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Paper:
Charters, K., Gabbe, B. & Mitra, B. (2018). Pedestrian traffic injury in Victoria, Australia. *Injury, 49*(2), 256-260.
http://dx.doi.org/10.1016/j.injury.2017.12.014

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Injury, Int. J. Care Injured xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Pedestrian traffic injury in Victoria, Australia

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ARTICLE INFO

Article history:
Received 24 June 2017
Received in revised form 3 December 2017
Accepted 14 December 2017

Keywords:
Injury prevention
Road traffic injury
Incidence
Pedestrian

ABSTRACT

Introduction: Road traffic injuries are the fifth leading cause of years of life lost, with pedestrians comprising 39% of all road deaths (Global Burden of Disease Mortality and Causes of Death Collaborators [1]). Programs that use injury surveillance data to identify high-risk targets for intervention are known to be effective for reducing injury. This study aims to identify trends in the population incidence of pedestrian traffic injury (PTI) in Victoria, Australia.

Method: A retrospective review of data from the Victorian Emergency Minimum Dataset, the Victorian Admitted Episodes Dataset, the Victorian State Trauma Registry and the National Coronial Information System was conducted of patients with a PTI who present to a public hospital emergency department, were admitted to hospital, sustained major trauma or who died of their injuries from January 1st 2009 to December 31st 2013. The primary outcome measure was population incidence of pedestrian traffic-related emergency presentations, hospital admissions, major trauma and deaths.

Results: Over the study period, 1838 cases presented to a public hospital emergency department and were discharged without admission to hospital and an additional 3241 cases were admitted to hospital. Of these, 628 cases were classified as major trauma including 90 in-hospital deaths. From January 1st 2008 to December 31st 2011, a total of 216 deaths occurred. A decrease in the population incidence of emergency presentations for PTI was observed over the study period. No significant change was observed in the population incidence of hospital admissions, major trauma cases or deaths from PTI. The demographics of PTI were observed more commonly to be young, intoxicated males and pedestrians aged over 65 years.

Conclusions: Although the population-adjusted incidence of emergency presentations for PTI in Victoria has decreased from 2009 to 2013, no change was observed in the incidence of hospital admissions, major trauma or pedestrian fatalities. Novel programs designed to address high-risk groups should be considered to achieve further reductions in PTI and severity of injuries.

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1 Introduction

Road traffic injuries are the fifth leading cause of years of life lost, with pedestrians comprising 39% of all road deaths [1]. Global attention to injury prevention and management has been associated with a reduction in pedestrian deaths in many high-income countries [2]. In Australia, pedestrian fatalities have decreased by 62% from 1995 to 2014 [3]. Nationally representative data on non-fatal pedestrian injury however is incomplete.

Statewide injury surveillance datasets can be used to inform and evaluate road safety interventions due to the accessibility of statewide injury surveillance datasets [4]. A small, but significant increase in the population incidence of hospital admissions for pedestrian traffic injury (PTI) was observed in Victoria from 2004 to 2008 [5]. Further research is indicated to identify whether this trend has continued and to identify groups with a high incidence of PTI to inform road safety initiatives.

The aims of this project were to identify trends in the population incidence of PTI in adults in Victoria, Australia from 2009 to 2013. Secondary aims were to identify patients groups commonly represented among the PTI population to target for public health initiatives.

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https://doi.org/10.1016/j.injury.2017.12.014
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Please cite this article in press as: K.E. Charters, et al., Pedestrian traffic injury in Victoria, Australia, Injury (2018), https://doi.org/10.1016/j.injury.2017.12.014

2 Methods

2.1 Study design

A retrospective review was conducted over a five-year period from January 1st 2009 to December 31st 2013 of all adult cases of pedestrian traffic injury in Victoria, Australia. Cases were identified using the Victorian Emergency Minimum Dataset (VEMD), the Victorian Admitted Episodes Dataset (VAED), the Victorian State Trauma Registry (VSTR) and the National Coronial Information System (NCIS). Approval was obtained from The Alfred Human Research Ethics Committee.

2.2 Inclusion and exclusion criteria

Cases were eligible for inclusion if they involved a pedestrian injured in a collision with one or more vehicles on a road, street or highway, aged 18 years or over, in Victoria from January 1st 2009 to December 31st 2013. Intentional pedestrian injuries as determined by police, coroner or medical record documentation were excluded. As in-hospital deaths are included in VSTR and NCIS data sets, pedestrians who died in-hospital were excluded from NCIS figures to avoid duplication. Similarly, cases of PTI admitted to hospital from the emergency department (ED) were excluded from the VEMD data set to avoid double counting.

2.3 Data sets and procedures

2.3.1 VEMD

Data on all patients who presented to an ED were obtained from the VEMD. The VEMD collects data on all presentations to public hospital emergency departments in the state, and other hospitals as directed by the Department of Health and Human Services. Cases were identified using the search criteria: Injury cause "pedestrian", Place code "Road, street or highway", Human Intent "Non-intentional" and Age "18 years or over" over the study period. Data were extracted on patient age, sex, and separation mode.

2.3.2 VAED

The VAED was used to identify all hospital admissions for PTI. The VAED collects data on all admitted episodes to Victorian public and private hospitals and is managed by the Department of Health and Human Services, Victoria. Cases were identified using the ICD-10-AM codes V031, V039, V041, V049, V061, V069, V092, V093 and V099, which indicate PTI. Cases were included for completeness where categorisation as traffic or non-traffic was unspecified, as it was more likely that these were traffic-related, however this presumption cannot be tested with current data available. Data were extracted on patient age, sex, length of stay, number of hours in ICU, number of hours of mechanical ventilation and separation mode.

2.3.3 VSTR

The VSTR was used to identify all cases of pedestrian major trauma and in-hospital deaths. The VTSR collects data on all patients with an Injury Severity Score >12, all who require urgent surgery or intensive care unit admission for over 24 h and were mechanically ventilated after admission, and all deaths after injury. Cases were identified using the search criteria: Injury Cause "Pedestrian", Age "18 years or over", Injury Place "Road, street or highway" and Intent "Unintentional". Data were extracted on patient age, sex, type of type of vehicle causing injury, pattern and severity of injury, blood alcohol concentration and discharge disposition. Vehicle type was extracted by the data manager from text narratives. Blood alcohol concentration was only documented if recorded by hospital staff. Although section 56(2) of the Victorian Road Safety Act 1986 permits the taking of blood to test BAC by a doctor from pedestrians above 15 years of age brought to hospital

Table 1
Profile of PTIs in Victoria, Australia from 2009 to 2013 (*Out-of hospital deaths from 2009 to 2012).

Variable Total Number:	VEMD 1838	VAED 3241	Major Trauma 538	In-hospital deaths 90	Out-of hospital deaths* 122
Sex:					
Male	895 (48.7%)	1442 (55.5%)	306 (56.9%)	59 (65.6%)	82 (67.2%)
Female	943 (51.3%)	1799 (44.5%)	232 (43.1%)	31 (34.4%)	40 (32.8%)
Age (years)					
18–24	456 (24.8%)	596 (18.4%)	89 (16.5%)	5 (5.6%)	21 (17.2%
25–34	428 (23.3%)	605 (18.7%)	91 (16.9%)	12 (13.3%)	20 (16.4%)
35–44	285 (15.5%)	415 (12.8%)	62 (11.5%)	9 (10.0%)	21 (17.2%)
45–54	229 (12.5%)	348 (10.7%)	67 (12.5%)	5 (5.6%)	14 (11.5%)
55–64	179 (9.7%)	354 (10.9%)	59 (11.0%)	6 (6.7%)	15 (12.3%)
65–74	134 (7.3%)	365 (11.3%)	71 (13.2%)	15 (16.7%)	11 (9.0%)
75–84	52 (2.8%)	378 (11.7%)	74 (13.8%)	20 (22.2%)	16 (13.1%)
85+	75 (4.1%)	181 (5.6%)	25 (4.6%)	18 (20.0%)	4 (3.3%)
Vehicle type					
Motor car	–	2795 (86.2%)	403 (74.9%)	71 (78.9%)	38 (31.1%)
4WD	–	–	18 (3.3%)	5 (5.6%)	3 (2.5%)
Trains	–	–	3 (0.5%)	0 (0%)	35 (28.7%)
Pick-up truck or van	–	–	11 (2.0%)	1 (1.1%)	15 (12.3%)
Truck	–	140 (4.3%)	38 (7.1%)	5 (5.626%)	16 (13.1%)
Bus	–	–	11 (2.0%)	1 (1.1%)	3 (2.5%)
Motorcycle	–	–	11 (2.0%)	1 (1.1%)	–
Tram	–	–	21 (3.9%)	3 (3.3%)	2 (1.6%)
Agricultural vehicle	–	–	0 (0%)	0 (0%)	4 (3.5%)
Other	–	186 (5.7%)	7 (1.3%)	1 (1.1%)	6 (4.8%)
Unknown	–	120 (3.7%)	15 (2.8%)	2 (2.2%)	0 (0%)
Blood alcohol concentration					
≥0.05 g/100 mL	–	–	132 (24.5%)	9 (10.0%)	29 (23.8%)
<0.05 g/100 mL	–	–	27 (5.0%)	6 (6.7%)	1 (0.1%)
Detected but not quantified	–	–	4 (0.7%)	0 (0%)	0 (0%)
Not detected	–	–	217 (40.3%)	30 (33.3%)	92 (75.4%)
No test results available	–	–	248 (46.1%)	45 (50.0%)	(0%)

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for treatment as a consequence of a motor vehicle crash, there is no legal requirement to do so for pedestrians, and it is not usual practice [6,7].

2.3.4 NCIS

The NCIS was used to identify pedestrian fatalities that occurred out of hospital. The NCIS collects data on all Australian deaths referred to the coroner's court since July 1st 2000 and contains information from police reports, autopsy and toxicology results, and coronial findings. All deaths due to an accident or injury such as road traffic deaths must be reported to the coroner in Australia. Cases were identified by selecting Date Notified "Between 01/01/2009 and 31/12/2012", Jurisdiction "Victoria", Age "18 years or over", Mechanism of Injury "Blunt force/transport injury event", Vehicle Details "Pedestrian" and Intent "Unintentional". Data were extracted by NCIS data technicians on the annual number of pedestrian fatalities, annual case closure rates, casualty demographics, location of death and type of vehicle causing injury and presented as aggregate data. Data from 2012 and 2013 were excluded from NCIS data extraction due to known low case closure rates (<70%). Case closure rates for 2009, 2010 and 2011 were 97.9%, 96.2% and 84.2% respectively.

Total deaths for 2008 were subsequently extracted from previously published reports from the VEMD, VAED and NCIS datasets for population adjusted trend analysis [5,8].

2.4 Analysis

Population estimates for Victoria were obtained from the Australian Bureau of Statistics using census data and population estimates collected on December 31st of the previous year. Incidence rate ratios (IRRs) with 95% confidence intervals (95% CI) were used to evaluate annual change in population incidence of PTI. A Poisson regression model was used to measure the distribution of data and was assessed using a Pearson-Chi squared test. If there was over-dispersion evident in the data, a negative binomial regression model was used. A p-value of <.05 was considered significant. All statistical analysis was conducted in Stata Version 11.3 (TX, USA).

3 Results

Over the study period, 1838 cases presented to a Victorian hospital ED and were discharged without admission to hospital and an additional 3241 cases were admitted to hospital for PTI. Of these, 628 cases were classified as major trauma including 90 in-hospital deaths. Table 1 shows the profile of these patients. From January 1st 2008 to December 31st 2011, a total of 216 deaths occurred. No significant change in the overall age structure of the Victorian population was noted over the study time frame.

Pedestrians aged between 18 and 24 and 25–34 were proportionately more involved in emergency department presentations, hospital admissions, major traumas and out of hospital deaths than other age groups. Older pedestrians above the age of 65 composed the majority of in-hospital fatalities (58.9%). In all datasets except the VEMD, there were proportionately more male casualties than female casualties. Crashes most commonly involved cars and 4WDs, which occurred in 86.2% of hospital admissions, 78.2% of major traumas, 84.4% of in-hospital deaths and 33.6% of out-of-hospital deaths. A higher proportion of crashes involving heavy vehicles including trucks, vans, buses and trams were observed in those resulting in major trauma (15.1%), in-hospital (11.1%) and out-of-hospital deaths (40.0%) than in those requiring hospital admission only (4.3%).

Although BAC was recorded by the VSTR, no test results were available for 41.3% of cases. Of those that did have a BAC recorded, 30.5% of pedestrians with major trauma and 22.8% of pedestrians who died of their injuries had a BAC equal to or above 0.05 g/100 mL. Of pedestrian major traumas that had a BAC level equal to or above 0.05 g/100 mL, there were proportionately more male (87.7%) than female casualties with the most common age groups being between 25 and 34 (33.9%) and 18–24 (29.5%). In cases of pedestrian major trauma where alcohol was not detected, there were proportionately more female (43.6%) than male casualties with the most common age groups being between 65 and 74 (17.4%) and 75–84 (17.0%). Table 2 shows the profile of these patients.

Figs. 1 and 2 show trends in the population incidence of PTI over the study period. Since 2009, there has been a marginal decrease in the population incidence of ED presentations for PTI (IRR 0.83, 95% CI 0.72, 0.96, p = 0.01), particularly between the years 2010 and 2012 where the incidence fell from 12.6 to 10.9 per 100,000 population. No change has been observed in hospital admissions for PTI (IRR 0.94, 95%CI 0.84, 1.04, p = 0.24) or pedestrian major trauma (IRR 1.01, 95%CI 0.96, 1.07, p = 0.67). From January 1st 2008 to December 31st 2011, no change in pedestrian fatalities was identified (IRR 0.95, 95%CI 0.18, 4.91, p = 0.95).

4 Discussion

This study indicates that although the population-adjusted incidence of ED presentations for PTI decreased from 2009 to 2013, no significant change in population-adjusted incidence was observed in hospital admissions for PTI, major trauma or fatalities. This parallels Australian hospital admission rates for PTI which have also remained stable from 2005 to 2012[8]. Road safety initiatives during the study timeframe that may have contributed to the reduction in ED presentations include more dedicated pedestrian footpaths and reduced speed limits of 40 km/h in areas of high pedestrian activity [9]. Evaluation of current efforts to reduce PTI is needed to reduce road traffic injury burden.

Comprehensive public health programs that focus on high-risk groups for pedestrian injury are required to achieve further reductions in PTI [5,10]. Common features of PTI identified in this study included male gender, young adults for ED presentations and hospital admissions, older adults over 65 for pedestrian major trauma and fatalities, and collision with cars and heavy vehicles,

Table 2
Profile of pedestrian major traumas in Victoria, Australia from 2009 to 2013 by blood alcohol concentration (ISS = Injury severity score).

Variable	Not detected	<0.05 g/100 mL	≥0.05 g/100 mL	Not tested
Total Number:	219	36	112	258
Sex:				
Male	95 (43.6%)	27 (75%)	96 (87.7%)	144 (58.8%)
Female	123 (56.4%)	9 (25%)	16 (14.3%)	114 (44.2%)
Age (years)				
18–24	27 (12.4%)	6 (16.7%)	33 (29.5%)	27 (10.5%)
25–34	24 (11.0%)	7 (19.4%)	38 (33.9%)	32 (12.4%)
35–44	22 (10.1%)	9 (25.0%)	21 (18.8%)	18 (7.0%)
45–54	23 (10.6%)	1 (2.8%)	13 (11.6%)	35 (13.6%)
55–64	25 (11.5%)	7 (19.4%)	2 (1.8%)	31 (12.0%)
65–74	38 (17.4219%)	2 (5.6%)	3 (2.9%)	43 (16.7%)
75–84	37 (17.0%)	2 (5.6%)	2 (1.8%)	53 (20.5%)
85+	22 (10.1%)	2 (5.6%)	0 (0%)	19 (7.4%)
Median ISS	20	22	21.5	19.5
Discharge disposition				
Home	44 (20.2%)	9 (25.0%)	37 (33.0%)	58 (22.5%)
Rehabilitation	137 (62.8%)	21 (58.3%)	64 (57.1%)	151 (58.5%)
Death	31 (14.2%)	6 (16.7%)	9 (8.0%)	44 (17.1%)
Other	6 (2.8%)	0 (0%)	2 (1.8%)	5 (1.9%)

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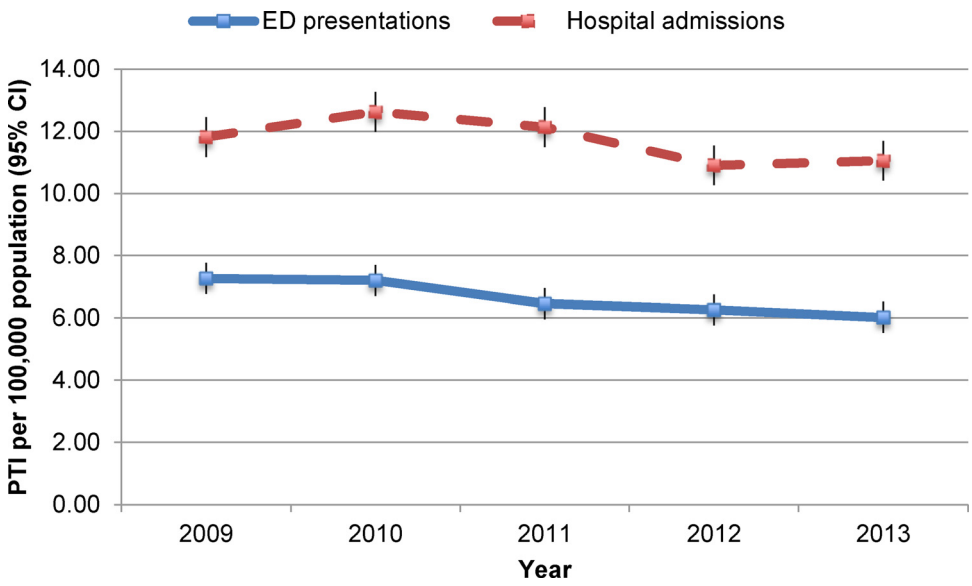

Fig. 1. PTI in Victoria, Australia from 2009 to 2013 (CI = Confidence intervals).

which is consistent with previous Australian reports [5,11]. Intoxication rates were similarly comparable with previous estimates between 23.7% and 42.9% [4,12]. Known risk factors for increased injury severity in the pedestrian population include male gender, age over 60 years, speed zone over 60 km/h, poor light conditions and collisions involving a heavy vehicle [4]. As the proportion of the population in Victoria above 65 years increases, it is important to evaluate initiatives for primary prevention and improved healthcare delivery as older pedestrians experience worse health outcomes for same injury severity [8].

The high proportion of young intoxicated pedestrians and seriously injured elderly support the need for a focus on prevention efforts in these groups. This is concordant with the results of the 'Review of the Inquiry into the Incidence and Prevention of Pedestrian Accidents' by the Road Safety Committee to the Parliament of Victoria in 2006 [13]. Recommendations for future preventative initiatives included the need for a pilot study into 40 km/h speed zones in front of retirement villages and areas with high volume of elderly pedestrian activity and entertainment districts, development of alcohol awareness programs specifically targeted at young adults and information disseminated at licenced premises including nightclubs, bars and hotels; and a trial of alcohol breath tests and illicit drug saliva tests on all pedestrians involved in a road traffic crash presenting to hospital [13].

Due to the large numbers required for trend analysis, we decided to conduct a retrospective cohort study from statewide injury registries. As such, we are confined to commenting on associations and cannot attribute trends in the incidence of PTI to specific public health interventions implemented over this time-frame. A strength of this design was the ability to capture a large proportion of our target population across the spectrum of injury severity and obtain data from a five year period from the VSTR,

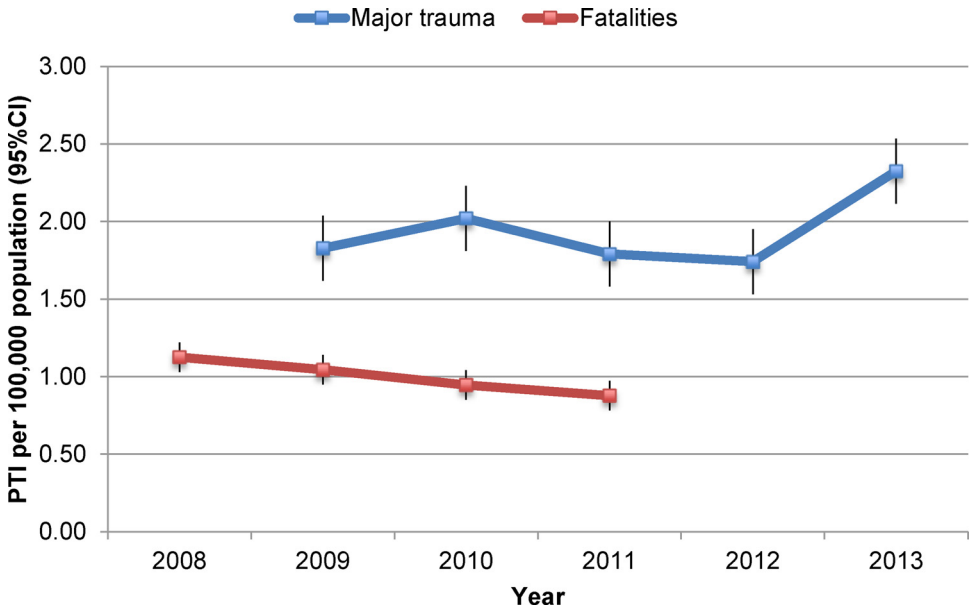

Fig. 2. Pedestrian major trauma in Victoria, Australia from 2009 to 2013 (Confidence intervals).

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VAED and VEMD, and three year period from the NCIS, which increases the internal validity of our results. Additionally, as these injury surveillance registries record prospectively collected data, the risk of recall bias is minimal.

Incident rate ratios were conducted using a Poisson distribution model, which assumes that every person in Victoria is exposed to the same risk of being in a pedestrian traffic crash. However this is not the case as exposure to traffic as a pedestrian is variable. Indeed, a small proportion of the Victorian population are not exposed to traffic as pedestrians at all, such as very young children and those confined to their homes by illness. The average number of kilometres travelled per annum as a pedestrian, a common marker of exposure in pedestrian injury research, is unknown in the Victorian population and was not measured in this study.

We recommend adding additional years of injury surveillance data to strengthen the conclusions of this study and to observe trends over a longer timeframe. Legislation to mandate testing would enable a greater understanding of the issue of alcohol as a risk factor for PTI. Additionally, linkage of health and crash datasets to better characterise crashes and injuries sustained would be beneficial for informing prevention strategies.

5 Conclusion

Although the population-adjusted incidence of ED presentations for PTI in Victoria has decreased from 2009 to 2013, no change was observed in the incidence of hospital admissions, major trauma or pedestrian fatalities. Novel programs designed to specifically address high-risk groups should be considered to achieve further reductions in PTI and severity of injuries.

Conflict of interest statement

There are no conflicts of interest to declare.

Acknowledgements

We would like to thank data managers of the VSTR, NCIS, VAED and VEMD for extraction of data and Dr Gerard O'Reilly for assistance with statistical analysis. Prof. Mitra and Prof Gabbe are supported by the Early Career Development Fellowship and the Career Development Fellowship respectively from The National Health & Medical Research Council, Commonwealth of Australia.

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