (15.1)	0.97 (0.86–1.08, <i>p</i> = 0.61)
Burns	15 (0.4)	94 (0.7)	<b>0.55 (0.32–0.94, <i>p</i> = 0.04)</b>
Self-injury	39 (1.0)	164 (1.2)	0.81 (0.57–1.16, <i>p</i> = 0.29)

\* MVA: Motor vehicle accident.

**Table 5** Patients with Injury Considered as “Life-threatening” (Third Level) by Emergency Personnel at Pre-hospital Setting

	Elderly No. (%)	Non-elderly No. (%)	Statistics Odds ratio (95% CI, <i>p</i> value)
Total no. of patients	3,968	13,610	2.62 (2.19–3.14, <i>p</i> < 0.0001)
“life-threatening”	199	269	
No. of injuries	813 (100)	5334 (100)	
“life-threatening”*	12 (1.5)	97 (1.8)	0.81 (0.38–1.72)

\* Life-threatening: Patients considered by emergency personnel in pre-hospital setting to be at high risk of death and needing urgent medical attention (third level).

injury and burns had a relatively low occurrence. There were 164 cases of self-injury and 94 cases of burns contributing 3% and 1.8% to injury related presentations to the ED respectively. Statistical analysis of the injuries between the elderly and non-elderly group revealed a significantly greater number of MVA in the non-elderly than elderly group (odds ratio; 0.16, 95% CI; 0.14–0.18) as well as burns (odds ratio; 0.55, 95% CI; 0.32–0.94). MVA-unrelated trauma and self-injury did not differ significantly between the two groups.

The number of patients triaged as “life-threatening” by emergency personnel in the pre-hospital setting was also determined (Table 5). In the five-year study period, 12 cases were triaged as “life-threatening” in the elderly group. Thus, injury was responsible for 6.0% of the total number of severe cases in the elderly. In the non-elderly group, there were a total of 97 severe cases due to injury. This was approximately 36% of all “life-threatening” cases in the non-elderly. Comparison of

**Table 6** Short-term Outcomes of Injury Presentations to the ED

	Elderly No. (%)	Non-elderly No. (%)	Statistics Odds ratio (95% CI, <i>p</i> value)
Total no. of injuries	813	5,334	
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“life-threatening”	12 (100)	97 (100)	
Death in ED	3 (25.0)	30 (30.9)	0.74 (0.18–2.97, <i>p</i> = 0.75)
Hospitalized	9 (75.0)	67 (69.1)	1.34 (0.34–5.22, <i>p</i> = 0.86)
Discharged from ED	0 (0.0)	0 (0.0)	
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“non life-threatening”	801 (100)	5,237 (100)	
Death in ED	4 (0.5)	18 (0.3)	1.46 (0.49–4.36, <i>p</i> = 0.50)
Hospitalized	60 (7.5)	159 (3.0)	<b>2.57 (1.91–3.47, <i>p</i> &lt; 0.0001)</b>
Discharged from ED	737 (92.0)	5,060 (96.6)	<b>0.40 (0.30–0.54, <i>p</i> &lt; 0.0001)</b>

the number of “life-threatening” cases revealed no statistically significant difference between the two groups (odds ratio; 0.81, 95% CI; 0.38–1.72).

Lastly, the short-term outcome of injury presentations to the ED was examined (Table 6). In elderly patients who were injured and triaged as “life-threatening” (*n* = 12), 25% died in the ED whilst 75% were hospitalized. In the non-elderly, 30.9% of patients triaged as in “life-threatening” condition (*n* = 97) died in the ED and 69.1% were hospitalized. Most of the patients who died in the ED were in the condition of cardiopulmonary arrest on arrival. There was no statistical difference between the elderly and non-elderly in the number of deaths in the ED or admissions as a result of “life-threatening” injury.

In the remaining elderly patients who presented with “non life-threatening” injury (*n* = 801), 0.5% (*n* = 4) died in the ED whilst 7.5% (*n* = 60) were hospitalized. Although the four patients were undertriaged by the emergency personnel, the majority of elderly patients with “non life-threatening” injury were discharged from the ED. This was also true in non-elderly patients, with 96.6% discharged from the ED, whilst 0.3% and 3.0% died in the ED or were hospitalized respectively. The proportion of elderly patients hospitalized as a result of non-threatening injury was significantly greater than the non-elderly group (odds ratio; 2.57, 95% CI; 1.91–3.47).

## Discussion

As the population of the developed world ages, injury to the elderly will become an increasingly important public health issue. Deterioration in sensory

perception, weakness, poor coordination and balance predispose the elderly to injury.<sup>8</sup> Once they have sustained an injury, their mortality rate is markedly greater than that of the young.<sup>6,7,9</sup> Their functional capacity could be adversely affected by injury, leading to increased dependency and decline in quality of life. Thus, injury has been recognized as a priority area for public health intervention.<sup>10</sup> As such, investigation into the characteristic of injuries to the elderly as they present to the ED would provide valuable information in implementing injury prevention.

This study examined the characteristics of elderly patients presenting with injury to the ED, and compared those with younger patients. It revealed distinct differences in the injury profile between the elderly and the non-elderly. Notably, there were less injury-related ED presentations in the elderly, being almost half the number in the non-elderly. This is consistent with the notion that injury is mostly a “disease” of the young. Older people are less physically active than their younger counterparts, therefore are less likely to be exposed to potential trauma.

Though the elderly showed a substantially lower number of injury presentations to the ED than the young, the number of elderly injury presentations increased considerably from 273 in 1996–1997 to 360 in 1999–2000. Our finding is perturbing, as it may be indicative of an ongoing upward trend in the elderly injury rate. Although the gradual growth of the elderly population may have contributed to some of the increase, it cannot account for the disproportionate rise in the number of injury presentations. A possible explanation is the well-recognized problem of elderly falls.<sup>10</sup> It has been reported that fall-induced injuries have increased substantially that cannot be ascribed to demographic changes alone.<sup>11,12</sup> Thus, it is possible that an increase in the incidence of falls may have contributed to the increase in ED injury presentations. Interestingly, the number of injury presentations in the non-elderly declined in the study period in contrast to the elderly population.

Elderly females were found to be more at risk from injury than males. Previous studies have demonstrated similar findings.<sup>9,10</sup> Davis *et al.* found an increased incidence of falls amongst Japanese women in their prospective study of Japanese elderly living in Hawaii.<sup>13</sup> Elderly females also form a higher proportion of trauma admissions to ICU.<sup>9</sup> It is difficult to provide a clear explanation for this phenomenon, though it has been postulated that female susceptibility to osteoporosis may make them more vulnerable to fall-related injuries.<sup>14</sup> In contrast, the non-elderly showed a greater proportion of male patients than females. This is likely to be a reflection of the occupational hazards & risk-taking activities of males in the younger age group.

The nature of injury presentation also differed between the elderly and non-elderly. Notably, the elderly demonstrated a significantly lower number of MVA compared to the non-elderly. This is likely to be due to over-representation of MVA as a cause of injury in the young.<sup>15</sup> However, MVA remained the second most common cause of injury in the elderly, a finding consistent with other reports.<sup>3,5</sup> Burns were also significantly fewer as a cause of injury in the elderly than non-elderly. Whilst this is reassuring to some extent, elderly people suffer the highest fatality rate of any age group.<sup>5</sup>

By far, MVA-unrelated trauma represented the most common cause of injury presentation to the ED within the elderly group. Although our study did not examine the exact mechanism of MVA-unrelated trauma, falls have been widely documented as a common presenting complaint to the ED<sup>16</sup> and a major cause of trauma in this population.<sup>17</sup> As mentioned previously, falls related injuries have increased, and may account for the high proportion of MVA-unrelated trauma in the elderly. Researchers have sought to reduce the impact of falls through prevention & rehabilitation,<sup>14,16</sup> but it remains the major cause of non-fatal and fatal injury in the elderly.<sup>10</sup> Although the exact nature of trauma requires further evaluation, our finding that trauma (with falls as the most likely underlying cause) as the most common injury presentation has implications for injury prevention.

Regardless of the type of injury sustained by the elderly, it has been reported that their outcome is poorer compared to their younger counterparts. We investigated this possibility by looking at the proportion of injured patients that died in the ED or were hospitalized as a result of their injuries. Our findings revealed that the vast majority of injury presentations were “non life-threatening”, with less than 2% of cases deemed “life-threatening” in each group. The incidence of “life-threatening” injuries in the ED at Keio University Hospital is similar to that of the Tokyo metropolitan area (1.9% in 1999). In these small number of patients placed in the “life-threatening” category, older adults had a similar number of hospitalizations and deaths when compared to the young. Regardless of age, severe injury resulted in similar adverse outcome.

In the majority of injuries that were triaged as “non life-threatening”, death was an uncommon outcome, with comparable small number of deaths in the elderly & non-elderly. However, there were a significantly greater number of elderly persons hospitalized than younger persons as a result of their injury. Higher injury hospitalization rates in elderly people compared to the young had been previously documented.<sup>4</sup> It is most likely that elderly patients had other comorbidities that influenced the decision to admit an elderly patient with injury. In a study reviewing 27,000 patients, 31% of

those over the age of 65 had pre-existing disease, which contributed to a length of stay more than twice that of younger adults.<sup>1</sup> In addition, their relative inability to cope with injury and the high incidence of complications after injury are considerations that may have also precipitated the need for hospital admission.

Previous studies have noted an increased mortality in the elderly with injury.<sup>6,9</sup> Our study did not demonstrate an increased number of elderly deaths in the ED from injury compared with the young. It is possible that death may have occurred during the hospitalization period, which was not accounted for in our study. It has been reported that elderly patients are more likely to suffer later death compared to an uninjured cohort.<sup>18,19</sup> In one study which stratified mortality into early and delayed (>24 hours), most of mortality in elderly trauma patients was delayed, unlike in younger patients, in whom mortality occurred early after injury.<sup>7</sup>

In summary, this study has utilized the database of the ED of Keio University Hospital to identify the characteristics of older patients with injuries. This study has shown that older patients comprise a small proportion of all ED injury patients. However, they are a distinct subgroup and several important differences between older and younger patients have been highlighted. In particular, when compared to the younger population, a higher proportion of older patients were female, presented with trauma unrelated to MVA, and were more likely to be admitted for “non life-threatening” injuries. These findings provide important information for the future planning and implementation of injury prevention in Japan.

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