

Transport-related fatalities and injuries leading to hospitalisation in pre-school children

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Abstract

Pre-school children grow and develop rapidly with age and their changing capabilities are reflected in the ways in which they are injured. Using coded and textual descriptions of transport-related injuries in children under five years of age from the Queensland Injury Surveillance Unit (QISU) this paper profiles the modes of such injuries by single year of age. The QISU collects information on all injury presentations to emergency department in hospitals throughout Queensland using both coded information and textual description. Almost all transport-related injuries in children under one year are due to motor vehicle crashes but these become proportionately less common thereafter, while injuries while cycling become proportionately more common with age. Slow-speed vehicle runovers peak at age one year but occur at all ages in the range. Bicycle-related fatalities are rare in this age group. If bicycle-related injuries are excluded, the profiles of fatal and non-fatal injuries are broadly similar. Comparison with a Queensland hospital series suggests that these results are broadly representative.

Keywords

Injuries, Hospitalisation, Pre-school children, Transport-related injuries

Introduction

The first few years of a child's life are marked by rapid growth and developmental changes. This fact is reflected in the changing patterns of injury suffered by children under five years of age [1, 2], both across and within broad categories of injury, which is as true for transport-related injuries as for any other injury mode. Few if any studies of transport-related injuries or fatalities in young children report the mechanisms of such injuries by sufficiently narrow age bands. The usual age breakdown reported is by five-year bands - with some studies separating out infants under one year - obscuring the substantial age-related alterations in modes of injury in children under five years in particular [3, 4, 5]. Moreover, most of the studies of transport-related injuries in young children focus on fatalities; while always tragic, such fatalities are relatively rare, at least in developed countries such as Australia, and may not be representative of the much larger number of non-fatal injuries. Without a more detailed understanding of how injury patterns

change by age, preventive interventions for this age group are likely to be less efficiently targeted than they could be.

From analysis of a file supplied by the Queensland Hospital Admitted Patient Data Collection, 1237 children under the age of five years were admitted to Queensland hospitals for a transport-related injury over the period, July 2002 to June 2007, a rate of 96.0 per 100,000. From January 2004 to June 2013, a total of 92 children aged 0 to 4 years were killed in transport-related incidents, a rate of 3.4 per 100,000, as reported by the now superseded Commission for Children and Young People, Queensland. While such injuries form a fairly small proportion of hospitalised injuries from external causes, as reported below, transport-related fatalities formed almost 30% of the deaths in children under five years of age in the reports of the Commission for Children and Young People, Queensland.

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Recent road safety strategies for Queensland make no specific mention of children, although the Queensland Department of Transport and Main Roads issued a motorcyclist riding guide which makes brief mention of children's safety without specifying to which ages it applied [6].

This study aims to detail the ways in which children under five years of age admitted to hospital are injured in transport-related incidents by single year of age, using data generated in Queensland. Wherever possible it makes comparisons with the types of transport-related incidents in which children in this age group and jurisdiction are fatally injured.

As noted above, most if not all studies of transport-related injuries in children under five years of age treat this age group as a whole or in some instances with children under one year of age as a separate category. The latter age categorisation is the one in use in the reports of the Commission for Children and Young People, Queensland. In Australia one report describes the "place of occurrence and road user group of children aged under five years seriously injured in a land transport accident" in the financial year 2006-07 year [3], finding 6% to have been injured in the driveway of the home, and 37% in the street or highway, but with 38% in an unspecified location. A second Australian paper gives the distribution of modes of transport-related injuries in children under five years of age as "Car 23%, Pedestrian 25% and Pedal cycle 32%" [4]. A report from the USA on deaths and non-fatal injury indicated that transport-related injuries were the second leading cause of unintentional injury death in children under one year of age at 3.7 per 100,000, and the leading cause in children in the age range one to four years at 4.2 per 100,000. Among non-fatal injuries, transport-related injuries comprised 4% and 5% of hospital admissions for unintentional injury in children aged under one year and one to four years, respectively, with a rates of 237 and 697 per 100,000 respectively [5].

Slow-speed vehicle run-overs (SSVROs) have been studied for many years in a variety of jurisdictions. In Queensland the most thorough analysis was recently published using data from a number of complementary local sources [7]. The authors provide a substantial list of references on the topic. Apart from incidence, children under one year of age are not considered separately from children age one to four years.

Methods

The data on non-fatal injuries were supplied by the Queensland Injury Surveillance Unit (QISU) for the years 2002 to 2012 and contain both descriptive text and coded variables. A detailed description of the structure and methods of the QISU can be found in [2]. The QISU data include all ED injury presentations including those patients who may present for treatment of a suspected injury, where no anatomical injury is found, or where the injury is minor enough for the patient to be treated and then released home from the ED. For these analyses only those patients under

five years of age who had an injury deemed sufficiently severe to warrant admission to hospital for further treatment were included. The sample thus represents the more serious end of the severity spectrum.

Coded variables identify transport-related injuries and provide some information on mode of injury, whereas the textual descriptions often give a more detailed picture of how the injury occurred. The combination of these variables make it possible in the majority of cases to assign the injury cause accurately to the following categories: motor vehicle crash (as passenger); struck by motor vehicle, in particular, slow-speed vehicle run-over; struck by pedal cycle; bicycle crash; motor-cycle associated; quad bike associated; and other and unknown. For motor vehicle crashes, in many instances a comment was made in the text indicating whether or not the child had been restrained, and this has been noted, although it was not always possible to establish how appropriate for the child's age and size the restraint had been.

Modes of fatal injury are described in the annual reports of the Queensland Commission for Children and Young People (2004/5 to 2012/13) accessible via the National Library of Australia [8]. In these reports the age breakdown among children under five years of age is less than a year and 1 - 4 years. For the purposes of this study, incidents involving stationary motor vehicles and atypical transport modes, such as ride-on mowers and farm machinery, which together comprise about 5% of incidents, are excluded. Incidents involving watercraft are also not considered.

A further comparison is made with injuries to children under five years of age admitted to Queensland hospitals over the period mid-2002 to mid-2007. No finer age breakdown was provided. In this instance categorisation of modes of injury is by means of the ICD10-AM codes.

Transport-related injuries were those so classified by QISU or the Commission for Children and Young People, Queensland, or in the hospital file, ICD10-AM codes with alphabetic code V, except that falls from clearly stationary vehicles other than bicycles, atypical transport modes, burns from hot vehicle parts and water transport injuries were excluded.

Since all data files contain non-identifiable records, the study was deemed to be exempt from formal approval by the relevant institutional Research Ethics Committee. In this descriptive study formal statistical analysis was not considered appropriate for this study.

Results

There were in the QISU file 542 hospitalised children under five years of age with transport-related injuries, representing 4.4% of all admissions in this age group. The breakdown by age (in single years) and injury mechanism is given in Table 1. Almost all injuries to infants under one year of age are due to being a passenger in a motor vehicle crash. In older children the proportion due to motor vehicle crashes fluctuates around 30 – 40%. Restraint use is on the

whole poorly documented, especially in children over a year old, nor is it always clear whether the restraint reported

is age-appropriate. In children aged under one year baby capsules are mentioned in a quarter of instances.

Table 1. Transport-related injuries in children < 5 years old, 2002 – 2012

Age of patient (yrs)	< 1		1		2		3		4	
	N	%	N	%	N	%	N	%	N	%
Type of incident										
MVC	48	94.1	29	28.7	44	44.0	49	36.6	51	32.7
Struck by vehicle	3	5.9	48	47.5	27	27.0	33	24.6	27	17.3
SSVRO	1	2.0	37	36.6	16	16.0	7	5.2	9	5.8
Bicycle	0	0.0	15	14.9	20	20.0	31	23.1	67	42.9
Motorcycle	0	0.0	2	2.0	1	1.0	5	3.7	8	5.1
Quad bike	0	0.0	4	4.0	3	3.0	9	6.7	2	1.3
Other/unknown	0	0.0	4	4.0	5	5.0	7	5.2	1	0.6
Total	51	100	101	100	100	100	134	100	156	100
% of all admissions	2.3		2.8		3.3		5.6		7.6	

MVC: Motor vehicle crash. Source: Queensland Injury Surveillance Unit

Being struck by a motor vehicle, and being run over at slow speed in particular, peaks as a proportion of incidents in children aged one year, occurring in more than a third of one-year-old children, 16% of two-year-olds and five to six percent in children aged three or four years. In about a third of slow-speed runovers the vehicle was reversing at the time of the incident. In a few instances, a child was struck by a motor vehicle while riding a bicycle or tricycle and in 10 instances at ages one to three years the child was struck and injured by a pedal cycle. Bicycle-related injuries without involvement of a motor vehicle become increasingly common from one year of age onward, comprising close to half of all injuries by age four years. Injuries associated with motor-cycles and all-terrain vehicles (“quad bikes”) are less common, but occur at all ages except the youngest. They together account for 8% of injuries at ages one and two, 12% at age three and 2% at age four. It seems from the textual descriptions that in some instances the child himself or herself was in at least partial

control of the vehicle. As a proportion of all admissions transport-related injuries increase steadily with age from 2.3% in children under one year of age to 7.6% in four-year-olds. This increase is partially due to the increase in bicycle-related injuries.

From 2004 to 2013 there were a total of 92 transport-related deaths of children under five years of age, 13 under one year (Table 2). Six children have been excluded from the analysis, three having been killed by machinery, two in boating incidents and one in a fall from a stationary vehicle. In children under one year of age, almost all deaths were due to motor vehicle crashes, as in the case of non-fatal injuries. In older children motor vehicle crashes accounted for about two-fifths of fatalities, while almost one half were as pedestrians. As in the case of non-fatal injuries, deaths associated by motor-cycles and quad bikes comprise a small proportion (5.4%) of all fatalities. No fatalities associated with bicycles were recorded during this period.

Table 2. Transport-related deaths in Queensland children under 5 years of age, January 2004 - June 2013

Age	< 1 year		1 – 4 years	
	N	%	N	%
Mode of death				
Passenger in motor vehicle	11	84.6	30	41.1
Pedestrian	1	14.6	36	49.3
Slow-speed vehicle run-over	1	14.6	20	27.4
Quad bike	0	0.0	2	2.7
Motor cycle	0	0.0	2	2.7
Other/unknown	1	14.6	3	4.3
Total	13	100.0	73	10.00

Source: Queensland Commission for Children and Young People

A comparison between the modes of fatal and non-fatal injuries is given in Table 3. Children injured in bicycle-associated incidents have been excluded to facilitate the comparison. In both children under one and children age

one to four years the distributions of modes of injury are broadly similar, the main difference being an excess of pedestrians among the fatally injured and a corresponding increase of non-fatal injuries due to motor vehicle crashes.

Table 3. Comparison of fatal and non-fatal injury patterns, excluding bicycle use

Age group	< 1 year		1 – 4 years	
	Deaths	Injury	Deaths	Injury
Passenger in motor vehicle	84.6	94.1	41.1	47.0
Pedestrian	7.7	5.9	49.3	39.4
<i>Slow-speed vehicle run-over</i>	7.7	2.0	27.4	18.8
Quad bike/Motor-cycle	0.0	0.0	5.5	9.2
Other/Unknown	7.7	0.0	4.1	4.3
Total	100	100.0	100.0	100.0

As a rough guide to the representative of the QISU sample, a comparison is made in Table 4 between the distribution of modes of injury obtained from all hospitalisations in Queensland from 2002/3 to 2006/7 and that from the QISU, for all children under five years of age. The categorisations are admittedly not precisely the same, but are close enough for a valid comparison.

The major differences between the two series is the greater proportion of other and unspecified modes and the over-representation of injuries classified as motorcycle-related versus injuries classified as quad-bike-related in the Queensland hospital data. Thus it is reasonable to claim that the QISU sample is broadly reflective of the pattern of transport-related injuries in Queensland preschoolers.

Table 4. Patients under 5 years of age admitted to Queensland Hospitals 2002/3-2006/7 compared to admitted patients under 5 years of age in the QISU sample

Patient classification	N ¹	% (QH)	% (QISU)
Person injured in a motor vehicle crash	436	35.7	40.0
Pedestrian	255	20.9	26.8
<i>struck by motor vehicle</i>	247	20.2	25.0
<i>struck by bicycle</i>	8	0.7	1.8
Cyclist	348	28.5	24.1
<i>struck by vehicle</i>	17	1.4	
non-collision	206	16.9	
unspecified	125	10.2	
Motor-cyclist/pillion passenger	62	5.1	2.9
Occupant of quad bike	22	1.8	3.3
Other and unspecified	97	8.0	2.9
Total	1220	100.0	100.0

Source: Queensland Hospital Admitted Patient Data Collection July 2002-June 2007

Discussion

As anticipated, modes of injury in children under five years of age vary substantially with the age of the child, reflecting the greater mobility and enhanced general capabilities of developing children. Almost all transport-related injuries to infants under a year occur in motor vehicle crashes, whereas by age four this mode represents about a third of such injuries. Restraint use in motor vehicle crashes tends

to be poorly documented, but there are indications that a proportion of pre-school children of all ages are improperly restrained.

Slow-speed runovers occur at all ages but are a particular problem at ages one, in particular, and two years of age, as noted in the case of fatalities by Griffin and colleagues [9]. Children older than two years are presumably more mobile and alert to their surroundings, and hence better able to avoid slowly moving vehicles.

Bicycle-related injuries are uncommon in children aged one or two years, but by age four comprise the largest proportion of transport related injuries at over 40%. They are apparently rare among fatalities, which is consistent with the low rate of cycle-related deaths in a report from the USA [5]. It may be that children killed by a motor vehicle while riding a bicycle are not always distinguished in published tables from children killed as pedestrians. As far as can be inferred from length of hospital stay, bicycle-related injuries in children under five years of age tend to be on average less severe (mean length of hospital stay = 1.5 days) than those associated with other modes of injury (mean length of hospital stay = 3.8 days). Nonetheless closer supervision of cycling in preschool children should perhaps be encouraged. Further research on this topic is warranted.

On the other hand it is arguable that riding on motorcycles or quad bikes by such young children, whether as passengers or controllers, entirely or partially, is not to be encouraged. There is evidence of an increase over time in injuries related to these vehicles from both Victoria [10] and in the current data. The American Academy of Pediatrics in 2000 recommended that children and adolescents under the age of 16 should not be permitted to be in control of a motorcycle or all-terrain vehicle and that riding pillion on these vehicles should be discouraged in younger children [11]. While there is merit in such a stringent approach, it is unlikely to be favourably received in either the USA or Australia, and efforts should rather be directed to harm minimisation.

Wider understanding of the patterns of transport-related injury would better inform health service providers dealing with small children, such as health nurses and paediatricians, as to the advice they should give to parents of children under five years of age. Much of this advice, with a lower level of age specificity, can be found in the fact sheets to be found on the website of Kidsafe Queensland [12].

One limitation of this study is the variable quality of the textual descriptions available, due in large part to the busy nature of the emergency departments in which the information is collected and also to the number of transfers from the first point of contact of the injured child with health services. In particular there is not enough information on the adequacy of child restraints in motor vehicle crashes. A special investigation may be needed to gain better information in this.

Another limitation is the partial nature of the QISU's coverage of Queensland hospitals. However over 86% of children under five years of age were admitted to one or other of the two major children's hospitals in Brisbane, frequently after transfer from another facility, so that

coverage is less of a problem than in older persons. The hospital admitted patient data are however comprehensive.

References

1. Schmertmann M, Williamson A, Black D. Leading causes of injury hospitalisation in children aged 0–4 years in New South Wales by injury submechanism: A brief profile by age and sex. *Journal of Paediatrics and Child Health*, 2012, 48:978-984
2. Siskind, V, Scott, D. Injuries leading to hospitalisation in the first year of life: analysis by trimester of age using coded data and textual description. *Australian and New Zealand Journal of Public Health*, 2013, 37:168-172.
3. Henley G, Harrison JE. Serious injury due to land transport accidents, Australia 2006–07. *Injury Research and Statistics series no. 53. Cat. no. INJCAT 129. 2009, Canberra: AIHW.*
4. Ivers R. Paediatric injuries: burden, risk factors and effective interventions. The George Institute, 2014. www.kidsfamilies.health.nsw.gov.au/publications/paediatric-injury-prevention-management-research.
5. Borse NN, Gilchrist J, Dellinger AM, Rudd RA, Ballesteros MF, Sleet DA. CDC Childhood Injury Report: Patterns of Unintentional Injuries among 0–19 Year Olds in the United States, 2000–2006. Atlanta (GA): Centers for Disease Control and Prevention, National Center for Injury Prevention and Control; 2008
6. Department of Transport and Main Roads, Queensland Motorcycle Riders' Guide, 2012.
7. Griffin B, Watt K, Wallis B, Shields L, Kimble R. Incidence of paediatric low speed vehicle run-over events in Queensland, Australia: eleven year analysis. *BMC public Health*, 2014, 14:245-252.
8. National Library of Australia publications. <http://pandora.nla.gov.au/pan/14014/20130121-0000/www.cypcpg.qld.gov.au/resources/publications/reports.html>
9. Griffin B, Watt K, Wallis B, Shields L, Kimble R. Paediatric low speed run-over fatalities in Queensland. *Inj Prev* 2011; 17:i10-13.
10. Bevan CA, Babl FE, Bolt P, Sharwood LN. The increasing problem of motorcycle injuries in children and adolescents. *Med J Aust* 2008; 189:17-20.
11. American Academy of Pediatrics, Committee on Injury and Poison Prevention. All-Terrain Vehicle Injury Prevention: Two-, Three-, and Four-Wheeled Unlicensed Motor Vehicles. *Pediatrics*, 2000, 105: 1352-54.
12. Kidsafe Queensland. <http://www.kidsafeqld.com.au/publications/fact-sheets>.