Trends in severe pedestrian injuries among older people in NSW.

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Abstract

Aims: Pedestrian injuries from motor vehicle collisions have a high morbidity, mortality, and cost. Older people (65+) are consistently overrepresented within this population. While recent research has reported decreasing pedestrian injury cases, the decline in the rate of older pedestrians is not as sharp as it is for children. Examining trends of older pedestrian severe injuries is necessary and revealing given the relatively high severity and injury burden of older people.

Methods: Pedestrian injury cases were obtained from the Traffic Accident Database System (TADS; NSW Roads and Traffic Authority), the NSW Admitted Patients Data Collection (APDC; NSW Health Department), and the Australian Bureau of Statistics mortality data file. All NSW residents aged 65 years or older and hospitalised or fatally injured in a pedestrian motor vehicle collision between years 1999-2007 were included.

Results: There was a significant reduction in incident cases of reported older pedestrian injuries from 1999 through 2007. However, there was no meaningful reduction in mortality among older persons, in contrast to a significant reduction among children and adults.

Conclusion: There is a decreasing trend in older pedestrian injuries in NSW, however, this trend is not apparent for indicators of more severe injuries. The injury burden of pedestrian injuries of older people is being underestimated. An examination of additional indicators of burden of injury will help elucidate the true extent of this public health problem.

Keywords
Pedestrian injury, vulnerable road user, older persons.

1. Introduction

Pedestrian injuries caused by motor vehicles are a unique subset of road-related injury, due to a high associated mortality, morbidity, and cost. Pedestrian injuries account for 18% of all road-based fatalities in New South Wales (NSW)[1], and 18.5% of casualty-related costs[2]. At particularly high risk of a pedestrian injury are children, frail or older persons, and young adult males[1], and older persons are consistently found to present the highest rate of mortality within pedestrian casualties[3-6].

In NSW, recent initiatives have been put into place to specifically address pedestrian safety. These initiatives include the introduction of a 50 km/h urban speed limit in July 1998 (leading to the enactment of the general urban speed limit of 50 km/h in November 2003), targeted driver awareness and public education campaigns focused on pedestrian safety, community based local council Road Safety Officer programs, the introduction of the 40 km/h reduced speed limit in local school zones which operated between 8 am and 9:30 am and 2:30 pm to 4 pm, and the introduction of a number of 40 km/h high pedestrian activity zones[1].

The effectiveness of these road safety initiatives has generally been positive. Following the implementation of the 50 km/h urban speed limit in NSW, research by the NSW Roads and Traffic Authority (RTA) found that, in the two years following implementation, there was an overall decrease of 22% in reported crashes involving a casualty, and a 50% decrease in crashes involving pedestrians[7]. More recent research has examined the trends of pedestrian injuries in NSW, and found there to be a significant decreasing trend in the rate of reported pedestrian injuries from 1999 to 2006[8]. While this trend was found within all age groups in the population, the rate of decline in the older population was significantly less when compared to other at-risk populations, such as children.
Given that NSW has an aging population[9], and that older persons tend to suffer more serious injury or death resulting from a pedestrian injury[3, 4], a disproportionate reduction of pedestrian injuries within the older population may present an increasing burden on the healthcare system. As examination of multiple datasets can often provide a more complete picture of trends in road traffic accidents[10, 11], this study seeks to further examine trends of pedestrian injuries among older persons in NSW, using indicators of all police reported casualties, hospital admissions, and mortality due to pedestrian injury.

2. Methods

2.1 Data sources

Indicators of pedestrian injury were assessed for three data sources: The RTA Traffic Accident Database System (TADS), the NSW Admitted Patients Data Collection (APDC), and the Australian Bureau of Statistics (ABS) mortality data file.

TADS includes information on all collisions with a moving traffic vehicle where a person was unintentionally killed or injured or at least one motor vehicle was towed away on a public road in NSW. Information recorded on TADS includes the date and time of incident, class of road user for each casualty, as well as 30 day follow-up of mortality status and whether the casualty was treated or admitted to hospital following injury. As the TADS includes all police-reported pedestrian casualties, to minimize reporting bias of minor injuries, this analysis will be restricted to the more serious range of police reported traffic casualties, where the casualty has been fatally injured or has been admitted to a known hospital following injury.

The APDC is a census of all services on inpatient separations from NSW public and private hospitals, private day procedures, and public psychiatric hospitals. The APDC is a commonly used indicator of the number of hospitalisations in NSW[12]. However, unlike TADS it does not include injuries that are treated at an outpatient facility or emergency department, nor pedestrian fatalities which occur at the crash site. As such, the APDC may be seen to represent the more serious non-fatal pedestrian injuries which lead to hospitalisations. The reason for a hospital admission is coded at the time of separation (discharge, transfer or death), and since 1 July 1998 this has been according to the 10th revision of the International Classification of Diseases, Australian Modification (ICD-10-AM).

The ABS Mortality Data File contains information from the Births, Deaths and Marriages Registrar in each state and territory in Australia up to December 2006, and is the most reliable source of mortality data in Australia. Information recorded on the ABS mortality data file includes administrative information, demographic information regarding the deceased, and the cause of death, coded according to the 10th revision of the International Classification of Diseases (ICD-10).

2.2 Case definition

The number of pedestrian injuries were identified in each data source for three age groups: children (0-14 years), adults (15-64 years), and older persons (65 years or older). Pedestrian injuries with an unknown age at injury have been excluded from these analyses. As two of the three data sources collect information by calendar year (TADS, ABS mortality data file) and not financial year (APDC), trends of injury counts were compared across calendar years 1999-2007.

A casualty due to pedestrian injury in the TADS was identified as a pedestrian casualty involving a motor vehicle, where the pedestrian was fatally injured at the site or transported to a hospital.

A hospitalisation due to pedestrian injury in the APDC was identified as a case who is a NSW resident, with a primary admission ICD-10AM code between S00-T99, and with an external cause code between V02-V09. To avoid multiple counts for the same injury presentation, hospital separations relating to hospital transfers and type changes have been removed.

A death resulting from a pedestrian injury on the ABS mortality data file was identified as a death of a NSW resident, with a contributing cause of death ICD-10AM code between V02-V09.
2.3 Statistical analyses

Poisson regression was used to estimate the trend and annual change ratio in injury and mortality counts over time, coding year as a continuous variable, adjusted by age group (children, adults, older persons) and sex, using mid-year population estimates from the ABS as an offset variable. Differences between age groups in the annual change ratio were assessed using interaction terms between age category and year. There was no significant interaction effect between gender and year, and so results have been presented for both males and females combined. For descriptive purposes, yearly age-sex standardised injury and mortality rates per 100,000 person-years were produced within each age group, using mid-year population estimates for each age group from the ABS. All statistical analyses used a significance level of 0.05, and were performed using SAS version 9.1.3 (SAS Institute, Inc., Cary, NC).

3. Results

3.1 Police reported casualties (TADS)

From 1999-2007, there were a total of 2,984 police reported pedestrian casualties in children, 10,801 pedestrian casualties in adults, and 2,722 pedestrian casualties in older persons. There was a significant decreasing trend in the number of police reported pedestrian casualties within the population of each age group (Figure 1a), with a decreasing trend of 6.5% per annum among children, 4.6% per annum among adults, and 3.8% per annum among older persons (Table 1). The trend for older persons was significantly different from that for children (p=0.032) but not for adults.

Throughout the study period, older persons in NSW had an average rate of 34.3 injuries per 100,000 person-years. Of these, 51.6% (1,405/2,722) of reported casualties were among females. Average injury rates became greater with age, with the lowest injury rate in those aged 65-69 (26.6 per 100,000 person-years) and the highest injury rate in those aged 80-84 and 85 and older (44.9 and 41.6 per 100,000 person-years respectively).

3.2 Hospitalisations (APDC)

From 1999-2007, there were a total of 1,872 hospital admissions for pedestrian injury in children, 6,251 hospitalisations for pedestrian injury in adults, and 1,723 hospitalisations for pedestrian injury among older persons. There was a decreasing trend in the number of hospitalisations within the population of each age group (Figure 1b), with a significant decreasing trend of 7.4% per annum among children, and non-significant decreasing trends of 2.4% per annum among adults, and 1.8% per annum among older persons (Table 1). The trend for older persons was significantly different from that for children (p<0.001) but not for adults.

Throughout the study period, older persons in NSW had an average hospitalisation rate of 21.7 injuries per 100,000 person-years. Of these, 50.4% (869/1,723) of admissions were among females. Average injury rates became greater with age, with the lowest injury rate in those aged 65-69 (17.0 per 100,000 person-years) and the highest injury rate in those aged 80-84 and 85 and older (28.3 and 27.0 per 100,000 person-years respectively).

3.3 Deaths (ABS)

From 1999-2006, there were a total of 80 deaths with a contributing cause of pedestrian injury in children, 461 deaths in adults, and 278 deaths among older persons. There was a difference in the pattern of mortality over time between age categories (Figure 1c), with a general decrease in the number of deaths among the population of children and adults, but an inconsistent pattern of mortality among older persons. The decrease in mortality followed a significant decreasing trend of 18.8% per annum among children and 10.9% per annum among adults, while there was a non-significant decreasing trend of 3.8% per annum among older persons (Table 1). The trend for older persons was significantly different from that for children (p=0.003) and adults (p=0.014), although this result is limited in interpretation by the erratic pattern of mortality among older persons.
Throughout the study period, older persons in NSW had an average mortality rate of 4.0 deaths per 100,000 person-years. Of these, 43.5% (121/279) of deaths were among females. Average mortality rates became greater with age, with the lowest mortality rate in those aged 65-69 (2.2 per 100,000 person-years) and the highest mortality rate in those aged 80-84 and 85 and older (6.1 and 7.7 per 100,000 person-years respectively).

4. Discussion

This study sought to identify the extent to which the decreasing trend of pedestrian injuries in NSW was represented among older persons, a vulnerable group of road users with a particularly high exposure and risk of mortality. We found that while there was a significant downward trend in the total number of pedestrian injuries among the older population, this trend was less evident and non-significant for the more serious indicator of hospitalizations, and erratic and non-significant for the severe indicator of mortality. This result contrasts to the pattern of results among children, who show a significant downward trend across all indicators of injury, and the pattern of results among adults, who show a significant downward trend in both reported injuries and mortality. In conjunction with the difference in trend estimates between children and older persons for all reports of injury, and the difference in trend estimates between adults and older persons for mortality, suggest that there may be a differential pattern of reduction in the more severe pedestrian injuries for older persons than for children and adults.

Furthermore, older persons continued to be overrepresented across all indicators of pedestrian injury, with the highest rates of reported injury, hospitalisations, and mortality. This result in itself was not unexpected, as older persons are known to be a subset of the population vulnerable to pedestrian injury. In particular, mortality from pedestrian injuries is usually much higher among older persons, as they are more likely to sustain or die from complications arising from serious injuries [3-6, 13] due to their relative lack of resilience, poorer reserves and greater co-morbidities[14, 15]. Poorer outcomes among older persons are evidenced by their over-representation in the mortality data. However, it is difficult to disentangle the effect of factors which place older pedestrians at increased risk, such as visual and auditory impairments or prohibitive traffic conditions[16], and elevated levels of exposure due to lifestyle factors within the older population. While there is some evidence that rates of physical activity and walking have been increasing in recent year among older persons in NSW, this is proportional to the rate of increase in children and adults[17], and cannot account for the differential rates of injury reduction observed in this study.

Combined, these results suggest that while there has been a decrease in the number of reported pedestrian injuries among older persons in NSW, the extent of this decrease is not carried through to the more serious injuries leading to hospitalisation or death. A similar differential pattern of injury severity has been found in New Zealand and the UK, where threat-to-life indicators have shown that the rate of serious road traffic injuries have not declined to the same extent as for indicators of minor injuries[18], or police reported traffic injuries[11]. Furthermore, as older persons continue to be overrepresented in pedestrian injury and mortality rates, and given that NSW has an ageing population, it is likely that older persons with serious injuries will begin to comprise a larger proportion of the total number of pedestrian injuries in NSW.

The primary strength of this study is that it is a population based study, and includes all incident police-reported pedestrian casualties, hospitalisations for pedestrian injury, and mortality from pedestrian injury in NSW. To the authors’ knowledge, this is the first study to compare incident pedestrian injuries across all three population-based indicators in NSW, and presents a novel perspective on identifying population differences between commonly reported health indicators. Indeed, previous research has shown that concordance between health datasets may not always be reliable, and the use of multiple indicators can provide a more complete picture of road traffic casualties [10, 11].

However, comparison across multiple indicators can be problematic, and there are limitations to the interpretation of the data. As the indicators are from different data sources and are recorded for different purposes, there may be some differences in the study populations in each dataset. For example, the TADS record all road casualties on a public road within NSW and may include interstate and overseas visitors, while the APDC records all hospital separations of NSW residents, including separations which occur interstate. While all attempts have been made to ensure study populations were comparable, and this is
unlikely to appreciably affect any observed patterns of injury, the potential for a difference in the capture of the injury populations cannot be excluded. Statistical interpretations of trend estimates for mortality may also be limited due to the low number of events. While this is particularly the case for children, who often presented with less than 10 fatalities per year, low injury numbers and low population size may help account for the erratic pattern of mortality among older persons in the study.

This study is also limited in the assumption that indicators of hospitalisation and mortality are representative of the more serious injuries within the population. While it is likely that pedestrian injuries leading to hospitalisation are more serious than police reported injuries not leading to hospitalisations, if we wish to make assumptions on the types of injuries sustained and the impact on the healthcare system, true indicators of injury severity and burden of injury need to be assessed. As older persons are more likely to suffer severe injuries and have a higher cost of hospitalisations, this represents an important component of the true pattern of pedestrian injury among older persons.

5. Conclusion

While there has been an overall reduction in the number of pedestrian injuries in NSW from 1999 to 2007, it is possible that the rate of reduction for the more serious pedestrian injuries, those which lead to hospitalisations or death, has not been declining among older persons to the same extent as the rate of reduction for children and adults. Given the overrepresentation of older persons in pedestrian injuries, and the ageing NSW population, older persons present a growing proportion of the total pedestrian injuries and a possible increased burden on the healthcare system. Measures of risk factors, mobility, injury severity, and pedestrian injury costs will help provide insight on the true extent of this public health issue.

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References


Table 1: Overall Rate and Annual Percent Change of Pedestrian Injury in NSW 1999-2007, for Children (0-14), Adults (15-64), and Older Persons (65 and older)

<table>
<thead>
<tr>
<th>Population</th>
<th>Total casualty count</th>
<th>Overall rate (per 100,000 person-years)</th>
<th>Annual Change Ratio (95% CI)</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Police reported casualties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children</td>
<td>2,984</td>
<td>24.9</td>
<td>0.935 (0.895 - 0.978)</td>
<td>0.032</td>
</tr>
<tr>
<td>Adults</td>
<td>10,801</td>
<td>27.0</td>
<td>0.954 (0.917 - 0.992)</td>
<td>0.426</td>
</tr>
<tr>
<td>Older persons</td>
<td>2,722</td>
<td>34.3</td>
<td>0.962 (0.944 - 0.980)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Hospitalisations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children</td>
<td>1,872</td>
<td>15.6</td>
<td>0.926 (0.885 - 0.969)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Adults</td>
<td>6,251</td>
<td>15.6</td>
<td>0.976 (0.937 - 1.016)</td>
<td>0.523</td>
</tr>
<tr>
<td>Older persons</td>
<td>1,723</td>
<td>21.7</td>
<td>0.982 (0.964 - 1.001)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Deaths†</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children</td>
<td>81</td>
<td>0.8</td>
<td>0.812 (0.693 - 0.952)</td>
<td>0.003</td>
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<tr>
<td>Adults</td>
<td>465</td>
<td>1.3</td>
<td>0.891 (0.798 - 0.995)</td>
<td>0.014</td>
</tr>
<tr>
<td>Older persons</td>
<td>279</td>
<td>4.0</td>
<td>0.962 (0.917 - 1.010)</td>
<td>-</td>
</tr>
</tbody>
</table>

* p-value for difference in annual change ratio, when compared to older persons.
† Data available for 1999-2006 only.
Figure 1: Annual Age-Sex Standardized* Rates of A) Police-Reported Casualties†; B) Hospitalisations‡; and C) Deaths‡ Due to Pedestrian Injury in NSW 1999-2007

* Age (in 5 year intervals) and sex standardized to the 2001 Australian population, for children (0-14 years), adults (15-64 years), and older persons (65 years and older) respectively.
† Source: Traffic Accident Database System, Road and Traffic Authority of NSW
‡ Source: NSW Admitted Patient Data Collection (HOIST). Centre for Epidemiology and Research, NSW Department of Health.