



Child pedestrian safety: 'driveway deaths' and 'low-speed vehicle run-overs', Australia, 2001–10

Executive summary

This report:

- provides a description of the circumstances of child pedestrian deaths due to motor vehicle accidents around the home and suggests some of the major factors;
- places these home accidents in the context of child pedestrian safety;
- examines the potential of available data sources for identification and understanding of low-speed vehicle run-overs beyond the home; and
- shows what available data sources can tell us about child pedestrian safety.

The issue of low-speed vehicle run-overs is important because it raises questions about whether the visibility from within many four-wheeled vehicles of small and near objects outside, in any direction, is adequate and whether the movements of pedestrians and motor vehicles need to be more segregated than they are at present in current built environments.

Key findings for pedestrians aged 0–14 years in motor vehicle accidents in Australia during the ten-year period 2001–10 are:

Around the home

- 66 pedestrians aged 0–14 years were killed in the ten-year period 2001–10 and 483 seriously injured in the eight-year period 2002–03 to 2009–10 (serious injury data were available for this period only) due to being hit by a four-wheeled motor vehicle moving around a home.
- On average, seven pedestrians aged 0–14 were killed each year (of the ten years) and 60 seriously injured each year (in the eight-year period) due to being hit by a four-wheeled motor vehicle moving around a home.
- 60 pedestrians aged 0–4 and six aged 5–14 were killed in the ten years 2001–10 due to being hit by a four-wheeled motor vehicle moving around a home.
- In the eight years 2002–03 to 2009–10, pedestrians aged 0–4 years accounted for 70 per cent of the pedestrians aged 0–14 years who were seriously injured around the home due to being hit by a four-wheeled motor vehicle.

- A further 293 pedestrians aged 0–14 years were seriously injured around the home due to being hit by some other road vehicle (for example, motorcycle, three-wheeled vehicle or pedal cycle).
- Factors in motor vehicle accidents around the home include people and vehicle factors, as well as features of home designs which create risks for children by exposing them to the movements of vehicles. Some researchers have suggested that people feel more relaxed and safe in the home environment and perhaps let their guard down. Rearward visibility has been observed to be limited in many vehicles and this has been described as a major factor. There have been suggestions in relation to home designs that unfenced driveways and doors between houses and garages allow children to move suddenly into the path of vehicles unbeknown to the driver. Long driveways also possibly encourage excessive vehicle speeds on entering and exiting the home, according to some studies.

Beyond the home

Identification of low-speed vehicle run-overs in traffic and non-traffic contexts beyond the home is more difficult, particularly for serious injury.

—What we know

- In all locations beyond the home, traffic and non-traffic, 204 pedestrians aged 0–14 years were killed in the ten-year period 2001–10 and 4 440 seriously injured in the eight-year period 2002–03 to 2009–10 in a range of motor vehicle accident types, including instances of low-speed vehicle run-over.
- Relatively few (13 in the ten years 2001–10) were killed on public roads in speed zones of 40 km/hr or less.
- Over half (58 per cent, 118 cases out of 204) of deaths beyond the home were on public roads in speed zones of 50 or 60 km/hr. This is where vehicles perform all kinds of low-speed manoeuvres: entering or leaving driveways, entering or leaving parking spaces, turning corners, picking up, setting down and so on. However, vehicle movement descriptors for traffic deaths indicate that relatively few vehicles were performing such manoeuvres at the time of collision with the child. Most vehicles were moving in a forward direction on a road when they hit the child.
- Over 14 per cent (29 cases out of 204) of deaths beyond the home were in non-traffic locations. These locations include car parks (parking lots) and roads in places such as schools, universities, hospitals, prisons, factory premises, military camps and so on where vehicle access is often restricted to specified members of the public and where we would expect vehicles to be travelling at relatively low speeds and performing low-speed manoeuvres.
- The prevalence of low-speed vehicle run-overs relative to other circumstances that characterise fatal collisions with pedestrians often can be ascertained from study of coroners' records and police reports, for both traffic and non-traffic deaths.

—What we do not know

Actual vehicle speed at the time of a collision with a pedestrian is rarely known for fatal collisions. Details of vehicle speed, and vehicle movements and speed limits at collision sites, which can be used as an indicator of likely vehicle speed, are also absent from national-level hospital records of collisions involving serious injury.

Summary tables

Tables 1 and 2 provide an overview of child pedestrian deaths and serious injury in the ten-year period 2001–10. Further details of the working behind these tables and the summary statements above can be found in the 'around the home' and 'beyond the home' sections of this report.

Table 1 Pedestrians aged 0–14 years killed in land transport accidents, Australia, 2001–10: location of accident by age group

Location of accident ^(a)	0–4 years	5–14 years	0–14 years
Traffic			
Built-up areas	54	77	131
Other traffic locations	8	36	44
Non-traffic			
Home	60	6	66
Farm	6	0	6
Other non-traffic locations	4	19	23
Total deaths	132	138	270
Death rate per 100 000 population per year ^(b)	1.0	0.5	0.7

(a) The location categories are mutually exclusive: the farmhouse on a farm is included under 'home', the footpath and street outside a home are included under 'built-up areas' (speed limits 60 km/hr or less) or 'other traffic' location.

(b) Rate for each age group is the number of deaths over the ten years divided by the sum of the population of the age group in each of the years 2001 to 2010 (using ABS 2011b) multiplied by 100 000.

Source: BITRE, using data from the Australian Road Deaths Database and the National Coronial Information System.

Table 2 Pedestrians aged 0–14 years seriously injured in land transport accidents, Australia, 2002–03 to 2009–10: location of accident by age group

Location of accident ^(a)	0–4 years	5–14 years	0–14 years
Street or highway ^(b)	613	2 568	3 181
Home	511	265	776
Farm	14	35	49
School	9	34	43
Other specified place of occurrence ^(c)	99	233	332
Unspecified place of occurrence	289	546	835
Total seriously injured	1 535	3 681	5 216
Serious injury rate per 100 000 population per year ^(d)	14.3	16.8	16.0

(a) The location categories are mutually exclusive: the farmhouse on a farm is included under 'home', the footpath and street outside a home are included under 'street or highway'.

(b) It cannot be assumed that all traffic cases are 'street or highway' as some cases are assumed to be traffic cases though the place of occurrence is unspecified. Unlike Table 1, this table is not based on a traffic / non-traffic distinction.

(c) 'Other specified place of occurrence' includes but is not limited to parking lots, sports and athletics areas and the countryside.

(d) Rate for each age group is the number of seriously injured over the eight years divided by the sum of the population of the age group in each of the years 2003 to 2010 (using ABS 2011b) multiplied by 100 000.

Source: BITRE, using data from the National Hospital Morbidity Database.

Introduction

This report examines the death and serious injury of pedestrians aged 0–14 years in collisions with motor vehicles, both on-road (traffic) and off-road (non-traffic), focusing in particular on fatal collisions with four-wheeled motor vehicles around the home. 'Low-speed vehicle run-overs' or 'driveway deaths', as they are often called, were the subject of two reports by the Australian Transport Safety Bureau (ATSB) in the 2000s: deaths in Australia were examined in detail for the years 1996–98 (ATSB 2002) and 1996–2001 (ATSB 2006). This report examines such deaths in Australia in the ten-year period 2001–10. Data on serious injury have been added, using data available at the national level.

In 2010 in Australia, there were 2 336 000 families with children under 15, representing 37.3 per cent of the total number of families (ABS 2011a). Children under 15 represented 18.9 per cent of the total population of Australia in 2010, down from 20.5 per cent in 2001. Children 0–4 years old represented 6.5 per cent of the total population of Australia in 2010, similar to the 6.6 per cent in 2001. Children 5–14 years old represented 12.4 per cent of the total population of Australia in 2010, down from 13.9 per cent in 2001 (Table 3).

Table 3 Population of Australia 2001–10 by age group at June 2001, June 2006 and June 2010

Age group	June–2001	June–2006	June–2010
0–4	1 282 357	1 310 082	1 449 672
5–14	2 704 841	2 740 363	2 768 752
15–64	12 990 508	13 954 776	15 075 382
65+	2 435 534	2 692 659	3 005 969
All persons	19 413 240	20 697 880	22 299 775
Per cent of total population			
0–4	6.6 %	6.3 %	6.5 %
5–14	13.9 %	13.2 %	12.4 %

Note: Comparisons between the 0–4 and 5–14 age groups should take into account that there are twice as many 5–14 year olds in the Australian population as 0–4 year olds.

Source: BITRE, using data from ABS 2011b.

The national framework for protecting Australia's children agreed by the Council of Australian Governments (COAG 2009a) follows the United Nations Convention on the Rights of the Child, to which Australia is a signatory, in defining the term 'child' as anyone under the age of 18 years. However, this study focuses on children 0–14 years of age for two main reasons. First, from age fifteen, children in Australia can start working and learning to drive vehicles, thereby changing their risk profiles. Second, relevant published data from the Australian Bureau of Statistics (ABS) and the Australian Institute of Health and Welfare (AIHW) focus on the 0–14 age group. The ABS, for instance, publishes population by remoteness area and age, in five-year age groupings only (0–4, 5–9, 10–14 and so on).

Further disaggregation of 0–14 year olds into the 0–4 and 5–14 sub-groups in many of the tables in this report is based on the assumption that these age groups represent different stages of childhood development. As the AIHW puts it (AIHW 2009, p. 102):

Children are particularly vulnerable to certain types of injury according to their stage of development. Infants and young children (0–4 years) explore their physical environment before they understand and have the skills to respond to hazards. Initiatives to prevent injuries among children of this age therefore focus on creating safer products and environments and raising the awareness of children's carers (NPHP 2004). Successful steps in this area have included child-resistant packaging to prevent poisoning, and legislation requiring the fencing of swimming pools and the use of car seats. Older children (5–14 years) are exposed to a broader range of settings, such as schools, sporting environments, streets and neighbourhoods. At the same time, their ability to make decisions about their safety increases.

Anecdotal evidence suggests that parents are increasingly inclined to drive their children around rather than allow them to walk in the streets. In the ten-year period 2001–10, on public roads, 502 children under 15 were killed while passengers in motor vehicles and 175 were killed while walking. The number of trips on public roads during which children are passengers compared with the number during which they are pedestrians is unknown, so the relative safety of being a passenger or a pedestrian can not be calculated. A rate of deaths per number of trips or trip kilometres, for example, would enable a comparison to be made. The perception that the streets are unsafe for children, partly due to the presence of motor vehicles, appears nonetheless to be present.

What has surprised many parents (and the wider community) is the extent to which off-road (non-traffic) locations traversed by motor vehicles also pose a threat to child safety. In places like parking lots, schools, sports grounds and even around the home, considered by many to be a safe haven, children have been killed or injured after being run over by a motor vehicle. These are places where vehicles are typically travelling at low speed, hence the appearance of the term 'low-speed vehicle run-over', which has emerged from child trauma units in hospitals, where staff are concerned with the frequency with which they are confronted with this mechanism of injury.

Child pedestrians aged 0–4 years are particularly at risk around the home; over 45 per cent of pedestrians in this age group who were killed and 33 per cent of pedestrians in this age group who were seriously injured were hit by motor vehicles around the home (Tables 1 and 2 above).

Housing and neighbourhood designs in Australia have brought vehicles into the home, school and other places frequented by children and created both on-road and off-road spaces with an interface between the movements of children and vehicles. This has created risks and a complex set of variables that are yet to be fully understood. Perhaps telling in this regard is the fact that there are very few recommendations made by coroners following investigation of low-speed vehicle run-over deaths in non-traffic circumstances; it is not easy to identify the major factors involved. While the numbers of deaths appear to be relatively small, there are fears among many in the medical profession that unless the major factors behind these deaths are understood and preventative measures implemented to mitigate the risks involved, the numbers of children killed or seriously injured could increase over the coming years. In any case, serious injury (which is more frequent) due to this type of accident is not something from which children (or their families) always fully recover, either physically or otherwise.

This report defines the problem of low-speed vehicle run-overs in a way that enables it to be observed quantitatively, then looks at its incidence around the home and beyond the home.

I Terminology and limitations of the study

Data have been drawn from different sources: hospitals, coroners, police and road safety authorities. Each source has its own conceptual framework and classification system. Consolidating data from these sources presents challenges. Simplicity of presentation can hide complexity and introduce errors. The notes under each table flag any complexities and potential sources of error.

The term 'motor vehicle accidents' is used throughout this report. Motor vehicles include two- and three-wheeled vehicles as well as vehicles with four or more wheels. It is mainly motor vehicles, four-wheeled ones in particular; that collide with pedestrians, causing death or serious injury. However, pedal cycles are occasionally involved in serious collisions with pedestrians, as are trams (streetcars) and even horses being ridden or drawing carriages. All these vehicles together with motor vehicles are called 'road vehicles' in road safety databases, and the Australian Road Deaths Database does not allow identification of the vehicle that hit a pedestrian, other than that it was a 'road vehicle'. Add trains and the category becomes 'land transport vehicles', which is the category hospital and coronial databases work with. Table notes and/or titles indicate the range of vehicle types covered as appropriate.

Some table titles include the term 'location of accident' and locations are listed as 'traffic' and 'non-traffic'. This is a simplification; the location of a collision and its classification as either traffic or non-traffic are sometimes not the same. A traffic accident can be defined as any vehicle accident occurring on, originating on, terminating on or involving a vehicle partially on a public street or highway. For example, in a case where a motor vehicle runs off a street into a house, killing someone inside or in the yard of the house, the vehicle movement is considered to have originated on the street and hence this accident is classified as a traffic accident even though the location of the fatal collision was a private home. Thus, in the tables here, the 'location of accident' for such a case would be 'built-up area' or 'other traffic' location, not 'home'.

Making a distinction between traffic and non-traffic accidents is also often not a simple matter. In non-traffic locations, vehicle access to the public is either prohibited by law (or custom) or restricted to specified groups of people. For example, parking lots in various institutions (hospitals, schools, universities and so on) are sometimes open to the public and sometimes access is strictly controlled; accident records do not necessarily provide this level of detail to enable an accurate traffic / non-traffic distinction to be made. While all data sources used here appear to use the same conceptual framework in assigning categories such as 'location of accident', 'traffic accident' or 'non-traffic accident', the actual classifications applied might differ in practice (most databases have 'in-house' interpretation guidelines for coders doing the classifying). A potential source of error, but probably not major error, in consolidating data from these different sources is therefore inconsistency in definitions and classification practices.

In police and road safety data, the term 'traffic' includes both roadways and pedestrian or cycling areas alongside roadways. Hospital data are based on a similar perspective; a 'public highway [trafficway] or street' is defined as 'the entire width between property lines (or other boundary lines) of land open to the public as a matter of right or custom for purposes of moving persons or property from one place to another...' (WHO 1992). Coronial data use specific codes for 'street or highway', 'footpath' and 'cycle or bike track' but these are all placed under the general location classification of 'Transport Area: Public Highway, Freeway, Street or Road'.

The classification of vehicle type (car, 4WD etc) is different in each of the data sources used for this report. It has not been possible to bring together into the one table those tables which show what kinds of vehicles have been responsible for child pedestrian death and serious injury.

Time series are not presented in this report. Coronial investigations of deaths can take several years to conclude. Apparently smaller numbers of deaths in more recent years can be due to the fact that investigation reports have not been finalised and case details not yet recorded, rather than an actual decline in deaths.

Identifying the incidence of low-speed vehicle run-overs is one task; identifying the factors that contribute to the risk of them happening is another. Both tasks are attempted here in looking at this type of accident around the home and beyond. This report uses a 'descriptive case-series approach'. A criticism of this approach is that it does not use 'control or comparison groups' in the population, that is, it does not compare groups exposed to a given risk factor with those not exposed. A range of possible risk factors is identified here, without attempting to assess the relative weight of such factors or whether they in fact carry any weight at all in explaining the incidence of this type of accident (see Queensland Injury Prevention Council—forthcoming reports—for further discussion of this issue).

2 Low-speed vehicle run-overs— definition of the accident type

The analysis in this report is based on data from the Australian Road Deaths Database, the National Hospital Morbidity Database and the National Coronial Information System. These sources have various limitations. Hospital data at the national level include only some details of the circumstances of accidents in both traffic and non-traffic contexts; vehicle speed and vehicle movements at the time of a collision and speed limit at the collision site are not among them. The Australian Road Deaths Database covers fatal traffic collisions only, includes speed limit at collision site, but has no information on vehicle speed or vehicle movements at the time of collision. Some information nonetheless can be gleaned from hospital data and the road safety databases, as this report attempts to demonstrate. The National Coronial Information System, and via this the full reports of accidents held in coroners' offices around Australia, is the best source of information at the national level on deaths due to low-speed vehicle run-overs, though vehicle speed is often absent from this source as well. Vehicle movements and speed limits can be coded from this source. However, accessing this information involves a difficult and time-consuming process of reading textual material then classifying (coding) and analysing cases. Before commencing such a task, therefore, it is essential to carefully define the problem to be analysed.

'Low-speed vehicle run-over' as a term describing a type of accident needs elaboration. Until such time as vehicle accident investigators have access to 'black box' data similar to that available for aircraft accidents, the exact speed of motor vehicles involved in serious crashes will remain unknown. And defining the cut-off point between 'low speed' and 'high speed' will be problematic. How then can the incidence of low-speed vehicle run-overs be measured?

There appear to be two interrelated questions. The first, 'Why are children (and others) on foot being killed and seriously injured by motor vehicles moving at low speed?', emphasises the variable 'vehicle speed' and makes no mention of the built environment. In the absence of reliable data on vehicle speed, part of the answer to this question is best provided by controlled vehicle tests, such as those conducted by the NRMA on visibility (NRMA 2012).

The second, 'Why are children (and others) on foot being killed and seriously injured by motor vehicles in settings or circumstances (turning, reversing etc) in which we would expect vehicles to be moving at relatively low speeds?', draws attention to vehicle movement rather than speed and to locations in the built environment. In other words, accident location and vehicle movement become surrogate variables for speed, which cannot be measured. The features of the built environment in the accident location become variables in their own right, as does speed limit, if the accident location is a public road. The problem of low-speed vehicle run-overs phrased in this way is then more amenable to investigation using available data sources.

The term 'vehicle' in 'low-speed vehicle run-over' also needs explication. If a concern with this accident type involves a concern with the visibility of small and near objects from inside four-wheeled motor vehicles, the definition of vehicle should include this particular vehicle type and exclude other vehicle types.

A suggested redefinition of the accident type, to make it observable, is thus:

Accidents in which a pedestrian is run over by a four-wheeled motor vehicle (or motor vehicle with more than four wheels) in a location or circumstances (turning, reversing etc) in which we would expect the vehicle to be moving at a relatively low speed.

This definition excludes cases where people are hit by pedal cycles, horses, trains, two- or three-wheeled motor vehicles or other land transport vehicles, though we might take note of their frequency.

The measurement of the speed of the vehicle is therefore not critical; it is the location and the vehicle movements that attract our interest. Moreover, too much focus on 'low speed' could hide part of the problem. We need to know if vehicles are speeding in driveways or in built-up areas where speeds are supposed to be limited. 'Speeding' here refers to speeds observed to be 'excessive' for the setting or circumstances, not an exact measurement of speed. Observed speed should not be a criterion used to exclude cases from this accident type. For example, if the movement of a vehicle into (or out of) a driveway or house yard was intentional with respect to parking at or leaving the property (as opposed to a vehicle unintentionally running off the road), and the vehicle was observed to be moving 'too fast', that case should be included. After all, if vehicles in these fatal collisions are observed to be travelling too fast on driveways, that raises the question of whether the length and/or other design features of some driveways permit inappropriate speeds.

A focus on location has the added advantage that responsibility for safety in particular locations is generally well-defined, a critical point when it comes to formulating policy responses and accident prevention programs.

Cases of motor vehicles running over pedestrians around homes fit this definition perfectly and these will be the starting point of our investigation here.

3 Around the home

Deaths around the home

The National Coronial Information System (NCIS) was the database used to explore the details of deaths around the home. Case inclusion / exclusion criteria were as follows:

Included

- Incidents which occurred in the driveway or in either the front or rear yard of the home.
- Incidents which occurred around a farmhouse.
- Incidents which occurred in an Indigenous community.
- Cases of pedestrians under age 15 run over; including children on a 'pedestrian conveyance' such as a skateboard, push cart, roller skates and so on.
- Cases where any four-wheeled motor vehicle was the counterpart (what hit the child), e.g. trucks, cars and so on.

Excluded

- Collision of a road vehicle into the front yard of a home at high speed after running off the road (as this is a traffic context).
- Incidents which occurred on the footpath or verge, alongside the roadway (as this is a traffic context).
- Incidents which occurred at a camp site, caravan park, car park, factory site or parkland area.
- Incidents which occurred on a farm paddock, public road or on vacant land.
- Cases where motorcycles, pedal cycles, horses or other land transport vehicles were the counterpart.

The term 'driveway deaths' does not capture the full extent of the problem here; 'around the home' on the other hand includes front and rear yards as well as driveways and captures all cases of child pedestrian deaths in these locations.

A total of 66 pedestrians aged 0–14 years were found to have been hit and killed by a four-wheeled motor vehicle around a home in Australia between January 2001 and December 2010, with 60 aged 0–4 years, 6 aged 5–14 years and nearly equal numbers of males and females (m=34, f=32). There were 19 closed cases of non-traffic child pedestrian deaths for which not enough information was available to classify the death in terms of the inclusion/exclusion criteria. Other non-traffic deaths were still open on the NCIS, i.e. currently being investigated by a coroner, and hence were not included as confirmed cases according to the criteria. The number of cases thus possibly exceeds 66.

Of the 66 cases, 54 deaths occurred in a driveway, another 12 elsewhere around a home.

Half the deaths involved cars; just over a third involved four-wheel drives:

Type of vehicle that hit child	4WD	Car	Truck	Four-wheeled vehicle but type unknown	Total
	25	33	6	2	66

Note: In this analysis, '4WD' includes four-wheel drive wagons and utes. 'Car' includes station wagons and other unspecified makes / models of utes and vans. There is no national or international standard classification of vehicle types. The most likely explanation, therefore, for differences between the findings of this study and other studies on low-speed vehicle run-over with regard to the types of vehicles involved is the use of different vehicle classifications.

Source: BITRE, using data from the National Coronial Information System.

Two-thirds of the vehicles were reversing:

Vehicle direction	Forward	Reversing	Other or unknown	Total
	16	44	6	66

Note: 'Other or unknown' vehicle direction includes cases which involved a three-point turn or both forward and reversing movements.

Source: BITRE, using data from the National Coronial Information System.

Of the deaths where the height of the child was known (n=31), 71 per cent involved children under 100 cm in height:

Height of child (cm)	Less than 85	85 to 99	100 to 114	115 or above	Unknown	Total
	11	11	5	4	35	66

Source: BITRE, using data from the National Coronial Information System.

Over half of the drivers were male:

Gender of vehicle driver	Male	Female	Not applicable	Unknown	Total
	34	20	4	8	66

Note: 'Not applicable' for gender of vehicle driver means there was no driver of the vehicle—it rolled—or the child was alone in the car and fell out when the car moved.

Source: BITRE, using data from the National Coronial Information System.

Just over half of the drivers (53 per cent) were a parent of the child:

Relationship of driver to child	Father	Mother	Aunt or uncle	Sibling	Other person not related to child	Not applicable	Unknown	Total
	23	12	7	3	9	4	8	66

Note: Other person not related to child' includes family friend, colleague, partner of parent, person attending house for goods delivery or collection, and other specified, unrelated persons. 'Not applicable' means there was no driver of the vehicle (it rolled) or the child was alone in the car and fell out when the car moved.

Source: BITRE, using data from the National Coronial Information System.

Occurrences were most frequent on days toward the end of the working week (Thursday through to Saturday):

Day of week of accident	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Total
	8	8	7	12	11	12	8	66

Source: BITRE, using data from the National Coronial Information System.

Half of the deaths occurred between midday and 6pm. Within the midday to 6pm period, the majority of deaths occurred between 2pm and 6pm (27 of 33 cases—a similar pattern was evident beyond the home in traffic contexts—see Table 10).

Time of accident	Midnight to 6am	6am to midday	Midday to 6pm	6pm to midnight	Unknown	Total
	0	20	33	11	2	66

Source: BITRE, using data from the National Coronial Information System.

Most deaths occurred in a Major City or Inner Regional Area (n=39 or 59 per cent). However, on a population basis, death rates worsen with increasing remoteness (Table 4).

Table 4 Pedestrians aged 0–14 years killed around the home due to a collision with a four-wheeled motor vehicle, Australia, 2001–10: numbers and rates by remoteness area of home at which accident occurred

	Remoteness area					Total
	Major city	Inner regional	Outer regional	Remote	Very remote	
Number of deaths	20	19	15	7	5	66
Per cent	30.3	28.8	22.7	10.6	7.6	100.0
Death rate per 100 000 population per year	0.1	0.2	0.4	0.9	1.1	0.2

Note: The home at which the accident occurred was in most cases (86 per cent) the place of usual residence of the child. The remoteness areas were specified according to the ABS Australian Standard Geographical Classification (ASGC—Cat. No. 1216.0). Rate is the number of deaths over the ten years divided by the sum of the population of 0–14 year olds in each remoteness area in each of the years 2001 to 2010 multiplied by 100 000.

Source: BITRE, using data from the National Coronial Information System and ABS population data.

Five of the deceased children were at an Aboriginal community outstation at the time of the accident. The Australian Institute of Health and Welfare, in collaboration with the BITRE, periodically publishes a comprehensive overview of the injury of Aboriginal and Torres Strait Islander people due to transport accidents, and the latest report in this series can be found at <www.nisu.flinders.edu.au>.

Serious injury around the home

Serious injury data from the National Hospital Morbidity Database were obtained for the eight financial years 2002–03 to 2009–10, comparable data being available from this source for this part of the study period only.

There were 483 child pedestrians aged 0–14 seriously injured around the home due to being hit by a four-wheeled motor vehicle in the period 2002–03 to 2009–10: with 329 aged 0–4 and 143 aged 5–14 (Table 5—suppressed values do not allow a precise age breakdown). Pedestrians aged 0–4 years thus accounted for 70 per cent of the pedestrians aged 0–14 years who were seriously injured around the home due to being hit by a four-wheeled motor vehicle (based on known values only—329/472).

Table 5 Pedestrians aged 0–14 years seriously injured around the home due to a collision with a four-wheeled motor vehicle, Australia, 2002–03 to 2009–10: place of occurrence of accident by vehicle type, age of child and sex

Place of occurrence of accident	Child hit by car, pick-up truck or van				Child hit by heavy transport vehicle or bus				
	0–4 years		5–14 years		0–4 years		5–14 years		0–14 years
	Male	Female	Male	Female	Male	Female	Male	Female	Total
Driveway to home	158	95	63	57	n.p.	0	n.p.	n.p.	380
Other and unspecified place in home	50	26	23	n.p.	n.p.	0	0	0	103
Total	208	121	86	n.p.	n.p.	0	n.p.	n.p.	483

Notes:

- Small cell counts have been suppressed and this is indicated by 'n.p.' or 'not published'. See the data sources section of this paper for an explanation of this practice.
- Collisions with heavy transport vehicles or buses were infrequent but are included here for completeness.
- A 'car' here is a four-wheeled motor vehicle designed primarily for carrying up to 10 persons. This definition includes minibuses. A 'pick-up truck or van' is a four- or six-wheeled motor vehicle designed primarily for carrying property, weighing less than the local limit for classification as a heavy goods vehicle and not requiring a special driver's licence.

Source: BITRE, using data from the National Hospital Morbidity Database.

Table 6 shows that 776 children aged 0–14 years were seriously injured in 2002–03 to 2009–10 due to being hit by some kind of road vehicle, four-wheeled vehicles included. To estimate the number of children who were hit and seriously injured by a road vehicle other than a four-wheeled vehicle, we can subtract the 483 in Table 5 from the 776 in Table 6, giving 293 children aged 0–14 in this type of collision.

Table 6 Pedestrians aged 0–14 years seriously injured around the home due to a collision with a road vehicle, Australia, 2002–03 to 2009–10: place of occurrence of accident by age of child

Place of occurrence of accident	0–4 years	5–14 years	0–14 years
Driveway to home	368	171	539
Other and unspecified place in home	143	94	237
Total	511	265	776

Note: The term 'road vehicle' includes pedal cycles as well as motor vehicles with two or more wheels.

Source: BITRE, using data from the National Hospital Morbidity Database.

Most serious injury around the home occurred in the major cities (Table 7). However, Table 17 shows that, for non-traffic collisions in general, including around the home, serious injury rates worsen with increasing remoteness.

Table 7 Pedestrians aged 0–14 years seriously injured around the home due to a collision with a four-wheeled motor vehicle, Australia, 2002–03 to 2009–10: place of occurrence of accident by age of child and remoteness area of residence of child

Place of occurrence of accident	0–4 years					5–14 years					0–14 years
	Major city	Inner regional	Outer regional	Remote	Very remote	Major city	Inner regional	Outer regional	Remote	Very remote	Total
Driveway to home	153	54	35	6	7	61	50	10	n.p.	n.p.	380
Other and unspecified place in home	40	14	19	n.p.	n.p.	13	8	n.p.	0	n.p.	103
Total	193	68	54	n.p.	n.p.	74	58	n.p.	n.p.	n.p.	483

Notes:

1. Small cell counts have been suppressed and this is indicated by 'n.p.' or 'not published'.

2. 'Major cities' and the other remoteness areas are defined in the Data Sources section of this paper.

Source: BITRE, using data from the National Hospital Morbidity Database.

Risk factors and preventative measures

A tentative summary of perspectives on the problem of vehicle run-overs around the home is presented below in Table 8, based partly on work by others on this topic that BITRE has been able to review. This table is not intended as a literature survey. See the 'Further information' section of this report for literature reviews.

Table 8 Perspectives on vehicle run-overs around the home, some of which are supported by existing research findings, others being points on which there is as yet no consensus

People factors

- Among pedestrians under 15, 0–4 year olds are particularly vulnerable to this type of accident (Tables 1 and 2 in this report support this hypothesis, even without taking into account the fact that there are twice as many 5–14 year olds in the Australian population as 0–4 year olds).
- Children aged 12 to 23 months appear the least likely to survive.
- Most victims are boys (Table 5 supports this for serious injury, but the NCIS study presented here found that nearly equal numbers of boys and girls were killed and this applied particularly to the 0–4 age group).
- Many of the drivers of the vehicles involved are family members or known to the child (supported here by the NCIS study).
- People feel more relaxed and safe in the home environment and perhaps let their guard down.
- People expect to be able to drive a vehicle door-to-door in most settings.

Vehicle factors

- Run-overs tend to occur when vehicles are reversing, but forward movement accounts for a significant proportion of cases (supported here by the NCIS study).
- This is not just 'a 4WD problem'. Cars are also responsible for much of the fatal and serious injury. Lack of national and international standard definitions of vehicle types makes the comparability of studies on this issue problematic.
- NRMA studies have shown that rearward visibility is surprisingly limited in many vehicles.
- Some researchers suggest that reversing cameras, sensors and other visibility aids have the potential to prevent rearward run-over incidents. Others note that the potential effectiveness of camera systems is still limited by the need for drivers to be monitoring the display and notice and react to the presence of a child. Installation of such devices might even contribute to a reduced sense of risk among drivers.
- Some car manufacturers (e.g. Volvo) are piloting the installation of sensors in the front and rear of vehicles which trigger braking without waiting for a driver response to an object in front of or behind the vehicle.

Environmental factors (risks associated with the built environment)

- Ideally, children should be completely separated from areas of vehicle movement. Yet contemporary house and neighbourhood designs create interfaces between the movements of children and vehicles which are hazardous for children. Doors between houses and garages are one example of such an interface, unfenced driveways are another.
- Long driveways perhaps encourage higher driving speeds up or down the driveway, as perhaps also do driveways running off busy streets.
- Changes to house and neighbourhood designs to segregate the movements of young children and vehicles will be the most effective measures to reduce the incidence of low-speed vehicle run-overs.

Source: BITRE

Griffin and others in a recent study of Queensland cases concluded that:

We concur with previous authors about four main areas for prevention of LSVROs: adequate supervision of children and not leaving children unsupervised in a vehicle; separation of driveway from play areas; installation of reversing cameras and sensors; and the education of parents and caregivers. A specific, planned, nationwide programme about prevention of LSVRO incidents, based on these four strategies, is urgently needed (Griffin et al 2011, p. 12. 'LSVROs' meaning 'low-speed vehicle run-overs').

4 Beyond the home

Identification of low-speed vehicle run-overs in traffic and non-traffic contexts beyond the home is more difficult. What we know and do not know is outlined in this section.

Deaths beyond the home—traffic

In all locations beyond the home, traffic and non-traffic, 204 pedestrians aged 0–14 years were killed (270 minus 66) in Australia in 2001–10 in a range of motor vehicle accident types, including instances of low-speed vehicle run-over (Table 9).

Table 9 Pedestrians (all age groups) killed in land transport accidents, Australia, 2001–10: location of accident by age group

	0–4 years	5–14 years	15–64 years	65+ years	Total
Traffic					
Built-up areas	54	77	691	510	1 332
Other traffic locations	8	36	637	134	813
Non-traffic					
Home	60	6	-	-	-
Farm	6	0	-	-	-
Other non-traffic locations	4	19	-	-	-
Total deaths	132	138	-	-	-

Notes:

1. Actual speed of the vehicle that hit the pedestrian is unknown in all cases.
2. In most of these cases, but not all, the child was hit by a four-wheeled motor vehicle (see Table 12 for traffic cases and Table 13 for non-traffic cases).
3. Non-traffic data were not obtained for the age groups over 14 as these are outside the scope of this study.
4. The location categories are mutually exclusive: the farmhouse on a farm is included under 'home', the footpath and street outside a home are included under 'built-up area' or 'other traffic' location.

Source: BITRE, using data from the Australian Road Deaths Database and the National Coronial Information System.

In traffic contexts, deaths of both 0–4 and 5–14 year olds were more frequent (56.5 and 75.2 per cent respectively) from 3.00 pm to before 8.00 pm (15:00 to 19:59), on weekends as well as on most weekdays after school (Table 10).

Table 10 Deaths of pedestrians in road traffic crashes, Australia, 2001–10: selected age groups by day of week and hour of day

Age	Day	Hour of day (0 = midnight to 00:59; 23 = 23:00 to 23:59)											Total
		0–5	6–11	12	13	14	15	16	17	18	19	20–23	
0–4	Sun	1	0	0	0	0	0	0	1	2	0	1	5
	Mon	1	3	0	0	1	1	1	0	1	0	1	9
	Tue	0	1	0	0	0	1	0	1	1	0	0	4
	Wed	0	3	0	3	0	0	2	4	2	0	0	14
	Thu	0	3	1	0	0	4	0	1	1	1	0	11
	Fri	0	1	1	1	0	1	2	1	1	0	0	8
	Sat	0	2	2	1	0	0	2	1	1	2	0	11
	Total	2	13	4	5	1	7	7	9	9	3	2	62
5–14	Sun	0	0	0	2	3	1	3	1	2	2	0	14
	Mon	0	1	0	1	0	7	4	5	0	1	0	19
	Tue	1	6	0	0	2	4	3	0	0	1	0	17
	Wed	0	3	0	1	0	4	6	2	0	1	0	17
	Thu	0	0	0	0	0	10	5	1	1	0	0	17
	Fri	0	2	0	1	2	6	1	1	2	2	1	18
	Sat	0	0	1	0	0	3	1	3	1	1	1	11
	Total	1	12	1	5	7	35	23	13	6	8	2	113

Note: 'Road traffic crashes' means any kind of road vehicle (car; truck; motorcycle; pedal cycle; tram etc) could have collided with the pedestrian. Table 12 shows that four-wheeled motor vehicles are most commonly involved.

Source: BITRE, using data from the Australian Road Deaths Database.

Actual vehicle speed at the time of a fatal collision with a pedestrian is rarely known. Nonetheless, information on surrogate variables such as speed limit at the collision site and vehicle movements (turning, parking, leaving a driveway, moving straight ahead on a road etc) at the time of a collision is often available for collisions in traffic contexts. After examining these variables, a number of observations were made as follows.

Relatively few pedestrians aged 0–14 years were killed on public roads in speed zones of 40 km/hr or less (Table 11).

Table 11 Deaths of pedestrians in road traffic crashes, Australia, 2001–10: speed limit at crash site by age groups

		Age groups					Total
		Unknown age	0–4 years	5–14 years	15–64 years	65+ years	
Speed limit at crash site (km / hour)	Unknown	0	1	3	36	17	57
	10	0	0	0	3	0	3
	20	0	2	0	1	0	3
	25	0	0	0	1	0	1
	30	0	1	0	0	0	1
	40	0	2	8	6	7	23
	50	0	29	23	233	169	454
	60	0	20	46	447	334	847
	70	0	1	5	130	58	194
	80	1	3	13	179	42	238
	90	0	0	0	28	3	31
	100	1	3	14	195	20	233
	110	0	0	1	90	8	99
	130	0	0	0	1	0	1
	Unlimited	0	0	0	14	3	17
Total deaths		2	62	113	1 364	661	2 202
Per cent of deaths on roads where limit ≤ 60 ^(a)			88.5	70.0	52.0	79.2	62.1

(a) Per cent based on total deaths minus cases where speed limit was unknown.

Note also that 'Road traffic crashes' means any kind of road vehicle (car, truck, motorcycle, pedal cycle, tram etc) could have collided with the pedestrian. Table 12 shows that four-wheeled motor vehicles are most commonly involved.

Source: BITRE, using data from the Australian Road Deaths Database.

Over half of pedestrians aged 0–14 years (58 per cent, $n=118$) killed beyond the home were killed on public roads in speed zones of 50 or 60 km/hr (Table 11). This is perhaps where we would expect vehicles to be performing all kinds of low-speed manoeuvres: entering or leaving driveways, entering or leaving parking spaces, turning corners, picking up, setting down and so on. However, vehicle movement descriptors for traffic deaths (i.e. all traffic contexts, not just these specific speed zones) indicate that relatively few vehicles were performing such manoeuvres at the time of collision with the child, although vehicle movement was unknown in 28 per cent of cases (Table 12). In Table 12, low-speed manoeuvres are included in the 'Other' category, along with, for example, vehicles running off the road and hitting the child. Most vehicles were moving in a forward direction on a road when they hit the child.

Data for the years 2001–07 (the latest data available covering this particular aspect of the subject under investigation here) show that pedestrians aged 0–14 years killed in a road traffic crash (in all traffic contexts, not just built-up areas) were most frequently hit by a car or a goods or trade vehicle (74.1 per cent of cases). Fatal collisions most often occurred after the child walked (or ran) onto the road in front of a vehicle moving on the road (66.2 per cent of cases). In 56.8 per cent of cases, the child did not appear to have seen the vehicle coming or did not adequately judge the speed or distance of the oncoming vehicle. Similar patterns were evident for both 0–4 and 5–14 year olds (Table 12).

Traffic contexts include the city and neighbourhood streets in which children walk to school, playgrounds, sports grounds, to visit friends and family and so on—situations, in other words, with a more or less dense mix of people, vehicles and all the various features of the built environment. The safety question is: 'Why are children being killed in this environment?'. Part of the answer appears to be driver error and part the natural behaviour of children. Vehicle factors might play a part; even at low speeds, many vehicles do not provide a driver with a good view of objects (whether moving or stationary) in the immediate vicinity of the vehicle, objects behind the vehicle in particular (NRMA 2012). However, available data sources, even coroners' records, do not allow us to ascertain the extent to which such visibility problems play a part in child pedestrian deaths in traffic contexts.

The built environment itself could be creating much of the risk; children (and older people) are forced to confront vehicle traffic as they walk around the neighbourhood or city streets. This raises questions about what constitutes appropriate regulation and management of traffic volumes and speeds in areas with significant pedestrian activity. Assessment of risks in the built environment falls within the ambit of town planning as much as road safety policy. Political and cultural assumptions impinge on such assessments. Many current built environments give priority to vehicle movement rather than pedestrian movement or safety.

Table 12 Deaths of pedestrians aged 0–14 in road traffic crashes, Australia, 2001–07: age groups by vehicle involved, circumstances and major factors

Vehicle that hit pedestrian		Number of deaths	Per cent
0–4 years	Car	17	37.0
	Goods or trade vehicle	14	30.4
	Truck > 4.5 tonnes gvm ^(a)	5	10.9
	Unknown vehicle	10	21.7
	Total	46	100.0
5–14 years	Car	47	50.5
	Goods or trade vehicle	25	26.9
	Truck > 4.5 tonnes gvm	9	9.7
	Other vehicle	4	4.3
	Unknown vehicle	8	8.6
	Total	93	100.0
Circumstances of collision			
0–4 years	Child walked onto road in path of oncoming vehicle	26	56.5
	Other ^(b)	2	4.3
	Unknown	18	39.1
	Total	46	100.0
5–14 years	Child walked onto road in path of oncoming vehicle	66	71.0
	Other ^(b)	6	6.5
	Unknown	21	22.6
	Total	93	100.0
Major factor			
0–4 years	Child failed to see vehicle or did not adequately judge the speed or distance of the oncoming vehicle ^(c)	24	52.2
	Driver error ^(d)	6	13.0
	Unknown	16	34.8
	Total	46	100.0
5–14 years	Child failed to see vehicle or did not adequately judge the speed or distance of the oncoming vehicle ^(c)	55	59.1
	Driver error ^(d)	15	16.1
	Unknown	23	24.7
	Total	93	100.0

(a) Gross vehicle mass (gvm) is tare weight (i.e. unladen weight) of the motor vehicle, plus its maximum carrying capacity excluding trailers.

(b) Other^(b) circumstances include a range of situations observed, with each of these being relatively infrequent. Circumstances are described here based on observations of both vehicle and pedestrian movements. Such movements at the time of a collision are described as 'crash events' or 'accident types' and classified in terms of diagrams contained in Australian Road Research Board 1994, Model guideline for road accident data and accident types, Technical Manual ATM No. 29, Version 2.1, pp. 18–19.

(c) Includes, for example, children who were inattentive, playing or otherwise distracted.

(d) Includes, for example, drivers who were drunk or speeding, inattentive drivers or drivers who ignored traffic signs.

Source: BITRE, using data from the national Fatal Road Crash Database.

Deaths beyond the home—non-traffic

Over 14 per cent (n=29) of child pedestrians killed beyond the home in 2001–10 were killed in non-traffic locations other than the home (Table 9), mainly by four-wheeled motor vehicles (Table 13—note that this table includes the 66 cases around the home). This is possibly an underestimate (see the notes in the 'Data sources' section on the National Coronial Information System). The location of the non-traffic deaths beyond the home included car parks (parking lots) and roads in places such as schools, universities, hospitals, prisons, factory premises, military camps and so on where vehicle access is often restricted to specified members of the public and where we would expect vehicles to be travelling at relatively low speeds and performing low-speed manoeuvres. Detailed study of coroners' records and police reports would be required to examine these cases in more detail and such work was not undertaken for this study.

Table 13 Pedestrians aged 0–14 years fatally injured due to a land transport accident in all non-traffic locations, Australia, 2001–10: counterpart vehicle in collision by sex of child

Pedestrian injured in collision with:	Male	Female	Persons
Light transport vehicle with four or more wheels	24	21	45
Heavy transport vehicle	n.p.	n.p.	6
Special industrial, agricultural or construction vehicle	n.p.	n.p.	6
Special all-terrain or off-road vehicle	15	7	22
Other specified vehicle	10	6	16
Total	57	38	95

Notes:

1. 'Counterpart' is what hit or collided with the child.
2. 'Other specified vehicle' includes motorcycles, railway vehicles and other land transport vehicles.
3. The 0–4 and 5–14 age groups have been aggregated to suppress small cell counts and preserve confidentiality (suppression is indicated by 'n.p.').
4. This table includes 66 deaths that occurred around the home.

Source: BITRE, using data from the National Coronial Information System.

Serious injury beyond the home

In all locations beyond the home, traffic and non-traffic, 4 440 pedestrians aged 0–14 years were seriously injured in Australia in 2002–03 to 2009–10 in a range of motor vehicle accident types, presumably including instances of low-speed vehicle run-over (Table 14).

Table 14 Pedestrians aged 0–14 years seriously injured in land transport accidents, Australia, 2002–03 to 2009–10: location of accident by age group

Location of accident	0–4 years	5–14 years	0–14 years
Driveway to home	368	171	539
Other and unspecified place in home	143	94	237
Street or highway	613	2 568	3 181
Farm	14	35	49
School	9	34	43
Other specified place of occurrence	99	233	332
Unspecified place of occurrence	289	546	835
Total seriously injured	1 535	3 681	5 216

Notes:

1. 'Other specified place of occurrence' includes, but is not limited to, parking lots, sports and athletics areas and the countryside.
2. Table 15 shows that the vehicle involved was most commonly a four-wheeled motor vehicle.
3. The location categories are mutually exclusive: the farmhouse on a farm is included under 'home', the footpath and street outside a home are included under 'street or highway'. 'Street or highway' in the hospital coding includes both roadways and pedestrian or cycling areas alongside roads.

Source: BITRE, using data from the National Hospital Morbidity Database.

Actual vehicle speed at the time of a serious collision with a pedestrian is never known from national-level hospital records of serious injury. Speed limit and details of vehicle movements are not available either, leaving the circumstances of serious injury of child pedestrians largely unknown. Nonetheless, an overview of child pedestrian serious injury during the study period can be obtained from national hospital data.

Both on-road and off-road (including around the home), pedestrians aged 0–14 years seriously injured in collisions with vehicles were most frequently (82.6 per cent of on-road cases and 48.1 per cent of off-road cases) hit by a car, pick-up truck or van (Table 15).

Table 15 Pedestrians aged 0–14 years seriously injured due to a land transport accident, Australia, 2002–03 to 2009–10: counterpart by location of accident and sex

Pedestrian injured in collision with:	In traffic locations			In non-traffic locations		
	Male	Female	Persons	Male	Female	Persons
Pedestrian conveyance	n.p.	n.p.	n.p.	63	17	80
Pedal cycle	68	37	105	146	64	210
Two- or three-wheeled motor vehicle	57	44	101	75	19	94
Car, pick-up truck or van	1 951	1 096	3 047	467	268	735
Heavy transport vehicle or bus	59	29	88	**	**	**
Railway train or railway vehicle	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
Other non-motor vehicle	12	9	21	17	21	38
Other and unspecified transport accidents	200	107	307	230	119	349
Total	2 358	1 330	3 688	1 014	514	1 528

Notes:

1. Small cell counts have been suppressed and this is indicated by 'n.p.' or 'not published'. ** means number suppressed to prevent calculation of small cell counts (it can be a large number).
2. The traffic cases include 482 cases (309 males and 173 females) where it was unspecified whether the collision occurred in traffic or non-traffic. These cases have been included as traffic using the ICD-10 definition (c) (Volume 1, p.1019) which states that 'A vehicle accident is assumed to have occurred on the public highway unless another place is specified.....'.
3. 'Car' here means a four-wheeled motor vehicle designed primarily for carrying up to 10 persons. 'Pick-up truck or van' means a four- or six-wheeled motor vehicle designed primarily for carrying property, weighing less than the local limit for classification as a heavy goods vehicle, and not requiring a special driver's licence.
4. 'Pedestrian conveyance' means someone on a skateboard, push cart, roller skates and so on.
5. 'Counterpart' is what hit or collided with the child.

Source: BITRE, using data from the National Hospital Morbidity Database.

Off-road collisions between pedestrians aged 0–14 years and four-wheeled motor vehicles (including cars, pick-up trucks, vans, heavy transport vehicles and buses) that resulted in serious injury to the child tended to be around the home (64.1 per cent of cases), with more male than female cases reported and more 0–4 year olds seriously injured around the home than 5–14 year olds (Table 16).

Off-road serious injury rates worsen with increasing remoteness (Table 17).

Table 16 Pedestrians aged 0–14 years seriously injured in non-traffic contexts due to a collision with a four-wheeled motor vehicle, Australia, 2002–03 to 2009–10: place of occurrence of accident by vehicle type, age of child and sex

Place of occurrence of accident	Child hit by car, pick-up truck or van				Child hit by heavy transport vehicle or bus				
	0–4 years		5–14 years		0–4 years		5–14 years		0–14 years
	Male	Female	Male	Female	Male	Female	Male	Female	Total
Driveway to home	158	95	63	57	n.p.	0	n.p.	n.p.	380
Other and unspecified place in home	50	26	23	n.p.	n.p.	0	0	0	103
Street or highway — roadway	6	5	15	10	0	n.p.	n.p.	0	38
Street or highway — unspecified	n.p.	n.p.	6	n.p.	0	0	0	0	17
Farm	n.p.	n.p.	11	5	n.p.	0	n.p.	n.p.	24
Parking lot	17	8	18	7	0	n.p.	0	0	51
Other specified place of occurrence	16	8	23	12	n.p.	n.p.	n.p.	n.p.	63
Unspecified place of occurrence	26	12	26	13	0	0	n.p.	0	78
Total	282	157	185	111	n.p.	n.p.	9	n.p.	754

Notes:

1. Small cell counts have been suppressed and this is indicated by 'n.p.' or 'not published'.
2. Collisions with heavy transport vehicles or buses were infrequent but are included here for completeness.
3. This table is restricted to cases coded as non-traffic. The cases where place was recorded as 'Street or highway' may have occurred on private access roads or at places where on-road vs off-road status was ambiguous.

Source: BITRE, using data from the National Hospital Morbidity Database.

Table 17 Pedestrians aged 0–14 years seriously injured in non-traffic contexts due to a collision with a four-wheeled motor vehicle, Australia, 2002–03 to 2009–10: place of occurrence of accident by age of child and remoteness area of residence of child

Place of occurrence of accident	0–4 years					5–14 years					0–14 years
	Major cities	Inner regional	Outer regional	Remote	Very remote	Major cities	Inner regional	Outer regional	Remote	Very remote	
Driveway to home	153	54	35	6	7	61	50	10	n.p.	n.p.	380
Other and unspecified place in home	40	14	19	n.p.	n.p.	13	8	n.p.	0	n.p.	103
Street or highway — roadway	n.p.	n.p.	n.p.	0	n.p.	19	5	n.p.	n.p.	0	37
Street or highway — unspecified	n.p.	n.p.	0	0	0	5	n.p.	n.p.	0	n.p.	17
Farm	0	0	n.p.	n.p.	n.p.	n.p.	7	6	n.p.	n.p.	24
Parking lot	20	n.p.	n.p.	n.p.	0	19	n.p.	n.p.	n.p.	0	50
Other specified place of occurrence	18	n.p.	n.p.	0	n.p.	20	10	5	n.p.	0	63
Unspecified place of occurrence	19	11	5	n.p.	n.p.	20	7	12	n.p.	0	78
Total	258	90	68	12	16	159	91	41	10	7	752
Serious injury rate per 100 000 population per year	3.5	4.4	6.4	6.0	12.8	1.1	1.9	1.8	2.6	3.1	2.3

Notes:

1. Small cell counts have been suppressed and this is indicated by 'n.p.' or 'not published'.
2. The remoteness areas were specified according to the ABS Australian Standard Geographical Classification (ASGC—see the 'Data sources' section of this paper). Rate for each age group is the number of seriously injured over the eight years divided by the sum of the population of the age group in each remoteness area in each of the years 2003 to 2010 multiplied by 100 000.
3. Row totals do not match those in Table 16 above because remoteness zone was unknown for two cases.
4. This table is restricted to cases coded as non-traffic. The cases where place was recorded as 'Street or highway' may have occurred on private access roads or at places where on-road vs off-road status was ambiguous.

Source: BITRE, using data from the National Hospital Morbidity Database and ABS population data.

5 Further research and monitoring

There are two interconnected issues that stand out as areas for further research: child pedestrian safety in built-up areas and child pedestrian safety around the home. In terms of the built environment, housing and neighbourhood designs are inseparable. For example, driveways are needed because contemporary neighbourhood design tries to keep parked cars off the street. Of course, the topic is much broader than that, and it is beyond the scope of this paper to explore it further, but factors in the built environment are clearly an area that warrants further research.

Vehicle run-overs of children in low-speed locations or circumstances are a subset of a wider problem of child pedestrian injury due to motor vehicles. Existing data sources are able to provide an overview, as indicated in Table 18.

Table 18 Monitoring child pedestrian injury

	Deaths	Serious injury
Traffic	<p>The Australian Road Deaths Database held by the BITRE provides some key variables: age, sex, state, date and time, speed limit at the collision site etc. Relevant data from this database are published annually by the BITRE.</p> <p>A National Road Crash Database being developed by the BITRE will provide some more details on the circumstances of both death and serious injury.</p> <p>More detailed study can be undertaken using the National Coronial Information System, although this can take several months or a year or two depending on the scope of the study and the granting of approval by the relevant ethics committees.</p>	<p>The National Hospital Morbidity Database held by the AIHW provides some variables: age, sex, location of collision, what vehicle hit the person etc. Relevant data are currently published annually in the AIHW land transport serious injury report series.</p> <p>A National Road Crash Database being developed by the BITRE will provide some more details on the circumstances of both death and serious injury.</p>
Non-traffic	<p>The Causes of Death data collection held by the ABS provides some variables: age, sex, location of collision, what vehicle hit the person etc. A specific request has to be made to the ABS to obtain the relevant level of detail.</p> <p>More detailed study can be undertaken using the National Coronial Information System, although this can take several months or a year or two depending on the scope of the study and the granting of approval by the relevant ethics committees.</p>	<p>The National Hospital Morbidity Database held by the AIHW provides some variables: age, sex, location of collision, what vehicle hit the person etc. Relevant data are currently published annually in the AIHW land transport serious injury report series.</p> <p>No other national sources are available for more detailed studies.</p>

Source: BITRE.

6 Data Sources

Responsibility for the interpretation of tables provided by sources external to the BITRE rests solely with the BITRE. Some of the providers of data used in this report requested that small cell counts in tables be suppressed to preserve the confidentiality of persons killed or injured and this request has been respected in this report. Also, the scope of data from some sources includes both rail and road transport accidents and such data have been presented under the heading 'land transport accidents' as opposed to just 'road transport accidents'.

It is important to note that all the national databases used in this report are compiled from information provided by the states and territories and often represent a subset of the information held in state and territory databases. More detailed findings than those presented here may be found in research conducted at the state level. Also, data were correct at the time of compilation of the report but are preliminary and may be subject to change as further information is received by the state data providers.

The Australian Road Deaths Database contains information on all persons killed in road crashes in Australia but covers public roads only. It is available at <www.bitre.gov.au>.

The National Coronial Information System (NCIS) is a national internet based data storage and retrieval system for Australian coronial cases. Information about every death reported to an Australian coroner since July 2000 (January 2001 for Queensland) is stored within the system. Further information regarding content and access is available at <www.ncis.org.au>. The BITRE is grateful to the NCIS team for providing information from the NCIS for this report. The NCIS team provided the following reasons for potential underreporting of relevant cases:

- Coded fields are generally not completed until the closure of a case, and the extent of information contained in the attached text reports may vary.
- Since only cases that were closed on the NCIS following a coronial investigation were included in this dataset, there may be cases of relevance still under coronial investigation that are not included in this report.
- The possibility exists that specific codes of importance (such as context (traffic or non-traffic) or location type (home, transport area etc)) may have been miscoded during data entry. In order to minimise the impact of this limitation, the circumstances surrounding all transport injury events involving a pedestrian within the specified age and date ranges were manually reviewed.
- Lack of availability or detail provided in attached documentation on the NCIS may have precluded the identification of all transport incidents around the home. To obtain missing information, requests would have to be made to the coroners' offices concerned and more detailed study undertaken. Sometimes, in any case, information on the files in coroners' offices does not contain the level of detail required for research on this topic.

The national Fatal Road Crash Database (FRCD) contains information on all fatal road crashes on public roads in Australia. It is produced by further coding of relevant cases in the NCIS. The BITRE is grateful to the NCIS team for permission to use the FRCD for this report. The FRCD is available on application and payment of a fee; see <www.ncis.org.au> for contact details.

The National Hospital Morbidity Database (NHMD) contains information on all persons admitted to hospitals in Australia and is compiled on a financial year basis. It is maintained by the Australian Institute of Health and Welfare (AIHW) and some of the information from the database is publicly available (see <www.aihw.gov.au>). Comparable data relevant to this report were available for the eight years 2002–03 to 2009–10 only.

The BITRE is grateful to the AIHW National Injury Surveillance Unit at the Research Centre for Injury Studies, Flinders University (see <www.nisu.flinders.edu.au>), for providing information from the NHMD on behalf of the AIHW. The BITRE collaborates with the AIHW under a memorandum of understanding and funding agreement which enables work such as this to be undertaken.

'Seriously injured' was defined for this report as an injury which results in the person being admitted to hospital and subsequently discharged alive either on the same day or after one or more nights stay in a hospital bed (i.e. deaths are excluded). As discharge from hospital can include transfer to home, to another acute care hospital and to another form of care (e.g. rehabilitation), a method has been used in this report to reduce over-counting of injury cases by omitting separations in which the mode of admission is recorded as being by transfer from another acute-care hospital, on the grounds that such cases are likely to result in two or more separation records for the same injury.

Records that met the following criteria are included in the serious injury tables:

- Australian hospital separations occurring 1 July 2002 to 30 June 2010, coded according to the third to sixth editions of ICD-10-AM (NCCH 2002, NCCH 2004, NCCH 2006, NCCH 2008).
- Principal Diagnosis in the ICD-10-AM range S00–T98 using Chapter XIX 'Injury, poisoning and certain other consequences of external causes' codes.
- Age of person at time of admission was 0–14 years inclusive.
- Mode of admission had any value except the one indicating that transfer from another acute-care hospital had occurred.
- Mode of separation had any value except the one indicating that the person died while in hospital.

Hospital cases were defined as being due to a land transport accident if they contained a first reported ICD-10-AM external cause code in the range V00–V89. Cases with a principal diagnosis other than injury and cases in which land transportation only appears as an additional external cause code were excluded on the grounds that injury due to a land transport accident was not recorded as being the main reason for admission to hospital.

Hospital cases were defined as non-traffic if they met the definition of a land transport case and where the fourth character of their first reported ICD-10-AM external cause code indicated that the person was injured in a non-traffic accident. For the tables here, this definition only applied to the ICD-10-AM code range V00–V09.

Remoteness area in the serious injury tables in this report refers to the place of usual residence of the person who was admitted to hospital. The remoteness areas were specified according to the ABS Australian Standard Geographical Classification (ASGC—Cat. No. 1216.0). According to this classification, remoteness is an index applicable to any point in Australia, based on road distance from urban centres of five sizes. The ABS has provided tables that specify the proportion of the population of each Statistical Local Area (SLA) in Australia whose place of residence is in each of five segments of the remoteness index. These segments are:

- Major cities, with ARIA index value of 0 to 0.2
- Inner regional, with ARIA index value of >0.2 and ≤2.4
- Outer regional, with ARIA index value of >2.4 and ≤5.92
- Remote, with ARIA index value of >5.92 and ≤10.53
- Very remote, with average ARIA index value of >10.53.

These tables were used to assign records to the five areas, on the basis of the SLA of usual residence of the person.

Most SLAs lie entirely within one of the five areas. If this were so for all SLAs, then each record could simply be assigned to the area in which its SLA lies. However, some SLAs overlap two or more of the areas. Records with these SLAs were assigned to remoteness areas in proportion to the area-specific distribution of the resident population of the SLA according to census data. For hospitalisations, each record in the set having a particular SLA code was assigned to one or other of the areas probabilistically, in proportion to the resident population of that SLA. The resulting values are integers.

The hospital datasets used for this report do not contain geographic information on the crash location and it is therefore not possible to determine with certainty if the crash occurred in the remoteness area of usual residence of the person injured. Remoteness area of residence is nonetheless a useful classification in itself and an indicator of crash location if it can be assumed that most crashes in which people are seriously injured occur in the vicinity of where they live. In any case, where the place of occurrence of the accident is around the home, remoteness area of usual residence of the person injured is likely to be an accurate indicator of the geographic location of the accident.

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