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ABSTRACT

Introduction: Child pedestrian fatalities associated with motor vehicles reversing or moving at low speed are difficult to identify in surveillance data. This study aims to determine the incidence of fatalities associated with what is thought to be an under-reported and preventable fatal injury mechanism

Methods: The term Low Speed Vehicle Run-Over (LSVRO) incidents encompasses pedestrian fatalities where vehicles run-over a child at low speed. Data were obtained for children aged 0 -15 years in the Australian state of Queensland (January 2004 – December 2008).

Results:

There were 15 deaths (12 boys and 3 girls) during 2004-2008 (Rate:1.67/100, 000). . Over half were aged 0 &1 years of age (n=8; 53.3%, Rate: 14.67/100,000), and one quarter were 2&3years of age (n=4, 27%, Rate 7.46/100, 000). There were no LSVRO deaths recorded among 10-15 year olds. Most (13/15) of the incidents occurred on private property, and only two occurred on a street /road.

Almost half of the fatalities were caused by a four wheel drive (4WD) vehicle; large family sedans were involved in four fatalities, and heavy vehicles were involved in three deaths. In 11 of the fatalities, parents were the drivers of the vehicle involved (mothers : 5; fathers : 6). In nine, the vehicle involved was reversing before it came in contact with the child. Fatalities occurred in each of the Socio – Economic Indexes for Areas (SEIFA) levels.

Conclusion: The unique data provided by the Child Death Review Team has signalled that LSVRO fatalities are a significant problem in Queensland. The CCYPCG continue collecting data, which,

when combined, will provide outcomes that will act as an impetus for promoting intervention and child advocacy.

Introduction

Low speed vehicle run-over (LSVRO) describes incidents where a pedestrian – usually a child – is injured or killed by a slow moving vehicle in either a traffic or non traffic area (CCYPCG 2005). LSVRO incidents were first described in 1980 in the US,. (Bell, Ternberg et al. 1980), and in the 1990s in the US (Williams 1981, Tanz and Christoffel 1985, Winn, Agran et al. 1991, Agran, Winn et al. 1994, Agran, Winn et al. 1996, Schieber 1996, Partrick, Bensard et al. 1998, Wright 1998), Canada (Brison, Wicklund et al. 1988), UK (Campbell-Hewson, Egleston et al. 1997), NZ (Roberts, Kolbe et al. 1993, Roberts, Norton et al. 1995) and Australia (Robinson and Nolan 1997, Stevenson 1997).

A lack of common definition and inconsistent coding means LSVRO fatalities are not easily identified. Despite similarities, they are variously recorded as back-over, drive-over, low-speed/velocity, slow-speed, reversing injuries, driveway run over's/crush/injuries, infant pedestrians, non traffic and roll over's. The true magnitude of LSVRO incidents is difficult to interpret due to differing time periods, jurisdictions and data collection methods of reported cases. No specific coding mechanism is available to readily identify these events, and population data is rarely provided. Consequently, LSVRO incidents are probably under-reported.

In Australia, an average of nine children are fatally run over each year in Australia.(Parliamentary Travelsafe Committee 2007). In 1996, the Queensland Council on Obstetric and Paediatric Morbidity and Mortality (QCOPMM) reported that, after pool drowning, LSVRO fatalities were the second biggest single cause of death from injury for children aged one to four(QISU 1999). Queensland has significantly higher per population fatalities than in the rest of Australia(Davey J 2007). Over six years, 12 fatalities (0 – 5 year olds) occurred in Queensland (3.94/100, 000 0 – 5 year olds) , and 17 fatalities in New South Wales. (3.26/100, 000). (Parliamentary Travelsafe Committee 2007) (See Table 1)

Table 1. Run-Over deaths of 0-5 year olds by jurisdiction
2000/01-2005/06

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	Total
NSW	6	2	4	1	2	2	17
Queensland	1	1	2	4	4	0	12
WA	1	1	0	1	1	2	6
Victoria	2	0	2	3	0	1	8
SA	2	1	2	0	1	0	6
NT	1	1	0	0	0	0	2
Tasmania	0	0	0	0	0	0	0
ACT	0	0	0	0	0	0	0
Total	13	6	10	9	8	5	51

(Table taken from Travelsafe report, September 2007(Parliamentary Travelsafe Committee 2007))

Combined preliminary data from the Queensland Health Admitted Patients Data Collection (QHAPDC) and the Queensland Injury Surveillance Unit (QISU) indicate that as many as 853 children have sustained injury significant enough to be admitted to hospital from Jan 1999 – Dec 2009.

LSVRO incidents in Queensland were highlighted in a report from the Commission for Children and Young People and Child Guardian (CCYPCG) – Child Death Review team(CCYPCG 2005) which recommended an investigation on ways to reduce LSVRO fatalities and injuries to children through research, education and consultation, and for mandatory requirements for dwellings(Parliamentary Travelsafe Committee 2007). Between 1 January 2004 and 31 December 2008, CCYPCG registered a total of 232 child deaths as a result of transport incidents in Queensland. Of these, 15 were due to LSVRO incidents.

Identifying LSVRO Incidents

For LSVRO events, ICD(WHO 1992) coding identifies only the location, not the speed of the vehicle, nor does "non-traffic" incidents from "traffic" incidents give a true indication of LSVRO status, and so may not detect LSVROs in parking lots or school pick up zones. To help improve identification of LSVROs, the CCYPCG primarily classifies deaths according to their circumstances. Sometimes, in police reports of death to a coroner, LSVROs can be identified where the ICD code does not accurately reflect the circumstances of death.

Brison identified LSVRO deaths using ICD-9 codes(WHO 1977), specifically E 814-825, which separated incidents into "traffic" and non traffic". For 33%, police and coroner's reports resulted in re-coding of "traffic" to "non-traffic". Robertson and Nolan (Robinson and Nolan 1997) used ICD-9 codes (specifically E820-E825) to identify factors associated with low speed non traffic fatality circumstances in Victoria. They, too, had to use supplementary state coroner data to identify LSVRO fatalities.

The CCYPCG uses the ICD-10 to code underlying and multiple causes of death. While this classification system is useful in promoting international comparability in the analysis of mortality statistics, ICD-10 carries certain inherent limitations, particularly in regards to the identification of LSVRO incidents. To help overcome these limitations, the CCYPCG primarily classifies deaths according to their circumstances. Based on the information contained in the Police Report of Death to a Coroner (this form is provided by the Office of the State Coroner), CCYPCG is able to identify cases where the ICD-10 code does not accurately reflect the circumstances of death. This would ultimately have the outcome of inaccurate rate representation. Data provided by the Queensland Health Admitted Patients Data Collection (QHAPDC) shows that two thirds (n=10) of these fatalities would have been missed if relying on hospital data alone.(Collection 2010)

Risk factors in LSVRO fatalities

Few studies include children over 5 years, therefore it is not known if LSVRO injury and fatality occurs in older children. Robinson (Robinson and Nolan 1997) and Murphy (Murphy, White et al. 2002) reported on deaths in children up to 15 years, but the small numbers of deaths makes comparison difficult.

Dwelling types and specifically driveway design play a significant role in these often catastrophic events.(Holland, Liang et al. 2000, Kai Hsun Hsiao 2009). The installation of reversing cameras and sensors has been recommended (Holland, Liang et al. 2000, Fenton, Scaife et al. 2005, Pinkney, Smith et al. 2006), as has supervision of children and ongoing education of drivers and parents. (Robinson and Nolan 1997, Holland, Liang et al. 2000, Kai Hsun Hsiao 2009)

Purpose of this study

This study examines the incidence of fatal LSVROs in Queensland, Australia, and whether older children (10-15 year olds) are involved, over a five year period, with the aim of determining risk factors that can inform injury prevention strategies. Epidemiological surveillance of both fatal and nonfatal LSVROs is essential, and adequate knowledge of the characteristics and associated risk factors is necessary to understand and describe the burden of injury.

METHODS

This is a retrospective analysis of 0-15 year old children fatally injured in LSVROs between January 2004 and December 2008 in Queensland using CCYPCGG data through police and coroner's reports. These data include age, gender, date and time of incident, date of death, day of week of incident, coroner's findings, cause of death (as per death registration), Accessibility/Remoteness Index of Australia (ARIA) incident, place of usual residence, Socio- Economic Indexes for Areas (SEIFA) status, direction of vehicle, type of vehicle (make and model in most cases), driver relationship to deceased, hospital attendance and Aboriginal or Torres Strait Islander status. A text description

provided additional information about the circumstances surrounding each individual event. The SEIFA is an analytical tool that enables investigation of the socio-economic wellbeing of Australian communities and which identifies areas of advantage and disadvantage.

Ethical approval was obtained from: Children's Health Service District (Queensland) University of Queensland Human Ethics), Mater Health Services Human Research Ethics Committee, Public Health Act Human Research Ethics Committee- Director General Approval.

RESULTS

Demographic characteristics

LSVRO fatalities in children aged 0-15 years across Queensland from January 2004 to December 2008 accounted for 15 of 44 (34%) (CCYPCG 2009) pedestrian deaths in this age group. Table 2 shows the age and gender breakdown of the fatalities. There were 15 deaths (12 boys and three girls). The highest rate of deaths was in children under two years old (n=8, incidents=14.7/100,000), with no fatalities from 10 to 15years. The majority of children killed were under five years (n=13, 86%, incidents= 4.8/100 000). Across all years, 87% were boys. Socio-economic status was defined by SEIFA scales (CCYPCG 2009), which are used by CCYPCG as a measure of advantage/disadvantage, and take into account variables such as income, education, skills of the area in which the child resides. Fatalities were evenly spread across each of the levels in the SEIFA index, though the small numbers render comparisons difficult. Most of the LSVRO deaths occurred in rural areas (four in major cities, six inner regional, three outer regional, two remote), using the ARIA (designation of degree of remoteness(CCYPCG 2009)), and 87% (13/15) occurred on private property, while only two occurred on a street/road.

Vehicle type involved in fatalities is described in Table 3. Almost half the fatalities (n=7) were caused by a four wheel drive (4WD) vehicle. Head injuries accounted for 10 of the fatalities, but cause of death of the others differed with vehicle type. In fatalities in 4WDs, six out of the seven were from to head injury. Sedans were involved in four, two of which were due to head injury, and two to head and chest trauma. Light commercial vehicles were involved in three deaths; two of which had multiple injuries and one a head injury. Five mothers and six fathers were driving. The vehicle was reversing in nine of the deaths, was moving forwards in five, and direction was not recorded for one.

All LSVRO incidents occurred between 8am and 8pm: five between 8am and 9am, two between 9am and 3pm and eight deaths occurred during the late afternoon / early evening (3pm and 8pm).

Table. 2. Gender/Age Representation

Age Group	Gender	
	Male n	Female n
0-2 yrs	7	1
2-4 yrs	2	2
4-6yrs	1 (4 year old)	0
6-8yrs	0	0
8-10yrs	2	0
10-15 yrs	0	0

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Table. 3.

Injury / Vehicle Relationship				
	4WD	Sedan	Heavy Vehicle	Unknown vehicle
Head Injury	6	2	1	1
Head and chest trauma		2		
Multiple injuries	1		2	
Total	7	4	3	1

DISCUSSION

In Queensland from 2004 to 2008, 34% of pedestrian deaths in children aged 0-15 years were from LSVROs, compared with Victoria in the period 1985 to 1995, where 15% of pedestrian deaths were LSVRO fatalities. (Robinson and Nolan 1997) Similarly to New South Wales and Victoria, males predominated. (Robinson and Nolan 1997, Holland, Liang et al. 2000) Fatalities did not seem to differ according to socio-economic scores. The majority of children killed were under five years which is similar to New Zealand(Kai Hsun Hsiao 2009). Such an age range is not surprising for this type of injury, as toddlers classically are quick, small and hard to see, and could be under the wheels of a car before a parent would know he or she was missing. The Queensland Department of Transport and Main Roads Registered Vehicle data base (Mills 2010) shows that 4WD and LCVs represent 35% of vehicles on Queensland roads. Perhaps the higher percentage of LSVROs in rural and remote areas could be explained by the larger type of cars used in the country, but with such small numbers, conclusions about this could be reached only with more detailed enquiry. However, we did

show that 4WD and LCVs were more likely than any other vehicle to be involved, concurring with previous reports (Holland, Ross et al. 2006) (Robinson and Nolan 1997).

In Victoria, children in rural, rather than urban regions were more vulnerable to LSVROs(Robinson and Nolan 1997) and our findings support this. Queensland has a higher percentage (48%) of population in rural communities compared to NSW (28.9%) and Victoria (24.5%). This may be a significant contributing factor to Queensland's higher incidence rates for LSVROs, however, rural children in Queensland are at significantly higher risk of fatality due to the distances to major health care facilities (CCYPCG 2009) than their counterparts from the smaller states.

We concur with previous authors about four main areas for prevention of LSVROs: adequate supervision of children (Murphy, White et al. 2002) and not leaving children unsupervised in a vehicle (Agran, Winn et al. 1991); separation of driveway from play areas (Robinson and Nolan 1997, Murphy, White et al. 2002); installation of reversing cameras and sensors (Holland, Liang et al. 2000, Pinkney, Smith et al. 2006) and the education of parents and caregivers (Partrick, Bensard et al. 1998, Pinkney, Smith et al. 2006). A specific, planned, nationwide programme about prevention of LSVRO incidents, based on these four strategies, is urgently needed.

Limitations

Due to low numbers the analysis for this paper is descriptive, and results are presented as tables and figures. Only data held by CCYPCG were used, as further data from police and coroners' records would have to be retrieved manually, and time precluded such data extraction. Further work would enable data such as the speed of the car involved, and nature of the injury that contributed to death.

We have examined only fatalities that occur as a consequence of LSVROs. In order to determine the overall burden due to LSVRO incidents, it is also important that nonfatal incidents are investigated. Preliminary nonfatal data from QISU(QISU 2010) suggests a much greater number of incidents and involvement of other vehicle types.

Benefits/Disadvantages of using child death data

The CCYPCG CDR are able to provide fields of data that would be otherwise unavailable (SEIFA of incident, direction of vehicle, type of vehicle, driver relationship to deceased and a text description, providing additional information about the circumstances surrounding each individual scenario). The CCYPCG now includes this specific cohort of deaths in their annual report, making data about LSVRO fatalities accessible. A custodian who collates such sensitive data from a number of sources, and then makes this data readily accessible to researchers is a pioneering effort in database management. Complete data that has searchable detail is invaluable to interrogate otherwise unrecognisable injury mechanisms, as well as identify accurate incidence rates and causal risk factors. The challenge lies in linking such death data to injury data across other various databases.

Implications for future research

In their inaugural report in 2005, the CCYPCG made a recommendation to the Premier that the Parliamentary Travelsafe Committee investigate and report on ways to reduce fatalities and injuries to children from low speed driveway run-over's in Queensland(CCYPCG 2005). The CCYPCG now includes this specific cohort of deaths in their annual report, making data about LSVRO injuries accessible. Linkages with other datasets, which will be possible in the future, will allow existing death data on LSVRO incidents. Once in place, a retrospective study of non-fatal LSVRO incidents in Queensland children, from 1999 to 2008, will be

undertaken. Such a review will provide a greater understanding of the circumstances surrounding non-fatal incidents. The effectiveness of intervention measures such as vehicle and property design changes and a state-wide education awareness campaign currently underway in Queensland will thus be able to be appropriately evaluated and implemented. In addition, such work will establish a reliable system of surveillance to readily identify LSVRO incidents and monitor them on an on-going basis. This study will provide an impetus for promoting interventions for this preventable injury.

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