Analysis of the causes of fatal child pedestrian crashes for 0- to 14-year-olds in Australia, 2001 to 2019

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This report is one section of a larger project: Improving strategies for prevention of serious road traffic injury involving children through enhanced analysis of the causes of crashes funded by the National Road Safety Innovation Fund.

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Executive summary and Recommendations for action

In Australia, land transport crashes are a leading cause of fatalities for children aged up to 14 years and pedestrian crashes account for nearly one-third of them. This study investigated the trends, causes and factors that lead to vehicle-related trauma in children, and aimed to use this analysis to develop broader recommendations for strategies to reduce child pedestrian fatalities.

A dataset was created for this analysis from electronic records held by the National Coronial Information System (NCIS), which is currently the richest source of information about sudden, unexpected, or unexplained deaths, including child pedestrian fatalities. The NCIS contains demographic information about the deceased and contextual information about the fatality as well as case reports including the coronial finding, autopsy and toxicology report, and police notification of death. Records from 2001 to 2019 inclusive and from all Australian jurisdictions were searched using search terms: blunt force and transport injury event as Mechanism of injury, pedestrian as vehicle Mode and 0 to 14 years (inclusive) as age range. This yielded a total of 495 cases which, when reviewed for applicability of search terms, missing data and errors, found a total of 439 child pedestrian fatalities occurred in Australia over the study period. For around one in 10 cases (9.3%) there was too little information in the coroner's files about the circumstances of these crashes so the final study included 398 cases. A coding system was developed for this exercise that included as much information as was available about the child and the driver involved, and the broader circumstances of the crash. All reports for each case were read by a member of the research team and the extracted information was entered in de-identified form into a new secure project database by coding and classifying the extracted data. The coding system included details of the events leading most immediately to the fatal crash as well as any pre-existing factors that contributed to the fatal crash. The resulting data analysis was divided into three main sections: overall analysis of the characteristics of fatal pedestrian crashes for children aged 0 to 14 years (inclusive), analysis of the circumstances of crashes involving younger children aged 0 to 10 years of age, separately for road and driveway fatalities and analysis of the circumstances of roadway crashes for older child pedestrians, aged 11 to 14 years of age.

The analysis of patterns of cases over the 19-year study period support the contention that child pedestrian fatalities are a continuing problem. Despite an initial reduction in the numbers of child pedestrian fatalities between 2001 and 2007, there is little evidence of change since then. Most fatalities occur on roads or in driveways, although there is a strong relationship with age. Roadway pedestrian fatalities mainly involve children aged 2 to 14 years, while driveway fatalities almost exclusively involve very young children aged 1 to 3 years. While road pedestrian fatalities involving children have decreased over the study period, driveway fatalities have not, and they now vie with road fatalities as the most common. Males are highly represented in child pedestrian fatalities but not for the youngest ages (1 to 3 years of age) or the oldest in this study (13 to 14 years of age) where gender representation is more equal.

Overall, the analysis of the circumstances and causes of child pedestrian fatalities identified common patterns. These varied to some extent by age of the child and/or location of the crash, but a summary of the immediate causal pathway and the most common contributing factors is shown in Figure 1. All pedestrian fatalities involved actions of each of two parties: the child and the driver. These actions are linked in time where the action of the child leads them to a vulnerable location close to and often into the path of the driver. Child actions include wandering or positioning themselves close to a road or vehicle, usually stationary in driveway incidents, or attempting to cross the road, in some cases to meet up with or follow a person they know.

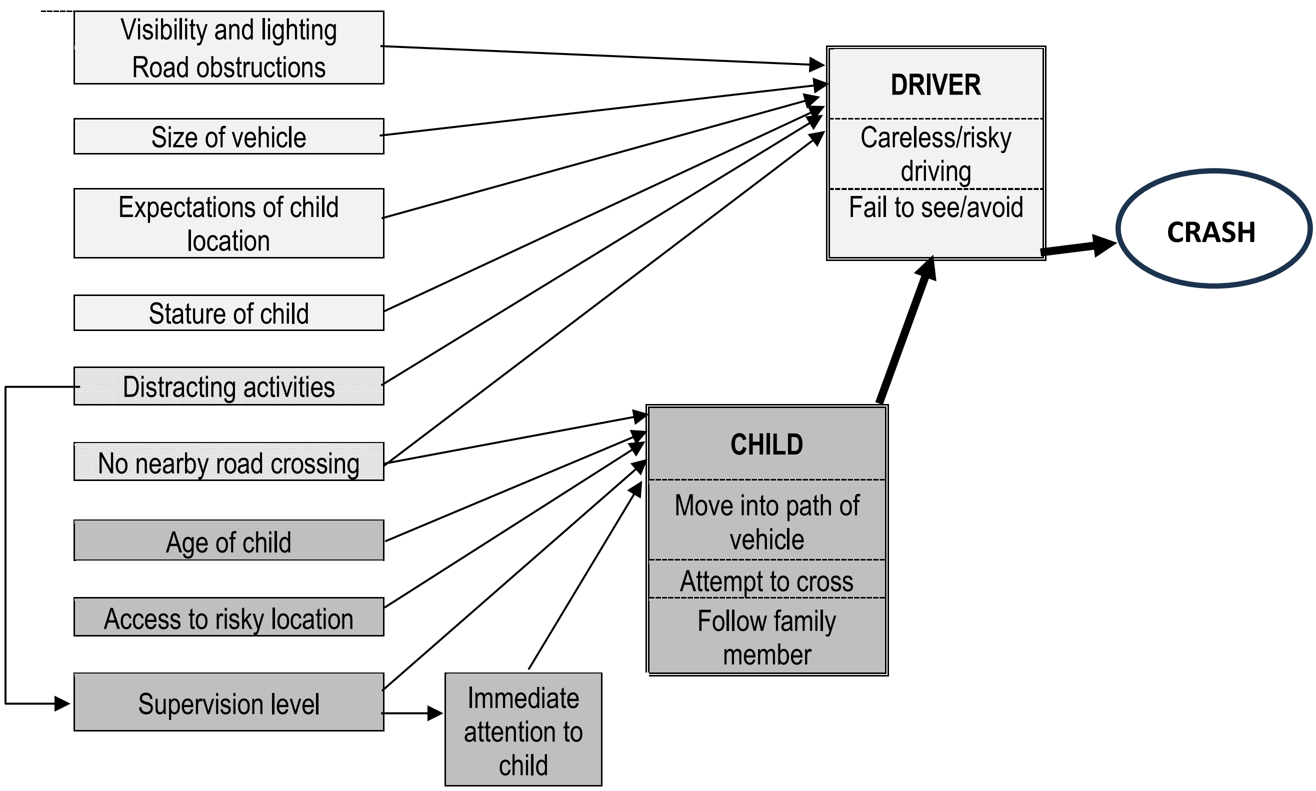

Figure 1: Summary of the contributing factors and immediate causes of child pedestrian fatalities.

The driver actions include how they responded to the presence of the vulnerable child: no response if the driver fails to see the child or where they see the child but are unable to act in time to avoid the crash, which is more likely if the driver is also driving carelessly or in a risky manner. Factors that increase the likelihood of the driver failing to see or respond in time include problems with visibility and lighting including twilight or sunset, obstructions to visibility within the road environment such as parked cars that occlude vision of a short stature child, and larger vehicles that provide poorer vision of the road around the driver. In addition, factors that influence a driver's expectations of child pedestrians in the location also play a role in many crashes. This includes hard evidence that child pedestrians may be around such as the presence of road crossings and driver beliefs, trust or acceptance that the child is elsewhere, which can influence whether or not the driver is aware and on guard for the possibility of child pedestrians. Lastly, distracting activities can influence driver actions either *within* the vehicle, such as vehicle screen controls, or mobile phones, or *outside* the vehicle such as traffic movements or a party at the residence in the case of driveway crashes.

Factors that increase the likelihood of the child being in a vulnerable location near a road or vehicle include their age, whether they have access to the location and whether and how they are being supervised. Younger children are more likely to move or follow someone into the path of a vehicle, and older children are more likely to be attempting to cross the road. In driveway fatalities especially, allowing access to the driveway area not surprisingly increases the likelihood that the child will do so, but in road crashes home security issues like lack of door locks played a role in facilitating the child's access to the roadway area. In addition, lack of a designated crossing meant the child was attempting to cross in a location where they were most vulnerable and where drivers do not expect to see them.

Supervision-related factors play a major role in driveway crashes and in roadway crashes involving younger children. Indirect or ambiguous supervision allows the child to move independently into areas near vehicles. The study showed a statistically significant relationship between age of the child and supervision in roadway crashes, where the children who were unsupervised in crashes were more likely to be older and those supervised with physical contact were the youngest. It is notable, however, that the children being indirectly or ambiguously supervised were mostly the youngest, indicating that problems with supervision is a contributing factor to young children being able to access a risky location near roads and vehicles. Children aged 11 to 14 years who were involved in crashes were mostly not supervised, as might be expected which means that these children were acting independently around the roadway and that these crashes occurred for a combination of the other factors shown in Figure 1. Whether supervision might have prevented pedestrian fatalities for these older children is arguable as children and parents/carers are working towards developing independence through these ages. Nevertheless, it is important for parents/carers and drivers to be aware that the generally smaller size and immaturity of many, especially younger children during this period make them vulnerable in road traffic settings and for drivers to be aware that factors like visibility of children in the road environment and from their large vehicles increase their risk of colliding with a child pedestrian.

Recommendations for action

Evidence from this study points to several recommendations for action to prevent child pedestrian fatalities. These include:

1. Driveway child pedestrian fatalities:

    1.1. We need to review strategies to reduce child pedestrian fatalities in driveways. In Australia, a report appears around every decade (e.g., Neeman et al., 2002; BITRE, 2012) calling for action to reduce child deaths in driveways, yet evidence from this study shows no reductions in child driveway fatalities over this period. It is time to respond to the findings of the current and previous studies and implement better strategies to reduce or eliminate these tragic outcomes.

2. Roadway child pedestrian fatalities

   2.1. Improvements in road design, including signage, marking and lighting, as well as traffic calming to reduce speeds are needed in areas where child pedestrians are likely to be (e.g., daycare centres, schools, playgrounds, shopping centres). These include ensuring that in these areas, access between entry/exit locations and the road is protected by strategically placed barriers, improving the visibility of children for drivers (e.g., removing parked cars and other visual obstacles) and ensuring that designated pedestrian crossings are also strategically placed.
   2.2. Improvements are needed in vehicle design to improve all around visibility of small stature children from vehicles, especially larger vehicles. Where vision-based or sensor technologies are used to improve or stand in place of clear vision from vehicles, they must be able to demonstrate all-around functionality and the driver must be aware of its strengths and limitations.
   2.3. We need to help drivers to be more aware of the risk of child pedestrian fatalities through more community education and communication campaigns that explain how driver behaviour plays a role in keeping child pedestrians safe.
   2.4. We need to increase awareness of parents and carers of children about their primary role in keeping children safe around vehicles and roads. This includes the importance of active attention and direct supervision of the child and keeping physical contact with younger children when they are around roadways. Awareness campaigns for parents need to be a regular feature of the road safety programme as the group of parents with young children is continually changing with their children growing up and new children being added to the vulnerable population.

3. Data collections for understanding the causes of child pedestrian fatalities.

   3.1. Efforts should be made to improve the quality of data available through the National Coronial Information System for use in analysis of the causes of fatal crashes. This includes developing systems that assist Police to collect as much information as is feasible about the circumstances and causes of the crash sites, providing sufficient resources to the NCIS to ensure that all available information about a case is included in the case records and encouraging and resourcing Coroners to seek out and review more information about the circumstances of child pedestrian fatalities in order to advocate for the strategic changes needed to reduce these tragic occurrences.

Introduction

Globally, road traffic crashes are a leading cause of death and serious injury in children from high and middle-income countries and contribute to a significant proportion of injury for children in lower-income countries. The WHO estimates that across the world, a child is killed on roads around every four minutes (WHO, 2015). No matter where these traumatic events occur, they cause immeasurable pain, suffering and grief for families and friends and for the driver involved in the crash. In lower income countries, the loss of a child can also cause economic hardship for families. Crashes involving children are tragedies that present a significant burden on society, in general, so there is a strong rationale to prevent them.

In Australia, land transport crashes are the leading cause of death for children between the ages of 1 and 14 years (AIHW, 2021). Most deaths of children in land transport crashes in Australia (59%) occur when they are passengers, or bystanders to the crash, but a significant percentage (29%) occur when children are pedestrians and so may play an active role in the crash (AIHW, 2020).

This project forms the major data analysis component of a project funded by a grant awarded to the non-for-profit Little Blue Dinosaur Foundation Limited (LBDF) as part of the Commonwealth Road Safety Innovation Fund. The Little Blue Dinosaur Foundation contracted the Transport and Road Safety (TARS) Research Group from the Schools of Aviation and Mathematics & Statistics to undertake the work. The aim of this project is to conduct analysis to understand more about the trends, causes and factors that lead to road fatalities in children and then to use this analysis to direct the design of trial programs to reduce them.

This report contains analysis of the wider causes and circumstances of crashes between land vehicle crashes and child pedestrians resulting in the deaths of children up to and including the age of 14 years from the six states (New South Wales, Queensland, South Australia, Tasmania, Victoria, Western Australia and two territories (Australian Capital Territory and Northern Territory) of Australia for the period 2001 to 2019 inclusive. This analysis covers all pedestrian crashes in these jurisdictions focussing on causal patterns for all child pedestrian crashes. It looks at the causes of crashes occurring on roadways and driveway crashes, which are the two main locations of crashes in this age group and examines the characteristics of the most common causal sequences of these crashes.

Rationale for this project

Children are particularly vulnerable to being severely injured in road traffic crashes for various reasons. Younger children are limited by their physical, cognitive and social development, making them more vulnerable in road traffic than adults. Because of their small stature, it can be difficult for children to see surrounding traffic and for drivers and others to see them. In addition, when a child is involved in a road traffic crash, their softer heads make them more susceptible to serious head injury than adults (WHO, 2015).

Effective road safety programs aimed at preventing road trauma rely on good quality data on when, why and how road safety risk occurs. Analyses of the data on causes of road crash fatalities have provided the evidence on which national and jurisdictional road safety strategies have been based for many decades. These analyses have identified specific commonly occurring features to target interventions to improve road safety. On this basis, crashes are most commonly attributed to factors such as driver error, especially speeding, distraction, alcohol and fatigue; they occur on regional roads and involve single vehicles so it is concluded that the development of strategies to reduce fatal crashes should focus on these issues.

While this approach has been useful, it has limitations. Many countermeasures adopted rely on secondary solutions such as helmets, seatbelts, vehicle airbags and roadside barriers which help to limit the damage that occurs in a crash but do nothing for crash prevention. Most obviously, the data analysis on which road safety solutions are based only looks at single factors in crashes, yet as most road safety professionals are aware, crashes, like all types of accidents, are a result of a combination of factors. Only focussing on one specific factor means we are missing out on understanding why that factor occurred, which, in many cases, also means we may not be targeting the most important causal factor/s.

An enhanced data analysis methodology based on system safety ideas is needed to understand that road traffic crashes have multiple causes and occur due to combinations of factors. Such in-depth analysis approaches have not been used much in road safety although they have been effective in analysis of the causes of work-related settings (eg., Feyer and Williamson, 1997; Hobbs and Williamson, 2002). The objective of enhanced analysis is to develop a more detailed understanding of the common factors that increased the risk of road or workplace accidents and to use this knowledge to develop more specific targets for safety interventions. Using this approach to improve the analysis of road crash data increases the value of crash analysis for directing road safety strategy and interventions, in general, and it will expand our understanding of the causes of road traffic crashes involving young children.

This project focussed on the causes of road traffic crashes that resulted in the death of a child up to and including the age of 14 years. The analysis used the most comprehensive available data on Australian crashes involving land vehicles provided by the National Coronial Information System. In particular, the analysis examined the causes of crashes where a child was potentially actively involved as a pedestrian.

The analysis was directed towards a clear set of outcomes:

- To describe the range of factors that contributed to crashes involving children as pedestrians in more detail than previously available.
- To describe combinations of factors preceding different types of crashes beyond what is routinely available.
- To use these descriptions to look at the most common factors that cause particular types of crashes and at how these factors relate to one another.

This analysis will provide a more in-depth understanding of the factors that cause or set the scene for different types of crashes and establish whether there are factors common to many crash types. By doing so, Australia will be able to develop more informed targets for prevention of child pedestrian crashes.

Method

This section describes the methodology used in this study.

National Coronial Information System and identification of cases

The National Coronial Information System (NCIS) was selected as the most suitable electronic database for this study because it is designed to include a record for every death reported to a coronial office in Australia and New Zealand. While jurisdictions differ on the specific definition of a reportable death, they all include the general requirement that any unexpected, unnatural or violent death is reportable to the coroner. The role of the coroner is to investigate the circumstances and causes of such deaths. As such, coronial records should contain as much detail as is available about the circumstances of the death and may include police reports, autopsy and toxicology reports as well as the coroner's findings. This study included only closed cases that had been finalised by the coroner, as these contained the most information about causes of the death, although the level of detail varies considerably between cases. Access to NCIS records requires ethical approval from each jurisdiction and from the Victorian Justice Health Research Ethics Committee. For this study, approval and data access was obtained from Australian states and territories: Australian Capital Territory, Northern Territory, New South Wales, Queensland, South Australia, Tasmania, Victoria, and Western Australia.

For this study, a search was conducted of all closed NCIS cases for the period 2001 to 2019, inclusive, using the search terms:

- **Mechanism of Injury** = (**Blunt force**) AND (**Transport injury event**)
- **Vehicle Mode** = **Pedestrian**
- **Age range <= 14 years of age**.

The cases identified using these search terms were accessed by one member of the project team who had access to the NCIS website. Each case was read, and specific, relevant information was extracted from electronic coroner's files, then entered in a de-identified form into a new secure electronic database created for this project and held at UNSW. The NCIS data was transformed into the project database by coding and classifying the extracted data.

The extracted database contained the following information from the original NCIS files.

- Casualty (deceased person) and counterpart (other person involved) characteristics, which included age, sex and whether the casualty or counterpart was likely affected by alcohol, pharmaceutical or illicit drugs at the time of the crash (coronial reports).
- Road and environmental conditions, which included location (roadway, offroad, rural, urban), road/path type, road/path condition, weather condition and the type of natural light at the time of the crash.
- Vehicle and crash characteristics, including the type of vehicle(s) involved, design and usability characteristics of the vehicle involved in the crash, the type of crash, manoeuvre of the vehicle(s), the crash impact.
- Other contributing factors including from narrative reports in the police report and

coronial report. This information provided deeper causal and contributing factors to child fatality crashes. These reports were examined and additional information regarding the circumstances of death were coded by one coder (the Research Associate) using a specific coding system developed by this research team for this extracted database (described below). Check coding was conducted on a random sample of 34 cases by a separate coder (one of the CI's – AW).

Coding methodology

The coding system is designed to use narrative reports of each incident to code the events leading up to the crash and fatality in terms of their nature, their relative location in the event sequence and their relative causal importance in the accident sequence. The coding aims to include as much information as is available about the broadest range of factors in the road system that contributed to the causes of the crash.

The system acknowledges that the immediate causes of crashes involve a series of events usually occurring just before the crash, and that the likelihood of these events combining to cause the crash can be influenced by a wide range of pre-existing factors in the road system. In the specific case of child pedestrian crashes, the immediate events are likely to involve at least actions by the child, and by a driver in combination with any of a range of pre-existing factors like the characteristics of the location of the crash, of the vehicle involved in the crash or any other vehicles, of the child and the driver and the nature of the supervision of the child. To reflect this level of complexity, the coding system incorporates coding of up to three events immediately preceding the crash which led directly to the fatality, as well as coding of any further pre-existing factors that made a direct contribution to the fatal crash. These are titled **precursor events (PE)** and **contributing factors (CF),** respectively. For the purposes of coding, the time before the crash refers to the relative sequential order of events leading up to the fatality. The time separating the events could have varied from seconds to minutes to hours or perhaps even days. Not all crashes involve the full range of precursor and/or contributing factors.

The logical framework for the coding system (see Figure 1) involves the time course of the precursor events leading to an adverse event, in this case, a crash, reading from right to left in the figure as well as any other pre-existing factors thought to have contributed to the events. Precursor events leading to the crash were defined as discrete events which played a role in the occurrence of the crash and were linked to it in time. While time between the events is variable and may range from seconds to hours or even days, PE1 is always closest to the crash, PE2 occurs prior to PE1 in the temporal sequence and so on. The system also incorporates any other factors that play a causal role. These are called contributing factors and are defined as underlying factors, circumstances, actions or conditions that pre-existed before the precursor event sequence began. CF's will have played a part in the origin or development of the crash or to increased risk of it occurring.

Precursor event coding:

This framework allowed for up to three precursor events leading to the contact between the child and the vehicle, each of which can be coded in terms of:

- *Environmental event* - the characteristics of the location of the event at the time and place, including slippery section of road, sudden pothole.
- *Equipment event* - relating to breakage of some equipment such as brake failure on a vehicle.
- *Behavioural event* - relating to the behaviour of a person involved in the fatal crash, including the child or adult(s), e.g., running in front of a vehicle, driver failing to pay adequate attention to the road.

Contributing factors coding:

In addition, the framework included a wide range of factors that contributed to the fatal crash as follows:

- *Environmental factors* - Involvement of factors relating to the current environment, including weather, darkness, heavy vehicle.
- *Safety equipment or devices* - The role of safety equipment or devices such as doors and gates that prevent the child from crossing the path of a vehicle, road crossings and the use of car mirrors.
- *Type of vehicle* - nature of the vehicle involved including size and condition.
- *Supervision* - The nature of supervision of the child, which was broken up into the following:
    a) No supervision - the child was knowingly left alone by the carer for a period of time.
    b) Indirect supervision - the child's carer(s) were in relatively close vicinity to the child but was doing some other activity at the time.
    c) Multiple or ambiguous supervision – multiple carers were available, but no one had the specific responsibility for the child.
    d) Direct supervision - the carer was in direct supervision of the child at the time, i.e., standing next to the child.
    e) Direct supervision with physical contact – the carer was making physical contact with the child at the time, i.e., holding the child or the child’s hand.
- *Child location* – The location of the child when last under direct adult supervision, including:
    a) the child was inside a secure environment and away from the path of vehicles.
    b) the child was outside a secure environment and near the path of vehicles.
- *Driver awareness* – The driver’s awareness of the location of the child in the period just before the fatality, including:
    a) Driver definitely aware – the driver knew the location of the child and could have responded to prevent the fatal crash.

b) Driver might have been aware – the nature of the event meant that in the normal course of events the driver might have seen or been aware of the child (e.g., the child ran in front of the vehicle).
c) Driver definitely unaware - the driver could not have known the location of the child and so could not have responded to prevent the fatal crash.

- *Driver supervisor* - The relationship between the child and the driver in terms of the child's supervision:
    a) Driver was child's supervisor (e.g., parent, relative).
    b) Driver was not child's supervisor.

The relationships between contributing factors and types of events in causing the crash can be depicted on the following framework:

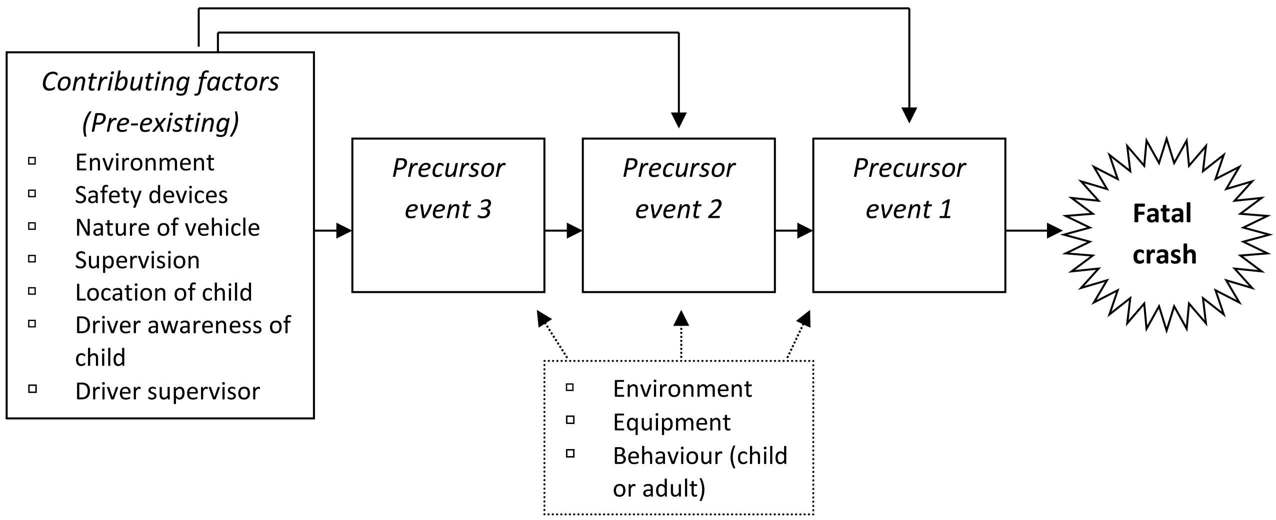

Figure 2: Framework for in-depth analysis of child pedestrian crashes.

Table 1: Example of application of coding framework

CF's		PE3		PE2		PE1		Crash
Range of pre-existing factors		*Event or activity that increases risk for child or of crash*		*Child moves into a vulnerable location near a vehicle or road*		*Driver fails to avoid vehicle contacting child (didn't see child/ brake in time or hard enough)*		*Vehicle hits child*

Data analysis

The overall aim of this analysis was to understand more about the major risk factors for fatality crashes involving a child as a pedestrian in order to identify whether and how these risk factors can be modified and/or removed. The analysis involved two main components.

1. Overall description of the characteristics of all children involved in these fatality crashes, analysis of the trends in fatal child-vehicle crashes involving 0- to 14-year-olds in Australia over the period 2001 to 2019.
2. Analysis of the causes of fatal child-vehicle crashes was conducted in two main sections. The first section looked at cases involving the youngest children, aged 0 to 10 years inclusive. This analysis was divided into cases occurring on roadways and in driveways as these were the most common locations of crashes involving the youngest children. The second section looked at cases involving older children, aged 11 to 14 years inclusive and, focussed only on road-related crashes as almost all of these cases occurred on the road.
3. In both sections and for each location of the crash, the analysis first identified the precursor events that led most directly to the crash and as well as any factors that contributed to the crash. The analysis then identified the most common causal sequences for each age group and crash location and looked at the relationships between events and factors with the purpose of uncovering the strategies and countermeasures most likely to prevent these fatalities. In summary, analysis for each section involved four steps:
   a) Analysis of the immediate causes of child pedestrian crashes for the age group and location through description of the precursor event sequence that led most directly to the crash in terms of whether the event involved: behaviour of other person, behaviour of the deceased child, environmental event, equipment event or medical event.
   b) Analysis of the contributing factors to the causal sequences for each crash in the age group/location where the contributing factors were coded into four main types: environment, equipment, medical, supervision. Supervision contributing factors were further classified into direct supervision with or without physical contact, indirect supervision, multiple or ambiguous supervision and whether the driver of the vehicle was also the child's supervisor.
   c) Identification of the most common causal event sequences for the age group and main locations of these crashes: on road, or in driveways or yards at a home where the road location was coded as: the area devoted to public travel within a surveyed road reserve and includes a footpath and cycle path inside the road reserve and a median strip or traffic island.
   d) Linking of contributing factors and precursor event patterns for crashes in each of the common causal sequences within each age group and location to determine whether and how their characteristics differ.

Reliability of coding

The reliability of coding was tested by a randomly chosen set of 34 cases independently coded by both the main coder and a second coder (AW). The agreement between the two coders was evaluated for the seven main coded variables including coding of PE1, PE2 and PE3 and of Contributing Factors: environment, equipment, medical and supervision factors. The results showed good consensus in coding for all variables. Cases where there was a discrepancy between coders were identified and were discussed between coders to achieve a consensus in the rules for coding for that variable. Where this occurred, the coding for that variable was checked in the remainder of the dataset and revised where necessary to ensure consistency of coding throughout the dataset.

Table 2: Summary of reliability of initial coding for each of the precursor events and contributing factors: environmental, equipment, medical and supervision showing percentage of cases with matching coding between coders.

	PE1	PE2	PE3	Contributing factors			
				Environment	Equipment	Medical	Supervision
% coding matched	85.3%	82.4%	79.4%	82.4%	82.4%	100.0%	79.4%

Quality of data from the NCIS

In any analyses of existing population data such as this study, it is important to be cognisant of the limitations of the data to ensure that when conclusions are drawn, they are based on valid foundations and any limitations are acknowledged. An analysis was conducted of the quality of the NCIS data included in this study and the results are summarised in Appendix B. In short, this analysis showed that the NCIS records are missing a considerable number of reports that should be available, but most cases contain at least a police report of the crash. It also shows that over the study period, the number of reports was increasing.

Results

A total of 495 cases were identified from the NCIS using the search terms relating to mechanism of injury, vehicle mode, child age range and year of crash. Examination of these cases resulted in 56 cases being excluded because they were duplicates or did not meet the search criteria (see Appendix A for details). This showed that a total of 439 pedestrian fatalities occurred for children up to the age of 14 years in Australia between 2001 and 2019. A further 41 cases had too little information to code causes and circumstances of the crash, leaving a total of 398 child pedestrian fatalities for the analysis. The first section of the results describes the overall demographic characteristics of the children involved in these crashes and at trends over the study period. The second part of the analysis looks separately at the characteristics of fatal child pedestrian crashes involving younger children aged 0 to 10 years then at older children aged 11 to 14 years.

Description of characteristics of fatal crashes involving children as pedestrians

Most crashes involved younger children (Figure 3), with one-quarter of fatalities involving 1 year old children and more than half were aged four years or under. From age six to 12 years, the percentage of cases remained lower, but increased again for 13- and 14-year-olds. Only a very small percentage of cases involved a child under the age of 1 year. Males accounted for approximately two-thirds of all cases (63.8%).

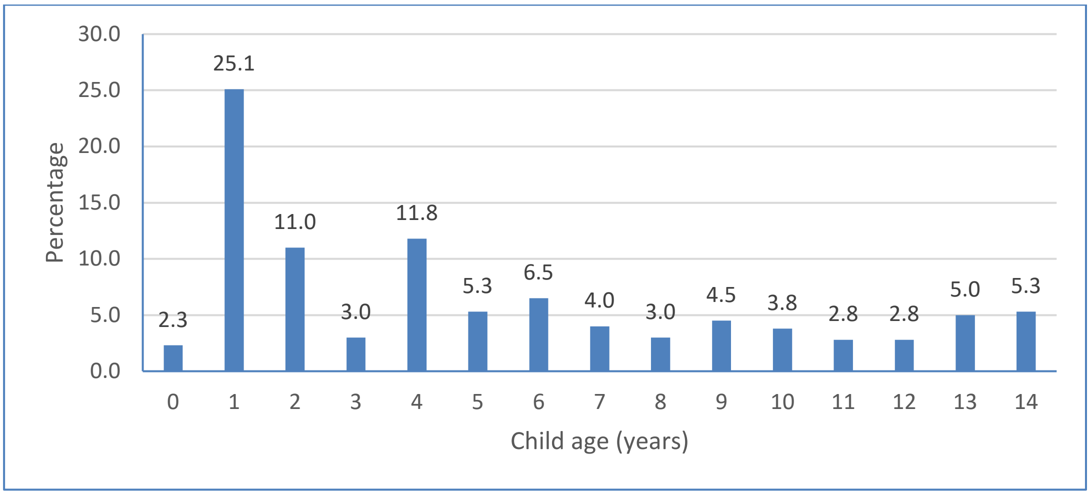

Figure 3: Age distribution of child pedestrian fatalities 0 to 14 years of age in Australia, 2001 to 2019.

As shown in Table 3, half of the pedestrian fatalities occurred on the road, followed by around one-third in driveway areas. A small percentage of cases involved a crash in a carpark or when the child was on a vehicle.

Table 3: Location of child pedestrian fatal crashes

Location	n (%)
Road	200 (50.3%)
Driveway	129 (32.4%)
Other	31 (7.8%)
On-vehicle	20 (5%)
Carpark	18 (4.5%)
Total	398 (100%)

Most child pedestrian fatalities involved a large vehicle (see Table 4), but this varied by location of the crash. Large vehicles, such as SUV's, were predominant especially in carpark and driveway crashes, whereas in roadway crashes, cars were also commonly involved. Crashes where the child was on a vehicle involved farm vehicles as well as large vehicles.

Table 4: Type of vehicle involved in child pedestrian fatal crashes for each location of the crash.

Vehicle type	Road		Driveway		On-vehicle		Carpark		Other	
	n	%	n	%	n	%	n	%	n	%
Large	70	35.0%	64	49.6%	9	45.0%	13	72.2%	9	30.0%
Car	49	24.5%	20	15.5%	2	10.0%	0	0.0%	5	16.7%
Truck	21	10.5%	11	8.5%	2	10.0%	1	5.6%	3	10.0%
Van	12	6.0%	4	3.1%	0	0.0%	2	11.1%	1	3.3%
Farm	1	0.5%	0	0.0%	6	30.0%	0	0.0%	6	20.0%
Bus	3	1.5%	0	0.0%	1	5.0%	0	0.0%	0	0.0%
Unknown	44	22.0%	30	23.3%	0	0.0%	2	11.1%	6	20.0%
Total	200	100.0%	129	100.00%	20	100.00%	18	100.0%	30	100.0%

The distribution of gender varies with age (Figure 4). Between ages 4 and 12, males account most pedestrian fatalities at each age. In contrast, for the youngest children (those aged three or under), both genders are equally likely to be involved. The same pattern is seen for the oldest children (13- to 14-year-olds). Comparatively few pedestrian fatalities involve children under 1 year of age, and most males.

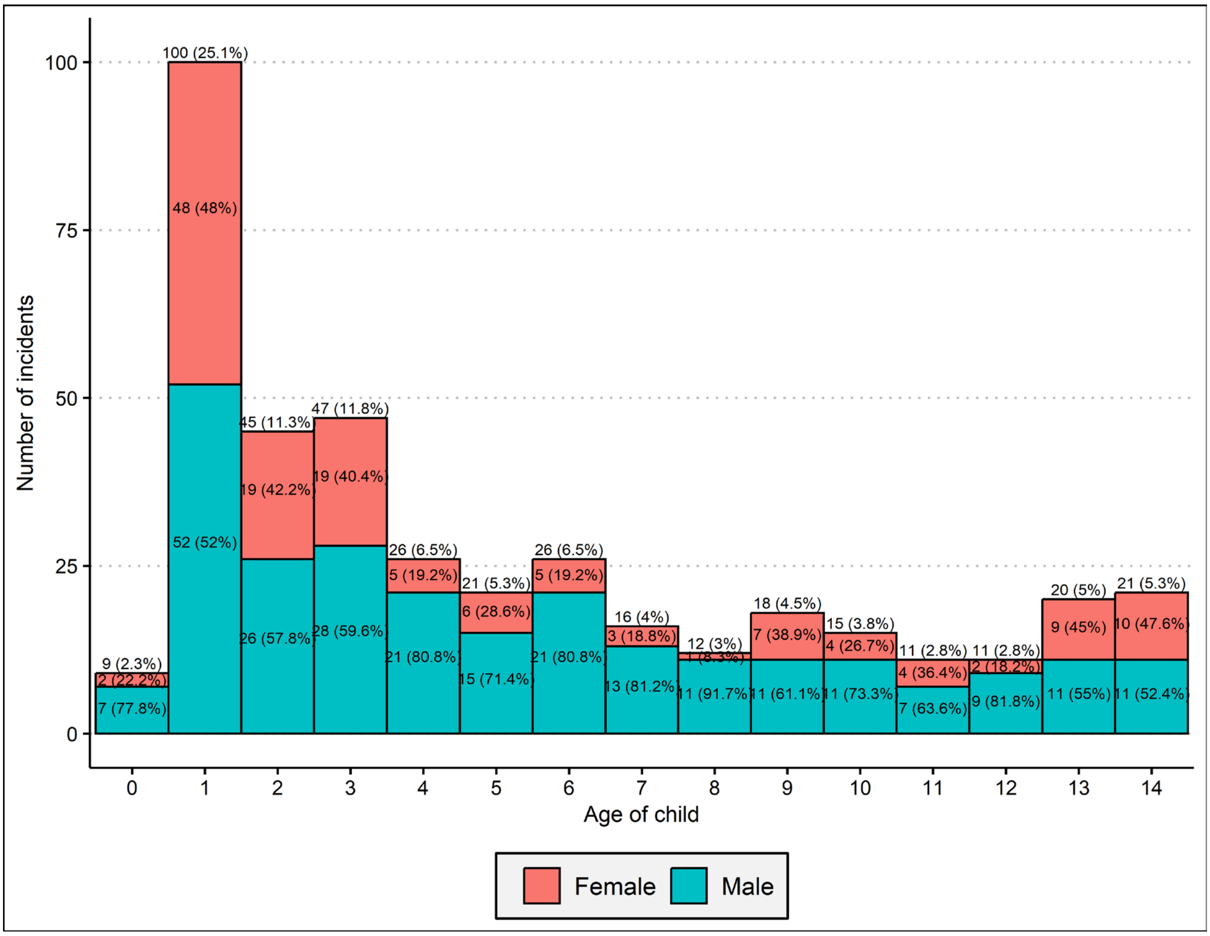

Figure 4: Frequency of pedestrian child-vehicle fatalities by age and gender (n=398)

There is a strong difference in the location of the crash for younger and older children (See Figure 5). Driveways are the location of the crash for more than three-quarters of 1 year olds and for around one-third of 2 and 3 year olds. For all older ages, the roadway was the location of the crash. Driveway fatalities had virtually disappeared after the age of three years. Other locations, including carpark and on-vehicle occurred at all ages, but especially for the youngest children (especially 2- to 6-year-olds).

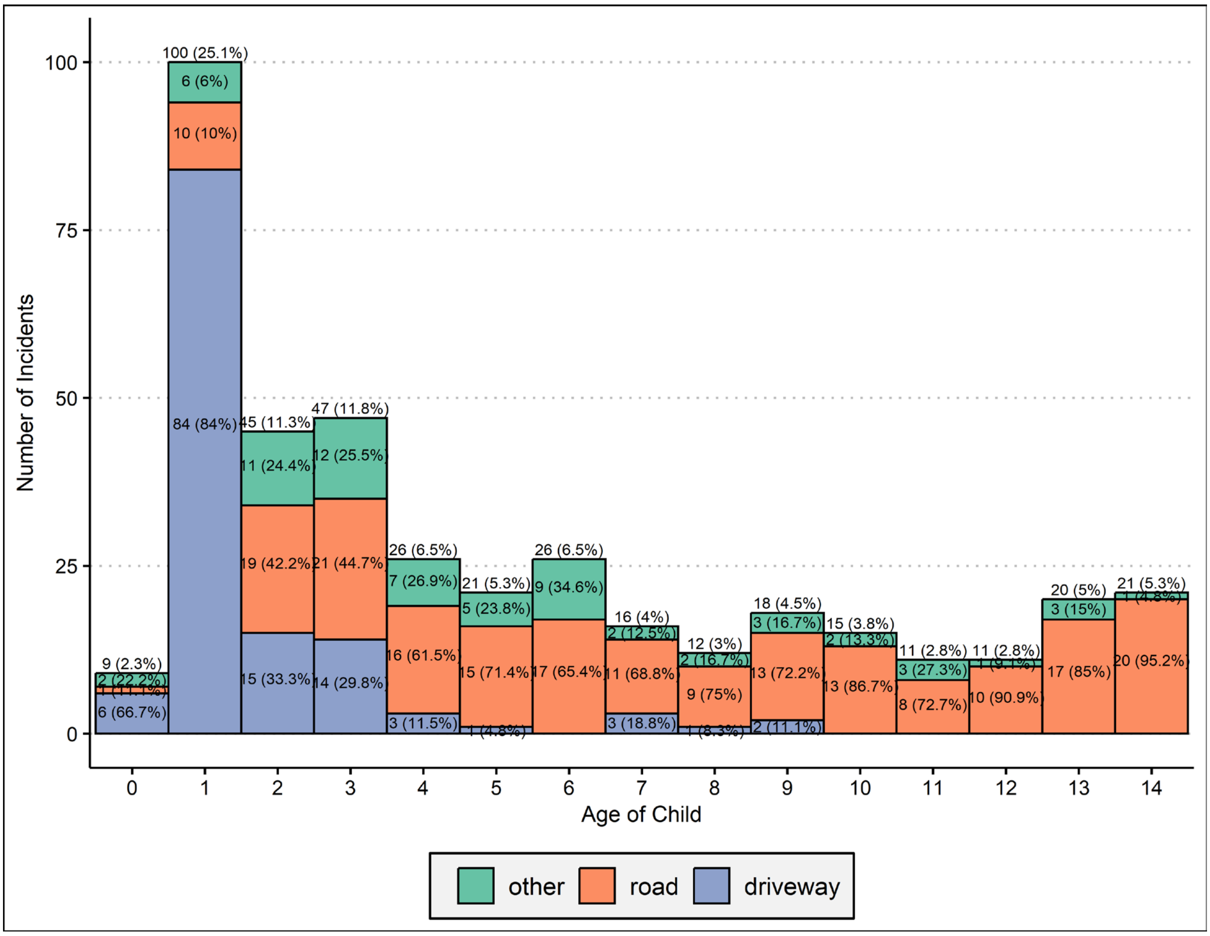

Figure 5: Frequency of pedestrian child-vehicle fatalities by age and crash location: on road, in driveways or other which includes carpark and on vehicle locations (n=398)

Trends in child pedestrian fatalities over period 2001 to 2019

Trends in the numbers of child pedestrian fatalities over the study period (see Figure 6) show a notable drop in case numbers between 2001 and 2007, but since then, while the numbers fluctuate from year to year, there is little evidence of further decline.

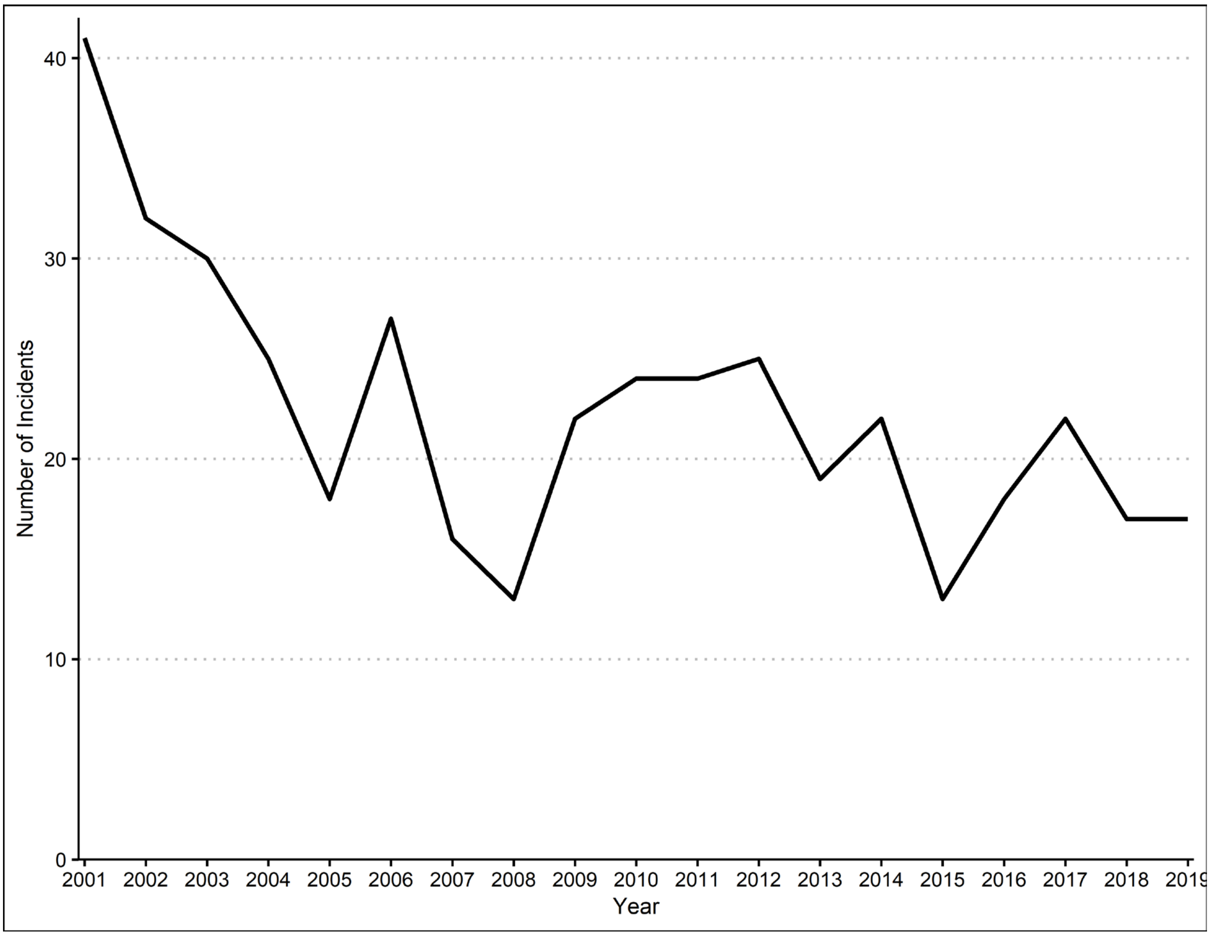

Figure 6: Numbers of incidents involving child pedestrian fatalities aged 0-14 years each year between 2001 to 2019 (n=398)

As shown in Figure 7, child pedestrian fatality incidents varied over the study period depending on the age of the child. For the youngest group (0 to 3 years), incidents dropped early in the period to around 2007, but returned to the same levels by the end of the period. For the older groups, incidents also decreased between 2001 and 2007 followed by some increase, but overall, the older age groups show lower numbers at the end of the study period compared to the beginning.

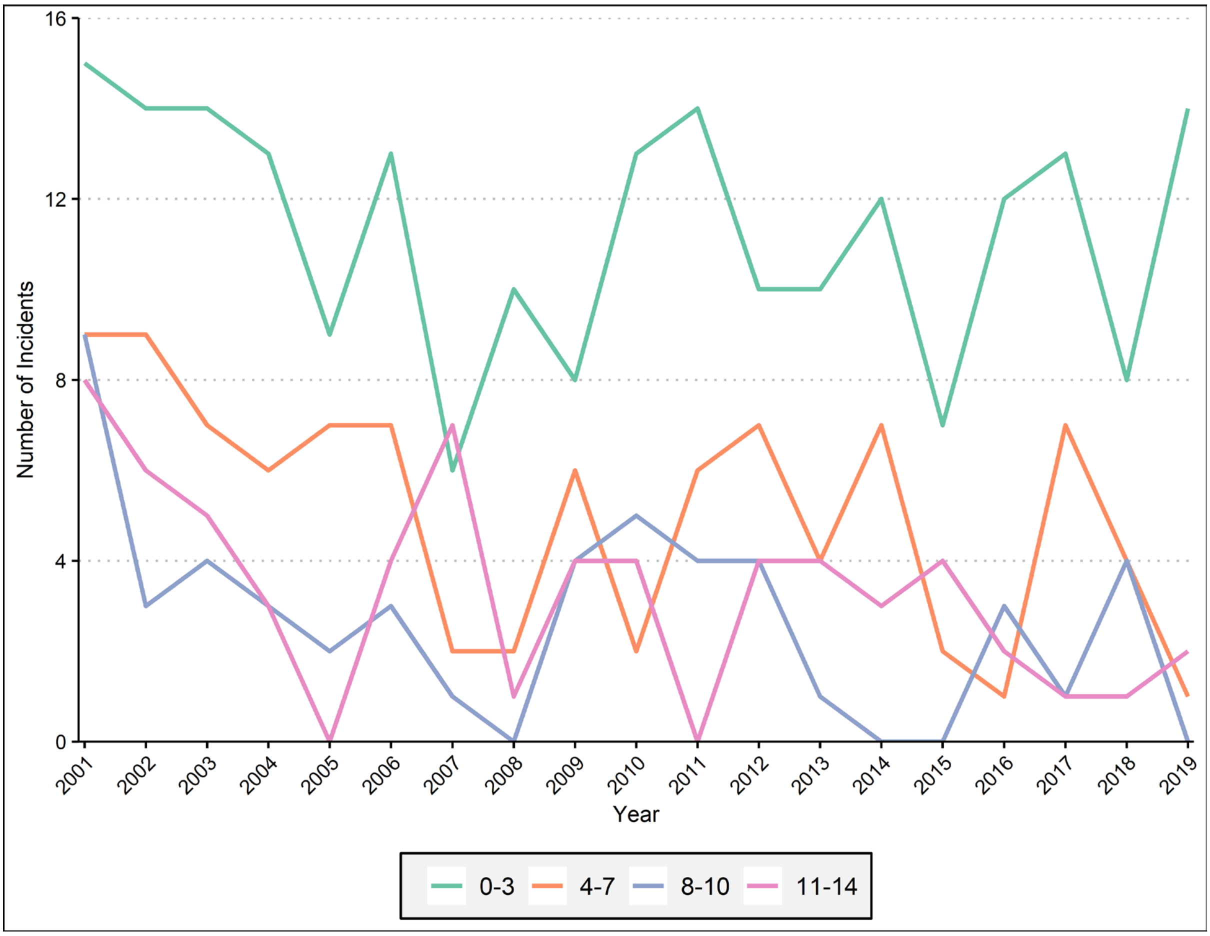

Figure 7: Trends in incidents of child pedestrian fatalities between 2001 and 2019 for age groups: 0 to 3 years, > 3 to 7 years, > 7 to 10 years and 11 to 14 years of age (n=398).

Trends for male and female child pedestrian fatalities were similar over the study period. Following an initial drop in the first five to seven years, the numbers increased or showed very little change for the remainder of the period. Male pedestrian fatalities dominated in almost every year and often, by a considerable extent (Figure 8).

Figure 8: Changes in incidents of child pedestrian fatalities between 2001 and 2019 for males and females (n=398)

Trends in the numbers of child pedestrian fatalities varied depending on the location in which they occurred (Figure 9). Road and driveway areas had the greatest number of fatal pedestrian crashes. Road crashes decreased between 2001 and 2007, but then numbers varied considerably, showing a slight reduction across the remainder of the study period. In contrast, driveway fatalities have remained around the same level for the 19-year study period and even shown a slight increasing trend from 2003 to 2019.

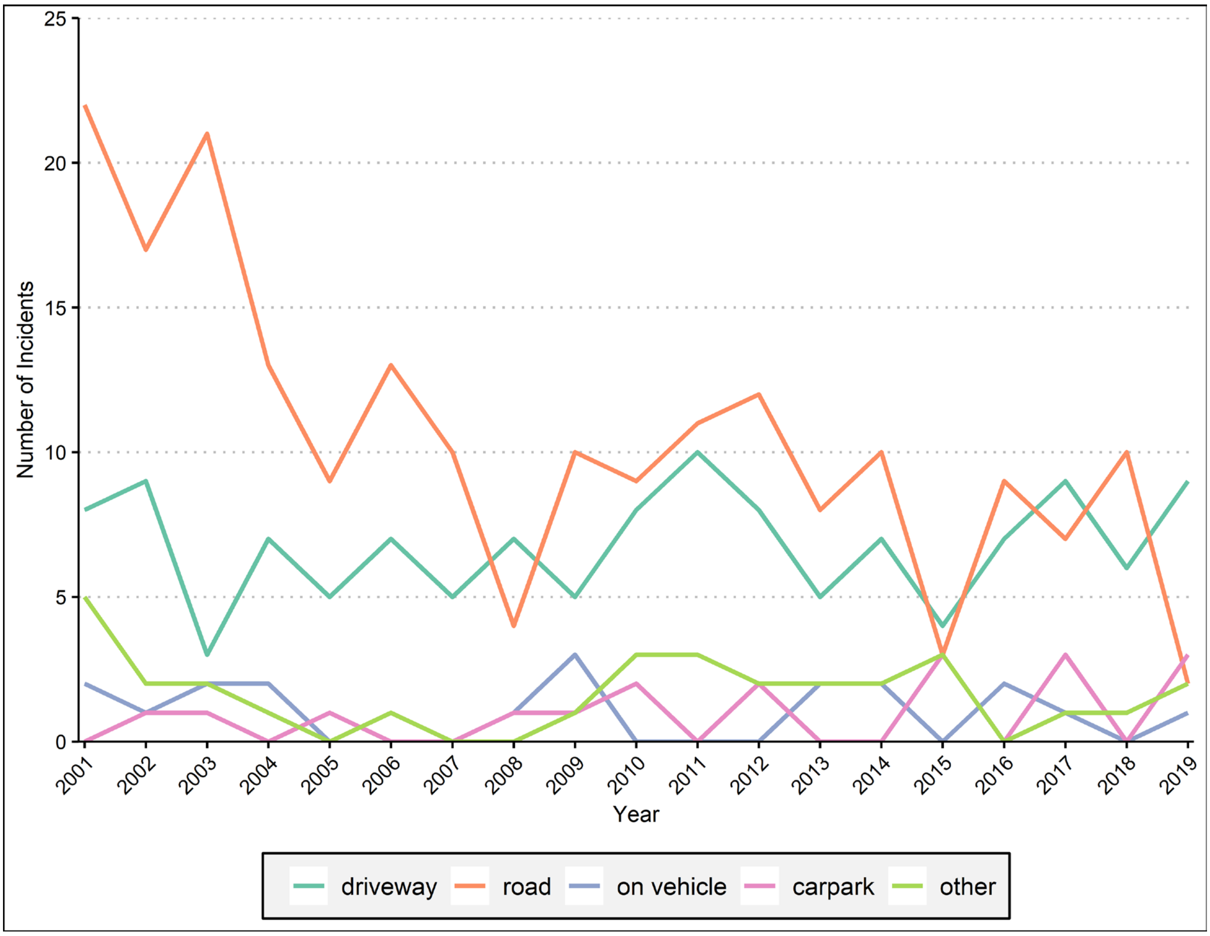

Figure 9: Trends in incidents of child pedestrian fatalities aged 0-14 years between 2001 and 2019 by location of the crash (n=398)

Analysis of the causes of fatal child pedestrian crashes for 0- to 10-year-olds.

This section looks at the characteristics of fatal pedestrian crashes for younger children across the 2001 to 2019 period. For 0- to 10-year-olds, the two most common locations were roadways and driveways (Table 5) together accounting for 81.8% of cases for this age group. Nearly half (43.3%) occurred on the road and well over one-third in driveways (38.4%). As these two locations dominated the cases involving younger children and because the causes of crashes in these locations are likely to differ, the analysis for 0- to 10-year-olds focussed separately on road related and driveway related crashes. Analysis of the causes of the three remaining locations in which younger children were involved will be covered in a separate report.

Table 5: Location of fatal child pedestrian crashes for 0 to 10 year-olds.

Location of crash	n (%)
Roadway	145 (43.3%)
Driveway	129 (38.5%)
Carpark	18 (5.4%)
On vehicle	16 (4.8%)
Other	27 (8.1%)
Total	335 (100%)

Causes of roadway crashes for child pedestrians aged 0 to 10 years.

The main findings of the analysis of the coronial records, the characteristics of all road-related fatal child pedestrian crashes are summarised in Table 6. The average age of children involved in road-related pedestrian fatalities is just over 5 years of age with 3- and 5-year-olds the largest subgroup accounting for more than one-third of all fatalities. Nearly three-quarters were male.

In almost all cases, the driver of the vehicle was another person, with only a small percentage of road fatalities involving a parent or carer. In just over half of the cases, the driver was not aware of the child's location near the road, but in the remainder the driver was possibly or even definitely aware of the presence of the child in the period before the crash. In nearly all cases where the driver reported they were unaware of the child's location, the Coder judged that the driver could or should have been aware (89.5%).

In the sequence of events leading to the fatal crash, the first two events (PE1 and PE2) involved the immediate causes of the child getting into a vulnerable location near the road and the driver's immediate role in causing the fatal crash. Child-related actions included the child moving into the path of the vehicle or attempting to cross the road and for a smaller percentage of cases, the child following or moving to join a family member on the other side of the road. Driver-related actions most often involved the driver failing to see or to avoid the child and in a smaller percentage of cases to careless driving. Where there was a third precursor event (PE3), it mostly involved supervision-related events: risky behaviour, or failing to respond to risk, distraction, and changes in supervisor.

Pre-existing factors were identified that increased the likelihood that the precursor events occurred. In the fatal road-related crashes involving 0 to 10 years, environmental factors like problems of visibility, road characteristics and distracting activities occurred in many cases which would have increased the likelihood that the driver failed to see a child near the roadside or could not avoid making contact. Lack of safety-related equipment like no pedestrian crossing and lack of security at their residence made it more likely that the child was in a vulnerable location just before the crash. In addition, in around two-thirds of cases, supervision of the child was either absent or indirect such as having multiple children to supervise.

Table 6: Characteristics of all road-related fatal child pedestrian crashes involving 0- to 10-year-olds in Australia, 2001 to 2019 inclusive, showing percentage of all road cases for each characteristic.

Child description		
Age - mean	5.16 years	
- Distribution	n	%
- ≤ 2 years	30	20.7%
- 3-5 years	52	35.9%
- 6-8 years	37	25.5%
- 9-10years	26	17.9%
Gender	Male = 71.7%	

Driver description			
Who was the driver?	Other person (91.0%)	Parent/carer (6.2%)	
Driver aware of child?	Not aware (59.3%)	Possibly aware (23.4%)	Definitely aware (15.2%)

Event sequence				
PE1 (100%) Most common actions	Child moves into path (26.9%)	Driver failed to see/avoid (38.6%)	Child attempts to cross (11.0%)	Careless driving (9.7%)
PE2: (79.3%) Most common actions	Child attempts to cross (17.9%)	Child moves into path (16.6%)	Risky behaviour by supervisor/ fail to respond to risk (13.8%)	Child moves to join family member (11.0%)
PE3: (53.8%) Most common	Risky behaviour by supervisor/ fail to respond to risk (18.6%)	Supervisor distracted (6.2%)	Risky behaviour by child (6.2%)	Change in supervision (4.8%)

Contribution factors				
Environmental (66.9%)	Visibility (37.2%)	Road Characteristics (24.1%)	Parent/child separated (7.6%)	Distracting activities (6.2%)
Equipment (35.2%)	Road-related (30.3%)	Vehicle-related (6.5%)	Residence-related (8.3%)	
Medical (11.7%)	Driver-related (6.9%)	Child-related (6.9%)		
Other (20%)	Multiple children (10.3%)	Child history of escaping (2.1%)	Unlicenced driver (1.4%)	
Supervision of child	Physical contact (7.6%)	Direct (28.3%)	Indirect/ambiguous (30.4%)	None (33.8%)
Who was supervisor?	Mother (22.8%)	Multiple carers (17.9%)	Other carer (14.5%)	Father (10.3%)

Most common PE sequences				
PE3-PE2-PE1 (accounting for 57.3% of road cases)	Other-Child-Driver (22.1%)	NA-Child-Driver (13.8%)	NA-Driver-Child (13.1%)	Other-Driver-Child (8.3%)

The analysis looked at the specific circumstances of the most common causal sequences for child pedestrian road crashes. These accounted for over half of all road cases. While the first layer of this analysis identified the most common causal features across all road child pedestrian fatalities, the objective of this further analysis was to group cases that had common immediate causal events and to look at the relationships between these causal events and the multiple other contributing factors that played a role in the fatal crashes. These results are summarised in Table 7.

The most common event sequence involved actions by another person, the child, and the driver. This sequence mainly involved younger children, with around two-thirds under the age of 6 and mostly males. The final event in the causal sequence mainly involved a driver who had no relationship with the child and was unaware of their presence at that location, failing to see them. The only additional information about why the driver failed to see the child is poor visibility due to lighting or road-related obstructions which was recorded in around one-third of cases. The child was in a vulnerable place around the roadway when they moved to join a family member or attempted to cross the road into the path of the vehicle. This risky action by the child just before the crash was enabled because in most cases they were not being supervised, or only indirectly and because the supervisor was distracted, engaged in risky behaviour, including being separated from the child, or there was a change in supervisor just before the crash.

The second most common event sequence only included actions by the child and the driver. Again, most of these children were male, but they were older, with around two-thirds older than 5 years-old. The driver in half of these cases was aware of the presence of the child but could not avoid the crash and, in the remainder, the driver was unaware of the child but was known to be driving carelessly or just failed to see the child. Again, there was limited information about the driver's involvement except for problems with visibility of the child, such as parked vehicles or low lighting in around one-third of cases. The child was in a vulnerable situation as they were attempting to cross the road or had inadvertently moved into the path of the vehicle. Approaching half of these children were not being supervised at the time, but these children were older. The younger children involved in this group of crashes were almost all being directly supervised at the time of the crash. The relationship between age and level of supervision is analysed further in later section of this report.

The next two common sequences involved action by the child as the last event leading most directly to the crash. For the more common sequence, action by the child was the only action able to be coded. The mean age of children for this sequence was 5 years-old, but the majority were younger. This sequence involved more girls than the other road sequences. No driver actions could be determined from the data available; however, poor visibility of the child or the road was recorded in half of cases which may have limited the driver's capacity to see the child. In most cases, the child's action involved running or wandering into the path of the vehicle, with the remainder attempting to cross the road. Most children were either not supervised at the time or supervision was indirect or ambiguous so allowing the child access to the road.

The fourth largest sequence involved mainly male children, with comparatively few girls. The mean age was 5 years-old, but most were older. In most cases in this sequence, the child ran into the path of the vehicle. The driver was found to have been driving carelessly in one-quarter of crashes, and again, the only other information available about the role of the driver was visibility problems in the location of the crash which were noted for most cases. Half of the children were being directly supervised in the period leading up to the crash, but in almost all cases (83.3%) the supervisor engaged in a risky behaviour just before the crash so allowing the child to move into a vulnerable location.

Table 7: Summary of circumstances of the four most common causal sequences for road-related fatal child pedestrian crashes involving 0 to 10 years of age in Australia, 2001 to 2019 inclusive.

Causal sequence (PE1-PE2-PE3)	Other person-Child-Driver	None-Child-Driver	None-None-Child	Other person-Driver-Child
n, % of road cases	n=32, 22.1%	n=20, 13.8%	n=19 (13.1%)	n=12 (8.3%)
Mean Age of child	4.38 years	7.0 years	5.16 years	5.0 years
Gender distribution	71.2% male	75% male	68.4% male	83.3% male
PE1 –Whose action?	Driver	Driver	Child	Child
- Action of person at that time	Failed to see child (56.3%) Not aware of child (65.5%) Not the supervisor (93.8%)	Aware of/failed to avoid (50%) Not aware of child (45%) Careless driving (25%) Failed to see child (20%) Not the Supervisor (100%)	Child ran/wandered into path of vehicle (63.2%) Attempted to cross (31.6%)	Ran into path of vehicle (83.3%) Attempted to cross (16.7%)
PE2 –Whose action?	Child	Child		Driver/Supervisor
– Action of person at that time	Moved to join family member (43.8%) Ran into path of vehicle (31.3%)	Attempt to cross (65%) Moved into path of vehicle (35%)		Risky behaviour by supervisor (41.7%) Careless driving (25%) Not aware of child (8.3%)
PE3 –Whose action?	Supervisor or Other	N/A	N/A	Supervisor/Driver
- Action of person at that time	Supervisor distracted (28.1%) Risky behaviour by Supervisor (25.0%) Change in supervision (21.9%) Known person arrives (15.6%)			Risky behaviour by Supervisor (83.3%) Careless driving (8.3%)
Contributing factors				
- **Environmental**	Visibility problems (34.4%) Parent-child separated (15.6%)	Visibility problems (35%)	Visibility problems (52.6%)	Visibility problems (58.3%)
- **Equipment**	No nearby crossing (18.8%) Home access insecure (12.5%)	No nearby crossing (20.0%)	No nearby crossing (10.5%)	Lack safety equipment (25%)
- **Medical**	Medical (9.3%)	Medical (10.0%)	No medical	Medical (8.3%)
- **Supervision**	No supervision (28.1%) Indirect supervision (43.8%) Direct supervision (28.1%)	No supervision (40.0%) Indirect supervision (10%) Direct/physical supervision (40%)	No supervision (36.8%) Indirect supervision (36.8%) Direct/physical supervision (21.1%)	No supervision (33.0%) Indirect supervision (16.7%) Direct supervision (50%)

Causes of driveway pedestrian crashes involving 0 to 10 year old children.

The main causes of child pedestrian fatalities occurring in driveways are summarised in Table 8 and they are different to road-related pedestrian fatalities. Children involved in driveway fatalities were much younger than those in roadway crashes, with over three-quarters of driveway crashes involving children aged two years or under. Unlike road-related pedestrian fatalities, they were equally likely to involve boys or girls.

In around three-quarters of the driveway cases, the driver was a Carer of the child, most commonly the father (41.9%). Despite this, the driver was not the child's supervisor at the time in more than half of crashes. In most driveway cases (75.2%), the most immediate cause of the crash involved the driver failing to see or to avoid the child. Some environmental factors might have influenced the driver observing the location of the child in 38.8% of cases. These included problems of visibility (14.7%) and driveway characteristics such as steep or inclined driveways (10.1%) as well as distracting activities (14.1%) around the driveway. These factors cannot account for all cases where the driver failed to see the child or avoid the crash. It is likely that lack of awareness of the location of the child played a role here, with the driver not detecting the child because they did not expect them to be in that location. In more than two-thirds of cases, the driver reported being unaware of the location of the child. The Coder, however, judged that almost all drivers could or should have been aware of the likely location of the child before they moved the vehicle.

There were a range of reasons for the child being in a risky location near the vehicle just before the vehicle was moved. The two most common were the child independently moving into the path of the vehicle (35.7%) or following or moving to join a family member which took them into the path of the vehicle (31.8%). In around half of driveway cases, a supervision-related event just before the crash played a part. This included the supervisor inadvertently allowing the child to access the driveway (17.1%), the supervisor engaging in a risky behaviour (21.0%) such as locating the child in a risky location just before the vehicle was moved, a change in supervisor just before the vehicle was moved (10.1%) and supervisor distraction (7.0%). While almost all cases were being supervised at some level, most child supervision (69.0%) in the time before the crash was indirect or ambiguous, with multiple carers which was likely to have diluted supervisory attention on the child. Furthermore, lack of secure barriers to prevent the child accessing the driveway also played a role in nearly one-third of these crashes (32.6%).

Table 8: Characteristics of all driveway fatal child pedestrian crashes in Australia, 2001 to 2019, showing percentage of all road cases for each characteristic

Child description		
Age - mean	1.75	
- Distribution	n	%
- ≤ 2 years	105	81.4%
- 3-5 years	18	14.0%
- 6-8 years	4	3.1%
- 9-10years	2	1.6%
Gender	Male=52.7%	

Driver description				
Who was the driver?	Father (41.9%)	Other carer (17.8%)	Mother (17.1%)	Other person (12.4%)
Driver aware of child?	Not aware (69.8%)	Possibly aware (9.3%)	Definitely aware (14.7%)	
Driver supervisor of child?	No (54.3%)	Yes (37.2%)		

Event sequence				
PE1 (100%) Most common actions	Failed to see/avoid (75.2%)	Reversing vehicle (5.4%)		
PE2: (96.1%) Most common actions	Child moves into path (35.7%)	Child moves to join family member (31.8%)	Child in risky location (9.3%)	Supervisor risky behaviour (7.8%)
PE3: (62.0%) Most common	Supervisor allows access (17.1%)	Supervisor risky behaviour (13.2%)	Change in supervision (10.1%)	Supervisor distracted (7.0%)

Contributing factors				
Environmental (38.0%)	Visibility (14.7%)	Distracting activities (14.0%)	Driveway characteristics (10.1%)	
Equipment (43.4%)	Lack of barriers to access (32.6%)	Issues reversing camera/vision from vehicle (10.9%)		
Medical (4.7%)	Alcohol use by driver or supervisor (3.9%)			
Other (26.4%)	Supervising multiple children (16.9%)	Distracting activities for parent (4.7%)		
Supervision of child	Physical contact (0.8%)	Direct (20.9%)	Indirect/ambiguous (69.0%)	None (5.4%)
Who was supervisor?	Mother (32.6%)	Father (13.2%)	Other carer (6.2%)	Multiple carers (31.0%)

Most common PE sequences		
PE3-PE2-PE1 (81.4% of driveway cases)	Other person-Child-Driver (46.5%)	None-Child-Driver (34.9%)

The two most common causal sequences for driveway crashes accounted for more than three-quarters of cases (75.2%) (see Table 9). The sequence with the most cases (Person-Child-Driver) involved very young children, with almost all aged 2 years or under. It also involved boys and girls equally. The event that occurred just before the crash was action by the driver who was, in most cases, a parent or carer. Hardly any cases involved another person not involved with the child. In most cases, the driver failed to see the child and in two-thirds of these cases, the driver/carer assumed the child was in a different location and was unaware of the presence of the child. For a few cases, some environmental factors likely made it harder for the driver to see the child, including poor lighting or visibility of the child and distracting activities such as a party or other activity near the driveway. In almost all cases, the child was near the vehicle because they had wandered into that location; in more than half of these cases because they had followed a family member. Most cases involved an event that allowed the child to independently move towards the driveway. This included access being provided to the driveway usually by the driver, the person supervising becoming distracted at that point, or a change in supervision. There were no security or door locks to prevent the child gaining access to the driveway area in more than half of these cases. Most of these cases involved indirect or ambiguous supervision of the child, often due to the presence of multiple carers.

In the second most common causal sequence involving driveways there were only two precursor events: action by a child followed by that of the driver, but there were clear similarities between this and the most common sequence. The children involved were again very young, with almost all well under 2 years of age and there was a fairly equal representation of boys and girls. The event that led most directly to the crash was again the driver failing to see the child and assuming that they were somewhere else. An even larger percentage of drivers were not aware of the child and a higher percentage, nearly two-thirds, the driver was not the child's supervisor. Again, environmental factors relating to visibility, the location of the driveway and distracting activities also contributed to the driver's failure to see, or be aware of, the child.

In this sequence too, the child became vulnerable when they wandered into the path of the vehicle, but in this sequence, they were less likely to be following a family member. Again, most children were being indirectly supervised in the period before the crash, but unlike the largest causal sequence, there was no other supervisory event that increased the child's risk. The child's movements were also facilitated by lack of security barriers in small number of these crashes.

Table 9: Driveway crashes: Circumstances of the two most common causal sequences for fatal child pedestrian crashes occurring in Australia, 2001 to 2019 inclusive.

Causal sequence: PE1-PE2-PE3	Other person-Child-Driver	None-Child-Driver
n, (% driveway cases)	60 (46.5%)	37 (34.9%)
Mean Age of child	1.63 yrs	1.41 yrs
Gender distribution (M:F)	51.7%:48.3%	59.5%:40.5%
PE1 – who was driver?	Parent/carer = 92% Other person = 8%	Parent/carer = 69.5% Other person = 21.6%
- Action of driver	Failed to see child (81.7%) + assumed child elsewhere (67%) Driver not aware of child (73.3%) Driver not supervisor (45.0%)	Failed to see child (94%) + assumed child elsewhere (74.3%) Driver not aware of child (81.1%) Driver not supervisor (64.9%)
PE2 – Action of child	Wandered into vehicle path (90%) + followed family member (59.3%)	Wandered into vehicle path (81.8%) (+Followed family member = 30%)
PE3 – Whose action?	Driver (61.7%) Parent/carer (36.7%)	
- Action of person	Access provided to driveway (35%) (+ Other driver = 71.4%) Supervisor distracted or engaging in risky behaviour (33.3%) (+ Change in supervision (21.7%)	
Contributing factors		
Environmental	Distracting activities (11.7%) Visibility factors (10.0%) Poor lighting (6.7%)	Distracting activities (21.6%) Visibility factors (13.5%) Risky location (5.4%)
Equipment	No security/door locks (58.3%)	No security barriers (16.2%)
Medical	Medical factor (6.7%) (80% alcohol use)	No cases
Other	Supervising multiple children (20.0%)	Supervising multiple children (10.8%)
Supervision of child	Indirect supervision (71.7%) (+55.8% multiple carers) Direct supervision (23.3%) (+ 93% single carers) No supervision (5.0%)	Indirect supervision (78.4%) Direct supervision (8.1%) No supervision (5.4%)

Analysis of the causes of fatal child pedestrian crashes for 11- to 14-year-olds.

A total of 63 child pedestrian fatalities involving 11- to 14-year-olds were located in the search of NCIS data. Most of these cases occurred on roadways (see Table 10) with the remainder occurring on-vehicle or other locations which included work and recreation places. As road-related fatalities dominated for this age group, the analysis of pedestrian crashes involving older children focussed on the 55 cases that occurred on-road.

Table 10: Location of fatal pedestrian crashes involving 11 to 14 year-olds.

Location of crash	n	%
Road	55	87.3%
On vehicle	4	6.3%
Other	4	6.3%
Total	63	100.0%

Causes of roadway crashes for child pedestrians aged 11 to 14 years.

Within the 11- to 14-year-old age group, the number of child pedestrian fatalities increased with age (Table 11). Two-thirds involved the oldest children aged 13 and 14 years. Across the age group, males and females were roughly equally represented, although when broken down by year of age, pedestrian fatalities involving 11- and 12-year-olds mainly involved males (see Figure 4).

The driver in these fatalities was mainly another person unrelated to the child. In just over two-thirds of cases, the driver reported being unaware of the child, but the remainder were at least possibly aware of the location of the child. Coder judgements were that the driver could or should have been more aware of the child in 87.2 percent of cases. In one-quarter of cases the driver was reported as engaging in careless or risky behaviour just before the crash, so making it more likely. In around 20 percent of cases the driver reported that they failed to see the child or were unable to avoid the crash. Some pre-existing factors increased the likelihood of the driver not seeing the child either at all or soon enough to avoid the crash. Problems of visibility, lighting and road characteristics that limited vision of the child were noted in more than half of crashes. In a small number of cases, the driver was recorded as being alcohol and/or drug affected.

The action of the child just before the crash brought them into a risky location near vehicles in most cases when they attempted to cross the road or inadvertently moved into the path of the vehicle. Most children were acting independently in the period before the crash as only a very small percentage were being directly supervised. In a small percentage of cases, the child or the supervisor engaged in a risky action just before the crash which made the crash more likely.

Table 11: Characteristics of all roadway pedestrian fatalities involving 11- to 14-year-olds showing percentage of all road cases for each characteristic.

Child description		
Age mean	12.89	
Distribution	n	%
- 11yrs	8	14.5%
- 12yrs	10	18.2%
- 13 yrs	17	30.9%
- 14 yrs	20	36.4%
Gender		
Male	31	56.4%
Female	24	43.6%

Driver description				
Who was the driver?	Other person 92.7%)	Parent 3.6%)		
Driver aware of child?	Not aware (69.1%)	Possibly aware (20.0%)	Definitely aware (10.9%)	

Event sequence					
PE1 (100%)	Run/move into path (29.1%)	Attempt to cross (16.4%)	Careless driving (14.5%)	Failed to see (12.9%)	Unsuccessfully avoid (10.9%)
PE2: (72.7%)	Attempt to cross (25.5%)	Risky child behaviour (16.4%)	Risky driving (10.9%)		
PE3: (27.3%)	Risky behaviour by child (5.5%)	Risky behaviour by supervisor (5.5%)	Risky location (3.6%)	Risky driving (3.6%)	Environmental (3.6%)

Contributing factors					
Environment (58.2%)	Visibility (25.5%)	Poor lighting (18.2%)	Road characteristics (9.1%)	School bus (7.3%)	Distracting activities (5.5%)
Equipment 7.3%)	No road crossing (9.1%)	Vehicle not roadworthy 3.6%)			
Medical (16.4%)	Driver drugs/alcohol (5.5%)	Child drugs/alcohol (3.6%)	Child intellectual/ behavioural problems 3.6%)		
Location of crash	Road (67.3%)	Intersection (12.7%)	Pedestrian crossing (10.9%)	Footpath (3.6%)	
Supervision of child	Direct (10.9%)	Indirect (1.8%)	None (81.8%)		
Most common PE sequences					
PE3-PE2-PE1 (52.7% road cases)	NA-Child-Driver (21.8%)	NA-NA-Child (18.2%)	NA-Child-Child (12.7%)		

The most common causal sequences involving 11- to 14-year-old pedestrians accounted for just over half of road-related pedestrian fatalities with this age group and took two different forms (Table 12). The first involved action by the child and action by a driver (21.8%) and the second only included one or two actions by the child (29.1%). The largest sequence was distinctive as it included more females than males. In this sequence, the action by the driver that led most immediately to the crash involved careless and risky driving or failing to see or to avoid the child. These cases also included contributing factors that would have increased the likelihood of these actions. Most cases involved visibility obstructions due to parked vehicles or road characteristics which made it difficult to see the child at all or in time to avoid them. Distracting activities that captured the driver's attention would also increase the likelihood of careless driving. Actions by the child strongly involved problems when they attempted to cross the road or when they moved into a risky location into the path of a vehicle. Almost all cases were not being supervised in the period leading to the crash. In nearly half, the driver reported being aware of the child before the crash, but they failed to take evasive action in time. The Coder judged that in most cases the driver could or should have been aware of the child's location.

The second type of sequence is shown as two in Table 12, but as they share many characteristics they will be treated as one. Both sequences involved only action by the child and in both, males were dominant. Neither sequence acknowledged any action by a driver in the crash, although the presence of contributing factors like visibility obstructions and poor lighting may have increased the likelihood that the driver in each case did not see the child. The driver in most cases reported that they were unaware of the child just before the crash, but a minority for each sequence admitted that they were aware of the possibility of a child being around the roadway. The Coder ratings were that in all cases the driver could have been aware of the child just before the crash. The child's action in both sequences mainly related to the child moving into the path of the vehicle or, less frequently, attempting to cross the road. In both sequences the child was not being supervised, so allowing the child to act independently. The one case where the child was being directly supervised, the child suddenly dashed across the road when they saw a friend on the other side.

Table 12: Roadway crashes: Circumstances of the most common causal sequences for 11–14-year-old fatal child pedestrian crashes in Australia, 2001 to 2019 inclusive

Causal sequence: PE1-PE2-PE3	NA-BD-BO	NA-NA-BD	NA-BD-BD
n, (% roadway cases)	12 (21.8%)	10 (18.2%)	6 (10.9%)
Mean Age of child	12.5	12.7	13.2
Gender (M:F)	41.7%:58.3%	70.0%:30.0%	66.7%:33.3%)
Who was the driver	Other person (83.3%)	Other person (100%)	Other person (100%)
PE1 – whose action?	Driver	Child	Child
- Action of person	Unable to avoid the child (33.3%) Careless/risky driving (33.3%) Failed to see child (33.3%)	Move/run into path of vehicle (60.0%) Attempt to cross (20.0%) Risky behaviour by child (20.0%)	Move/run into path of vehicle (66.7%) Attempt to cross (16.7%)
PE2 – whose action?	Child	-	Child
– Action of person	Crossing road (58.3%) Moved into path of vehicle (16.7%) Child in risky location (16.7%)	NA	Risky behaviour by child (50.0%) Attempt to crossroad (33.3%) Person known to child arrives (16.7%)
PE3 – Whose action?	NA	NA	NA
Contributing factors			
Location of crash	Road (66.7%) Intersection (25.0%) Crossing (8.3%)	Road (70%) Intersection (20%) Crossing (10%)	Road (83.3%) Intersection (16.7%)
Environmental	Distracting activities (25.0%) Visibility obstructed on road (25.0%) Visibility obstructed due to vehicle (16.7%)	Visibility obstruction on road (60.0%) Lighting (10.0%)	Lighting (50%) Visibility obstruction on road (16.7%) Terrain hazard (16.7%)
Equipment (8.3%)	Lack of crossing (8.3%)	No footpath (10.0%)	None
Medical (0%)	-	Child influenced alcohol/drug (10.0%)	Child intellectual disability (16.7%) Suicide (16.7%)
Supervision of child (91.7%)	No supervision (83.3%) Direct supervision (8.3%)	No supervision (100%)	No supervision (83.3%) Direct supervision (16.7%)
Driver awareness of child	Not aware (50.0%) Definitely aware (41.7%) Possibly aware (8.3%)	Not aware (80.0%) Possibly aware (20.0%)	No aware (66.7%) Possibly aware (33.3%)
Possibility of driver being aware?	Could have been aware (50.0%) Should have been aware (33.3%) Could not have been aware (16.7%)	Could have been aware (100%)	Could have been aware (100%)

Why do child pedestrian fatalities involving 0–10-year-olds occur when they are being directly supervised?

Analysis of both road and driveway child pedestrian fatalities highlights lack of supervision of the child as one of the main contributing factors for these crashes. The analysis also shows, however, that pedestrian crashes do occur in both locations when the child is being directly supervised and even when the supervisor has physical contact with the child. This paradoxical finding was investigated further by looking specifically at the cases where the fatal crash occurred despite the child being supervised with physical contact. As shown in Table 13, these fatalities occurred almost exclusively in road related crashes, and they occurred for two main reasons. For just over half of road related cases, child supervision failed when the child suddenly, just before the crash, broke free from the supervisor's contact allowing the child to come into contact with the vehicle. For the remainder of road crashes and for the single driveway crash involving supervision with physical contact, the crash occurred for reasons relating to the driver or the vehicle and in these cases, the supervisor was often also injured in the crash.

Table 13: Analysis of the circumstances when child aged 0 to 10 years was being Direct supervision with physical contact.

	Road	Driveway
Broke free from supervisor	7 (58.3%)	0
Crash driver or vehicle-related	5 (41.7%)	1 (100%)
Other	0	0
Total	12 (100%)	1 (100%)

Further analysis of the causes of cases involving direct supervision of the child showed similar findings for road-related but not for driveway crashes (Table 14). When the crash occurred on a roadway, it mostly involved the child suddenly moving impulsively towards the road, and despite being in direct physical contact with the child, the supervisor did not have time to stop them breaking away just before the crash. When this type of crash occurred in a driveway, it mostly involved interruption of the direct supervision when the supervisor changed or became distracted. Driver or vehicle-related reasons were next most common for roadway and driveway crashes and in these cases direct supervision of the child played no role. These results suggest that so long as direct supervision especially involving physical contact is maintained, child pedestrian fatalities can be avoided.

Table 14: Analysis of the circumstances when child aged 0 to 10 years was being Directly supervised.

	Road	Driveways
Child moved impulsively	15 (36.6%)	3 (10.7%)
Crash was Driver or vehicle-related	11 (26.8%)	5 (17.9%)
Supervision changed/distraction	10 (24.4%)	20 (71.4%)
Unknown	5 (12.2%)	0 (0%)
Total	41 (100%)	28 (100%)

Relationship between supervision and child age

The study investigated whether and how the level of supervision varied with the age of the child. This analysis focussed on roadway and driveway cases separately due to their different age patterns and locations. For roadway pedestrian fatalities, the analysis looked at all cases as well as at younger (0-10 years-old) and older (11-14 years-old) cases separately.

As shown in Table 15, the analysis for all roadway cases showed a statistically significant difference in the ages of the children involved in crashes at different levels of supervision. Children being directly supervised with physical contact were the youngest as might be expected, and where there was no supervision, the child was significantly older, being nearly 10 years old on average. Children being directly supervised were also significantly younger, but it is notable that cases with indirect or ambiguous supervision were similarly very young and in most need of supervision, being around four years old on average.

The relationship between age and supervision level for the younger group showed the same pattern with the children who were not supervised being statistically significantly older than children who were being supervised at any level. Again, children who were indirectly or ambiguously supervised were very young. For the older group, there was no relationship between age and supervision as most were not supervised at all.

Table 15: Relationship between age of the child and supervision level in the time before the crash for all roadway cases (0-14yrs), and younger children (0-10yrs) and older children (11-14yrs) separately.

	All Cases		0-10yrs		11-14 yrs	
Supervision level	N	Mean Age	N	Mean Age	N	Mean Age
Direct supervision with physical contact	12	3.58	12	3.58	0	0
Direct supervision	47	5.74	41	4.76	6	12.50
Indirect supervision	21	4.38	20	3.95	1	13.00
Multiple/ambiguous supervision	20	4.20	20	4.20	0	0
No supervision	96	9.55*	51	6.63*	45	12.87
Total	196	7.17	144	5.13	52	12.83
		$F_{(4,191)}$= 23.55		$F_{(4,139)}$= 7.32		$F_{(2,49)}$= 0.32
		p<0.001		p<0.001		ns

(* Post hoc contrasts (LSD) show statistically significantly different from all other levels)

For the analysis of the age by supervision relationship for driveway fatalities the two direct supervision groups were collapsed because direct supervision with physical contact only applied in one case. This analysis again showed a statistically significant difference between level of supervision and age with children, although all children in driveway crashes were very young and the age range was small. Again, children who had no supervision were older, but they were no older than the children being directly supervised and both groups were significantly older than the children being indirectly or ambiguously supervised. This finding highlights that indirect and ambiguous supervision of the very youngest children played a significant role in child pedestrian fatalities in driveways. The results also show that around driveways, very few children were not being supervised at all, and they were, on average, older than the others in this group. However, almost all children killed in driveway crashes were younger than 3 years old, so they were too young to be left unsupervised.

Table 16: Relationship between age of the child and supervision level in the time before the crash for all driveway cases.

	All Cases	
Supervision level	N	Mean Age
Direct supervision (+ with physical contact)	28	2.64*
Indirect supervision	45	1.42
Multiple/ambiguous supervision	44	1.25
No supervision	7	2.57*
Total	124	1.70
		$F_{(3,123)}=5.81$
		$p<0.001$

(* Post hoc contrasts (LSD) show statistically significantly different from other levels)

Discussion

The results of this study highlight further the need to understand the circumstances and appropriate countermeasures to prevent child pedestrian fatalities. National population studies show that for children, land transport crashes are the most common cause of death and child pedestrian crashes are a significant proportion of these deaths. The findings of this study extend this by showing that the numbers of child pedestrian fatalities have not changed in recent years. Delving further into the data, pedestrian fatalities involving the youngest children have shown no sign of reducing over the last decade. While the number of road-related fatalities have reduced, pedestrian fatalities in driveways have not. These results highlight the need to do more to address these tragic outcomes through understanding how they happen and then designing interventions to address the factors that make them more likely.

The location of the crash was influenced by the age of the child. Almost all driveway crashes involved very young children, mostly aged one year, and this formed the largest age group of child pedestrian crashes across the dataset. This, together with the finding that driveway crashes have remained persistently high over the 19 years of the study, provides a strong justification for more concerted action to reduce driveway crashes. Roadway crashes were the largest group of crashes for all ages from two years and older. Roadway and driveway crashes were by far the most frequent child pedestrian fatalities. For this reason, this report focussed on analysis of the circumstances and causes of these types of pedestrian crashes. A further report will cover the circumstances of carpark and on-vehicle pedestrian crashes.

The circumstances of road-related child pedestrian crashes are quite similar across ages, 2 to 14 years of age. Males dominate at all ages across that period, except for the very youngest group under one year and the oldest two years (13- and 14-year-olds) where males and females are equally likely to be involved. The most immediate causes of the crash involve action by the driver in response to action by a child which placed them in a vulnerable position near the roadway. In almost all these crashes, the driver was simply passing by and unknown to the child. Most often the driver failed to see or avoid the child which was often made more likely by problems of visibility such as poor lighting, or road characteristics that also made it difficult to see a small child, such as heavy traffic or parked vehicles on the side of the road. In a smaller percentage of cases, the driver was recorded as driving in a careless manner such as exceeding the speed limit or being distracted. The problem here is that the records available from police or coroner often fail to contain much information about the role of the driver in these crashes, so it is not possible to know whether or how factors like high speed or inattention contribute to the driver's inability to avoid the crash.

The behaviour of the child that led most directly to roadway crashes mostly involved them moving into the path of the vehicle or, especially for the older children, actively attempting to cross the road. Several factors increased the likelihood that the child would take this action and be exposed to the risk of being near a roadway. The most common were poor supervision by a parent or carer and lack of nearby road crossings or other safety equipment such as barriers between footpath and road. Most children involved in fatal pedestrian crashes were not being supervised and this increased markedly with age. At best, the children involved in roadway crashes were being indirectly supervised by parents and carers in the period before the crash. Inadequate supervision increased the likelihood that the child, would independently move to a risky location near the roadway. In a significant percentage of cases, regardless of the level of supervision, the supervisor engaged in a risky behaviour just before the crash, such as deciding to walk with the child on the side of the road, rather than the footpath, or starting to cross the road outside a designated crossing. This contributed to the crash by increasing the likelihood that the child was exposed to the risk near roadways.

Further analysis of the common causal sequences of roadway crashes helps understanding of the specific causes of crashes, especially the relationships between types of events that lead most directly to the crash and the factors that made them more likely. For example, the largest group of cases for the 0 to 10 year-old group involved younger children, many of whom had run across the road to join a family member or person known to them. This occurred in a context of low levels of direct supervision where the supervisor became distracted or engaged in risky behaviour just before the crash, so allowing the child the opportunity to move to a risky location. The driver's involvement in these cases related mostly to failure to see the child and not being aware of the child rather than any overt unsafe behaviour. The next most common causal sequence involved older children attempting to cross the road, but in this case, there was evidence of careless driving and in most cases the driver was aware of the location of the child, but they failed to avoid them. Inadequate supervision factors were less involved in these cases. The circumstances and causes of child pedestrian crashes on roadways encompass multiple factors, but the same factors do not always apply in all crashes. Through investigating how combinations of causes and contributing circumstances come together, the targets of action to prevent crashes will be much more specific and effective.

The circumstances of driveway related child pedestrian fatalities were notably different from those occurring on the road. Most strikingly, these cases mainly involved children aged two years or younger, and boys and girls were equally represented. In most cases, the driver was a person known to the child, most often the father. In these crashes, the driver reported being not aware of the location of the child and had failed to see or avoid them. Only a few factors were identified that may have influenced the driver's behaviour. These included poor visibility and activities that distracted the driver. In contrast, multiple factors were identified that increased the risk of the child being near the path of the vehicle. Most commonly these involved the young child wandering or running into the vicinity of the vehicle or following a family member into the area. In most cases, the child's supervision was indirect or ambiguous with multiple carers which allowed the child to move into a risky location without being noticed by a carer. In addition, lack of security to prevent the child accessing the driveway was a factor in a significant number of cases with, in some cases, the supervisor allowing access.

In-depth analysis of the most common crash sequence found that it occurred when a very young child was only indirectly or ambiguously supervised due to multiple carers, in combination with inadequate formal security to restrict the child's access to the driveway. In many cases, the crash risk increased in the period just before the crash when the supervisor's attention to the child was further diverted due to distraction, or supervision suddenly changed. The risk was further enhanced in some cases when another person (mostly the driver) allowed access to the driveway such as by leaving a door unsecured. These combined circumstances allowed the child to wander into the path of the vehicle. In most cases, the driver was unaware of the child and failed to see them. While the driver was almost always a parent or carer of the child, they were the active supervisor in just over half of these crashes. Despite this, most drivers assumed the child was elsewhere in the period immediately before the crash.

The second most common driveway crash sequence tended to involve a driver who was not the parent/carer and was not the supervisor at the time and mostly the driver reported not being aware of the child and failing to see the child. In most of these cases, indirect supervision allowed the child to wander into the path of the vehicle. The only additional information about contributing factors for this sequence was distracting activities, such as a party or gathering of people occurred in some cases. This likely influenced the level of supervision and attention to the child and may also have influenced the driver's behaviour and attention to the specific circumstances at the time just before they moved the vehicle.

The causes of child pedestrian fatalities in road and driveway locations share some factors but differ on others. Inadequate supervision of the child was a consistent contributing factor across both road and driveway crashes. The level of supervision varied with age of child, so in driveway crashes which involve very young children, hardly any cases were not being supervised at all, but most involved indirect or ambiguous supervision. In contrast, for road-related cases who were usually older, no supervision was much more common. In one-third of cases involving 0- to 10-year-olds there was no supervision, and for 11- to 14-year-olds, hardly any children were being supervised in the time before the crash. Within the 0- to 10-year-old age group, the children who were not supervised at the time of the crash tended to be older as would be expected, but the 11- to 14-year-old age group did not show a relationship between age and supervision. The study found that inadequate supervision was a factor in most cases, and this allowed children access to risky locations near vehicles, thereby increasing the risk of child pedestrian fatalities.

The role of supervision might be challenged by the finding that, contrary to expectations, some road and driveway-related fatalities occurred while the child was being directly supervised, and some road crashes occurred even when the child had physical contact with the supervisor. Further analysis of these cases, however, shows that these crashes occurred for reasons unrelated to the child or because the child unexpectedly removed themselves from direct supervision immediately before the crash. Overall, this analysis shows that inadequate supervision is a major contributor to child pedestrian fatalities, and it highlights the importance of supervision of young children to avoid pedestrian fatalities.

It is well-recognised that children, especially younger children do not understand the concept of risk around roads and need to be supervised to keep them safe in these environments (Soole et al, 2011). Advice for parents currently recommends that parents/carers keep physical contact with children up to the age of 8 years then actively supervise children between the ages of 8 and 10 years when in traffic environments (e.g., NSW Department of Education, 2023). It may be difficult to achieve the level of supervision required to ensure children are prevented from accessing risky areas around vehicles, especially the requirement to maintain attention and close proximity to the child at all times (Saluja et al 2004). Consequently, the role of supervision must be seen as one of multiple strategies for keeping child pedestrians safe around vehicles (WHO, 2015).

The analysis of specific causal sequences for crashes supports the concept that multiple factors combine to increase the risk of a child pedestrian fatality. Inadequate supervision is one common factor. For both road and driveway crashes, other factors were involved, and they influenced the child or driver, or both. For road fatalities, factors like visibility and road obstructions influenced whether the driver could easily see the child and, consequently, played a role in whether the driver was able to respond to the potential crash in time to prevent it. The risk of driveway crashes was increased when someone provided access, or the child followed a family member into the driveway area.

The increasing implementation of some technologies might be expected to reduce the risk of child pedestrian crashes. A particular example is the increasing uptake of reversing cameras and sensors in vehicles which might be expected to have reduced driveway fatalities over the 19-year study period. With no indication that driveway fatalities have decreased over the study period, the results do not support this. As shown in this study, driveway crashes involve vehicles moving forward as well as reversing, so these cameras alone will not be of benefit for preventing all driveway crashes. In a small number of cases, and especially in the most recent years of the dataset, lack of cameras or camera blind spots were reported as a contributing factor to the crash. It may be that the benefits of cameras and sensors for reducing child driveway fatalities have yet to be seen. Nevertheless, these technologies alone are unlikely to prevent child pedestrian fatalities in driveways. The use of sensor technologies, especially in large vehicles, may help drivers respond more quickly to avoid child pedestrian's if they suddenly appear on road. Further evidence is needed to confirm this.

In all child pedestrian fatalities, the driver has the final role. If the driver is aware of the potential for a child to be in the vicinity of their vehicle, they will be more likely to be alert to the risk and to take evasive action to avoid the crash. In all road and driveway crashes, however, most drivers reported that they were not aware of the presence of the child near their vehicle leading to their inability to see and avoid the crash. Yet, in almost all such cases, it was judged by the Coder that the driver should or could have been aware of the child. This suggests that implementation of strategies that promote greater mindfulness by drivers of the presence of vulnerable road users, like child pedestrians, would help to address their safety. This could include effective vehicle sensors that warn the driver and can help slow the vehicle sufficiently for the driver to take action to avoid the crash.

Of course, this strategy may not be sufficient to address pedestrian crash risk if the driver was driving in a careless or risky manner. The analysis points to careless driving as a cause amongst the road-related cases. For many child pedestrian cases, however, the coronial records contain very little information about the behaviour of the driver. For example, reports of having too little time to take evasive action are self-reported and not confirmed. This means that the influence of careless or risky driving in the causes of child pedestrian fatalities may be underestimated. Certainly, most of the literature on the causes of child pedestrian crashes emphases the actions of the child which are assumed to make the crash inevitable, and the role of the driver is viewed as secondary, if it is mentioned at all.

Despite being the most comprehensive source of information about the causes and circumstance of child pedestrian fatalities, the NCIS data was highly variable in quality, with very little information available about the causes of the crash for some cases. Furthermore, the coroner's files contained more information about the circumstances that led to the child being in a risky location near moving vehicles than about the driver's role in the crash, especially in road-related crashes. Very few case reports contained sufficient information to understand whether factors like the speed of the vehicle, engagement in non-driving activities, or fatigue influenced the driver's capacity to detect the child's location in time to avoid the crash. Evaluation of the records available in the NCIS shows that around half contained a police report and no other information. Furthermore, the police reports vary greatly in the information collected. While the Coroners Court system and the NCIS are most valuable resources for road safety, they are currently missing opportunities to collect systematically the in-depth information needed to understand how to tackle road safety problems like child pedestrian fatalities.

Conclusions

Child pedestrian crashes do not occur only because children suddenly dart out into traffic leaving drivers with no opportunity to avoid them. This analysis showed that mostly, they occurred because the child had followed someone they know into the risky location or were simply standing in a location at the side of the road or a driveway that makes them difficult for drivers to see. The causes lie in how the child came to be in the risky location in the first place. Problems of inadequate supervision were common across most driveway crashes, along with lack of barriers to prevent the child accessing the driveway. Roadway crashes most often occurred in circumstances where supervision of the child was limited or absent, and in many cases, this was exacerbated when the supervisor engaged in a risky behaviour or became temporarily distracted at the wrong time just before the child and the vehicle came into contact.

The causes also lie in what drivers do to avoid children around roads. In most cases, the driver reported that they were unaware of the child's presence in that location and that if they became aware, they were not able to stop or take action to avoid the child in time. Investigation of the circumstances of these crashes suggests, however, that for most of these crashes, the driver could have and even should have been more aware of the child. The reports contained in the coronial files contain very little information about the driver's behaviour including their driving speed or their involvement in distractions. Coroner's reports need to collect more information about the role of the driver in these crashes.

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Appendix A

Description of sample and sampling

The initial search of the National Coronial Information System using the mechanism of injury (blunt force and transport injury event), vehicle mode (pedestrian), child age range 0 to 10 years inclusive) and year of crash range (2001 to 2019) identified a total of 495 cases. Further examination of cases resulted in exclusion of 56 cases for a variety of reasons shown in Table A1. Most of these cases were excluded because they fell outside the search terms resulting in a total of 439 cases that met the search criteria. A further 41 cases did not contain enough information to code causes so could not be included in the analysis of causal sequences, so this analysis was conducted on a total of 398 cases. Although there were some differences in the reasons for excluding cases between the two age groups studied, the proportion of excluded and missing data was similar for each age group.

Table A1: Summary of composition of final dataset for analysis providing reasons for excluding cases.

Characteristic	**0-10yrs**	**11-14yrs**	**Total sample**
Total cases returned using search terms	413	82	495
Cases excluded for following reasons:			
– Duplicate cases	2	1	3
– Occurred outside the date range (2001-2019)	18	7	25
– Railway incidents	12	0	12
– Non-pedestrian (scooter, skateboard)	7	3	10
– Occurred overseas	2	0	2
– Involved multiple fatalities	1	0	1
– Cases still open	3	0	3
Total cases excluded	45	11	56
Total cases meeting search criteria	**368**	**71**	**439**
Insufficient information to code causal sequences	33	8	41
Total cases excluded or uncodable due to insufficient information	**78**	19	**97**
Total cases in final sample n (%)	**335** (81.1%)	**63** (76.8%)	**398** (80.4%)

Appendix B

Quality of Coroners records for determining the circumstances of child pedestrian fatalities

A random sample of the Coronial cases included in this study was used to evaluate the quality of the data available for understanding the circumstances of child pedestrian fatalities. Obviously, the quality and depth of analysis of data on the circumstances of crashes depends on the quality of the data available. A total of 45 cases were randomly selected for this exercise.

Each Coroner's record could have included up to four reports: Police, Autopsy, Toxicology and Coroners report. The analysis looked at the number of reports for each of the 45 cases. As shown in Table B1, nearly half of cases had only one report. In most cases this was a Police report. Coroner's summary reports were only available in one-third of cases (Table B2). Analysis of the availability of reports over the study period suggests that this situation is improving with more reports being available in recent years (Figure B1). Nevertheless, the mean number of reports is still only half the total number that might be expected for cases like child pedestrian fatalities where there is a strong case for improving countermeasures to prevent such tragic outcomes.

Table B1: Number of cases with varying numbers of reports contained in the NCIS record.

Number of Reports	n	Percentage
1	20	44.4%
2	11	24.4%
3	8	17.8%
4	6	13.3%
Total	45	100.0%

Table B2: Percentage with each type of report and mean number of reports across all cases

Police	Autopsy	Toxicology	Coroners	Total (mean reports)
82.2%	60.0%	31.1%	35.6%	2.00

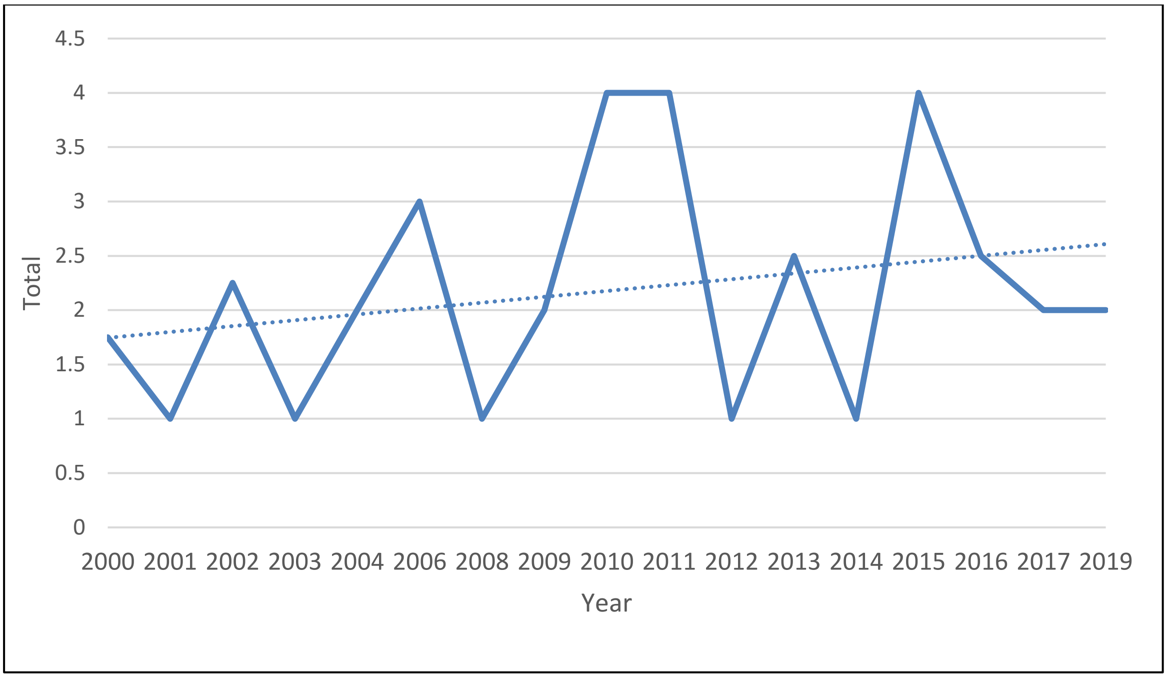

Figure B1: Changes in mean number of reports in Coronial records over the period 2000 to 2019.