Australian Government

Department of Infrastructure, Transport, Regional Development, Communications and the Arts

Bureau of Infrastructure and Transport Research Economics

Run-off road crashes in Australia, 2016-2020

At a Glance

- This Information Sheet provides a descriptive analysis of run-off road (RoR) crashes and compares these with other types of crashes in Australia.
- Between 2016 and 2020, the average annual number of road deaths in Australia was 1,187. Deaths from run-off road crashes averaged 458 deaths per year.
- Over this five-year period, run-off road crashes accounted for 20 per cent of all reported crashes and a significantly higher 39 per cent of all fatal crashes. In comparison, head-on crashes accounted for 12 per cent of all reported crashes and 20 per cent of all fatal crashes.
- Fatal run-off road crashes are almost always (96 per cent) single-vehicle involved. More than 77 per cent of fatalities from run-off road crashes are vehicle controllers (drivers or motorcyclists).
- While only 2 per cent of all crashes are fatal, 4 per cent of run-off road crashes are fatal. Almost 45 per cent of reported run-off road crashes are recorded with hospitalised injuries[1], compared with only 33 per cent of all crash types.
- Over the five years, the number of fatal run-off road crashes remained steady while the number of other crashes decreased.
- Fatal run-off road crashes are more common late at night and on weekends.
- More than 50 per cent of fatal run-off road crashes happened in areas with a posted speed limit of at least 100 km/h.
- Almost two thirds of fatal run-off road crashes happened in regional Australia.
- Curved alignment, insufficient natural lighting (between dawn and dusk) and rain (leading to slippery roads and limited visibility) are commonly reported with run-off road crashes.
- While information on risky behaviours (including driving with excess alcohol or with drugs in their system, driving without wearing a restraint or driving without a valid licence) are often not all reported in crash data, where data is available it suggests that these are more common in fatal run-off road crashes than other crash types.

---

[1] Hospitalisation as reported by jurisdictions.
Definitions of hospitalisation range from taken to hospital to admitted to hospital with a stay of 24 hours or more.

Literature Review

A review of road safety literature from road safety authorities or research centres identified only a few publications on the topic of run-off road crashes. Also, findings from international journals can have limited relevance due to differences in circumstances of roads and enforcement activity between countries. Within Australia, Western Australia Police published an analysis on data from 2006 to 2010 and Austroads have published several reports since 2014.

Data Sources and Limitations

The main source used in this study is the National Crash Database (NCD, unpublished). A dataset of all reported casualty crashes from 2016 to 2020 has been used for this study. This has been supplemented by open data from several jurisdictions which provide data on risk factors that are not available in the National Crash Database.

Data collected by state and territory governments are initially recorded by police. Police records are limited to reported road accidents only. Definitions of injuries in the National Crash Database vary by jurisdiction.

Methodology

This Information Sheet emphasises the importance of run-off road crashes by presenting proportions of (fatal) run-off road crashes in all types of crashes, outcome severity of run-off road crashes and annual trends of fatal run-off road crashes. Data analysis in this research project focuses on fatal run-off road crashes. Analysis of crashes resulting in serious injury – defined as an injury resulting in hospitalisation irrespective of the length of stay – is limited at the national level due to differences in jurisdiction injury definitions.

Data analysis of non-fatal crashes has been carried out using available open datasets from selected jurisdictions. Data analysis includes three parts from the following perspectives - road users, vehicles and crash related risk factors. Variables selected for study are recognised characteristics of or risk factors for crashes.

Age and gender of vehicle controllers in fatal run-off road crashes are compared to information in fatal non-run-off road crashes. Moreover, risky behaviours of vehicle controllers - fatigue, alcohol and/or illegal drugs - are more likely to be recorded as factors in crashes that result in deaths and serious injuries.

The motor vehicle type and manufacture year are the main characteristics available for a vehicle. The vehicle age is calculated by subtracting manufacture year of the vehicle from crash year.

The nature of a crash includes location, day and time of a crash. Road type, remoteness and jurisdiction classification are derived from the crash location. Speed limits of crash locations are analysed and combined with remoteness for further details and insights. State open datasets were used to investigate speed as a factor in run-off road crashes, as well as to investigate road geometry and atmospheric conditions. Curves, wet road surfaces, rains and poor lighting conditions (e.g. darkness) could all affect visibility and vehicle control.

Definitions

The definition of run-off road crashes in this paper is consistent with the definition from the Guide to Road Safety (Austroads 2021, pp. 171-180). The main sub-groups within this class of crashes are crashes where a vehicle has left the carriageway on the straight or curved section of the road. The key characteristic is that a motor vehicle leaves the road after losing control. The vehicle may or may not hit an object or another vehicle, and have run off the road to either the right or left. See Appendix A for the selection of jurisdiction codes for run-off road crashes.

Importance of Run-off Road Crashes

Run-off road crashes accounted for 20 per cent of all crashes and a significantly higher 39 per cent of all fatal crashes in Australia during the five-year period 2016 to 2020. By comparison, head-on crashes accounted for 12 per cent of all crashes and 20 per cent of all fatal crashes.

Figures 1.1.1 and 1.1.2 provide an overview of crash types for all severity levels and correspondingly their percentages in all (fatal) crashes from 2016 to 2020.

Figure 1.1.1: Crash types - all severity levels, 2016-2020

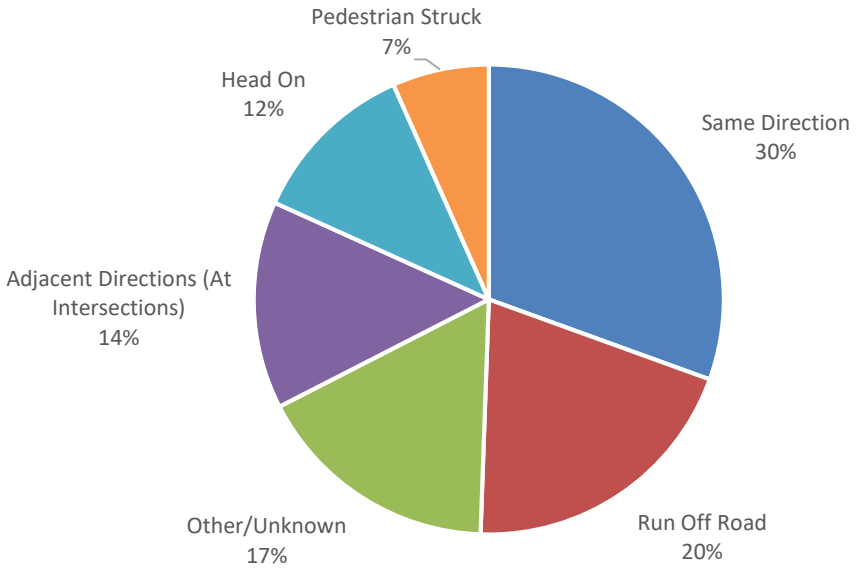
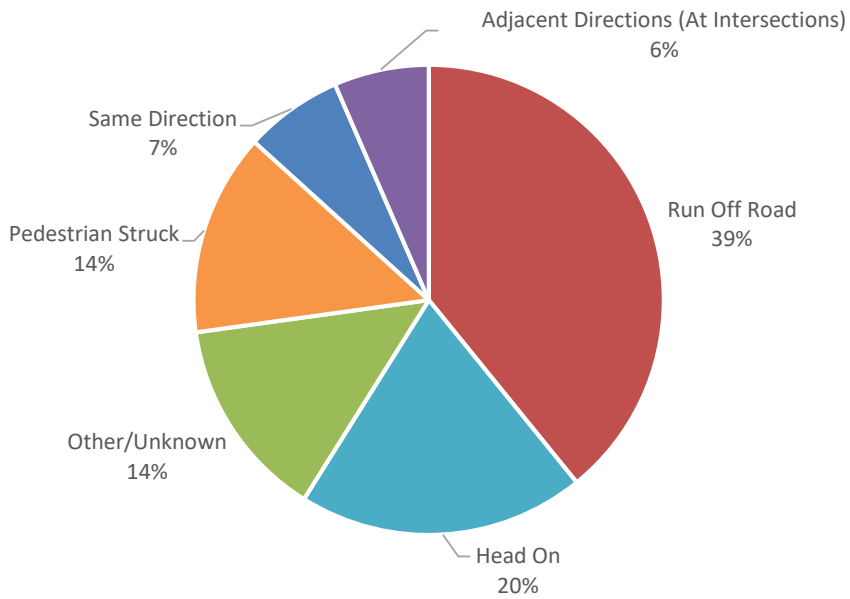


Figure 1.1.2: Crash types - fatal crashes only, 2016-2020



Note: "Head On" crashes include "Overtaking" and "Head On" crashes; and exclude "U turn" and "Vehicles from opposing directions" crashes; "Other crossing" under "Vehicles from opposing directions" are not included. A very small percentage (<=0.3 per cent) of crashes under the overtaking group are head-on crashes as well.
"Unknown" is no more than 0.5 per cent. "Other" crash types include "Manoeuvring", "Miscellaneous", "On Path", "Overtaking" and crash types not included in any other groups.

Source: BITRE NCD (unpublished).

Run-off road crashes form an important focus area in not only reducing total numbers of crashes but also the severity level of crashes. While only 2 per cent of all reported crashes, regardless of crash type, are fatal, 4 per cent of run-off road crashes are fatal. Almost 45 per cent of run-off road crashes are recorded with hospitalised injuries, compared to 33 per cent of all types (Table 1.1).

Table 1.1: Severity of run-off road crashes, 2016-2020

All crashes	Proportion	Run-off road crashes	Proportion
Fatal	2%	Fatal	4%
Injury - hospitalised	33%	Injury - hospitalised	45%
Injury - not hospitalised	65%	Injury - not hospitalised	51%
Total	100%		100%

Note: Jurisdiction definitions of a hospitalised injury include confirmed admitted to hospital (Victoria and New South Wales); taken to hospital (Queensland and Australian Capital Territory), admitted to hospital overnight stay (Western Australia) and admitted to hospital for 24 hours or more (Tasmania).

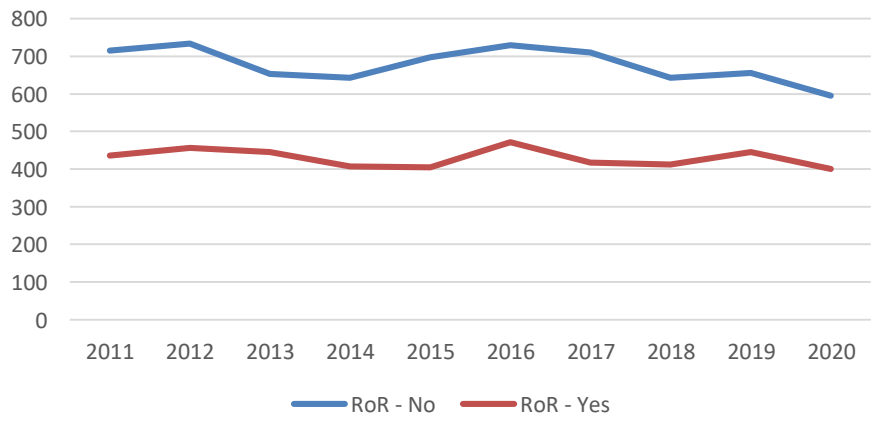
Source: BITRE NCD (unpublished).

Table 1.2: Fatal crashes by year - run-off road and not run-off road

Year	RoR - No	RoR - Yes	Total	RoR - No	RoR - Yes	Total
2011	715	436	1,151	62%	38%	100%
2012	734	456	1,190	62%	38%	100%
2013	653	445	1,098	60%	40%	100%
2014	643	407	1,050	61%	39%	100%
2015	697	404	1,101	63%	37%	100%
2016	730	472	1,202	61%	39%	100%
2017	710	417	1,127	63%	37%	100%
2018	643	412	1,055	61%	39%	100%
2019	656	445	1,101	60%	40%	100%
2020	595	400	995	60%	40%	100%

Source: BITRE NCD (unpublished).

Figure 1.2: Fatal crashes by year



Source: BITRE NCD (unpublished).

Over the ten year from 2011 to 2020, the number of fatal crashes has declined, at the same time as the number of motor vehicles on register (Australian Bureau of Statistics 2021) has increased by 2.2 per cent on average per annum.

Comparing however crash types over the two five-year periods (Table 1.3), total numbers of fatal non-run-off road crashes have decreased, (although not statistically significantly), whereas the number of fatal run-off road crashes have remained steady.

Table 1.3: Fatal crashes by every five years

Five years	Fatal crashes	
	RoR - No	RoR - Yes
2011-2015	3,442	2,148
2016-2020	3,334	2,146
% of change	-3%	0%

Source: BITRE NCD (unpublished).

Data Analysis

Table 2.1 presents the fields from main dataset - National Crash Database - analysed in this paper categorised by three themes - road user details (Persons), vehicle characteristics (Vehicles) and crash related risk factors (Crashes). This is consistent with the themes in the National Road Safety Strategy 2021-2030 - safe roads, safe vehicles and safe road use.

Table 2.1: Selection of fields

Theme	Field	Description
Persons	Road user classification[1]	Driver, Passenger, Motorcyclist, etc.
	Vehicle controller - age[1]	<=16, 17-24, 25-29, 40-49, 50-59, 60-74, 75+
	Vehicle controller - gender[1]	Female, Male, Unspecified
	Alcohol test[1]	Fail
	Valid licence[1]	No
	Restraint used[1]	No
	Helmet worn[1]	No
	Drug test[1]	Positive
Vehicles	Vehicle type[1]	Passenger car, Motorcycle, Van, Truck, Bus, etc.
	Vehicle age[1]	0, 1, 2, …, 28, 29, 30+
Crashes	Day of week[1]	Sunday, Monday … Saturday
	Weekday vs Weekend[1]	Weekend: Friday 6 pm - Monday 6 am
	Day vs Night[1]	6 am to 6 pm vs 6 pm to 6 am
	Hour[1]	0, 1, 2, … 23
	Speed limit zone[1]	<= 40 km/h, 50 km/h, 60 to 70 km/h, 80 to 90 km/h, 100 km/h, >= 110 km/h, Unknown
	Remoteness[1, 2]	Major Cities, Regional, Remote
	Road type[1, 3]	National or State Highway, Arterial Road, Sub-arterial Road, Collector Road, Local Road
	Alignment (Horizontal)[4]	Curved, Straight
	Alignment (Vertical) [4]	Crest, Dip, Grade, Level
	Lighting[4]	Daylight, Dawn/dusk, Darkness
	Road surface[4]	Dry, Wet
	Weather[4]	Fine/Clear, Raining

Note: 1. As reported by jurisdictions;
2. Grouping based on ABS Remoteness Structure;
3. Geoscape roads hierarchy (formerly PSMA);
4. State and territory open datasets.

Sources: BITRE NCD (unpublished); open datasets from jurisdictions.

Over the five-year period (2016-2020), there were 2,146 fatal run-off road crashes on Australian roads, with 2,199 vehicles involved and 2,292 lives lost – an average of 458 deaths per year. It is noteworthy that 96 per cent of all fatal run-off road crashes involved only a single-vehicle (Table 2.2).

Table 2.2: Fatal run-off road crashes, 2016-2020

Year	Fatalities	Vehicles	RoR crashes (C)	Single Vehicle RoR crashes (SV)	Proportion, SV/C
2016	506	485	472	454	96%
2017	452	431	417	400	96%
2018	435	421	412	394	96%
2019	477	457	445	429	96%
2020	422	405	400	386	97%
Total	2,292	2,199	2,146	2,063	96%

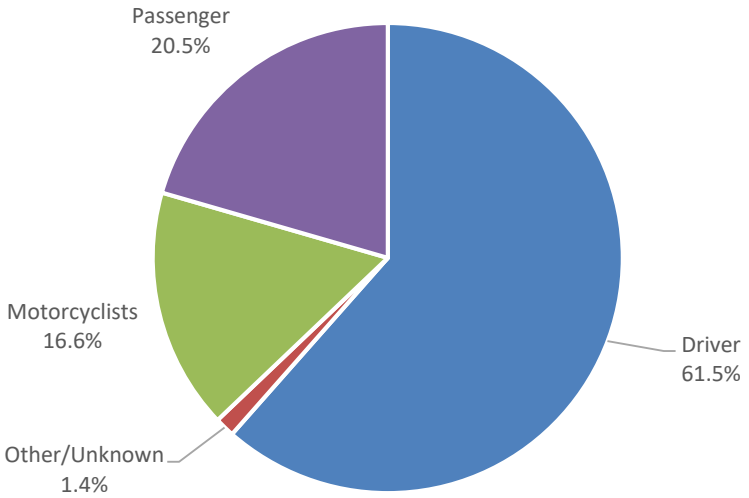
Source: BITRE NCD (unpublished).

Persons

Between 2016 to 2020, the total number of fatalities resulting from run-off road crashes is 2,292; most of these were vehicle controllers.

Drivers and motorcyclists together accounted for 78 per cent of all fatalities in run-off road crashes. Therefore, further analysis on risk factors or behaviours that related to vehicle controllers are of great importance. However, it would be more meaningful to take all vehicle controllers involved (died or survived) in fatal run-off road crashes into consideration.

Figure 2.1: Road user type - fatalities in run-off road crashes, 2016-2020



Note: There were eighteen cyclists and eight pedestrians included in the category “Other/Unknown”. There was only one record classified as “Other” road user type and four records classified as “Unknown” road user type.
Motorcyclists include motorcycle riders and motorcycle pillion passengers. There were 11 (0.5%) motorcycle pillion passenger deaths over the five years. There were no recorded pedal cycle pillion passenger fatalities in run-off road crashes, however, pedal cycle pillion passengers were recorded in fatal crashes that were not run-off road, and run-off road crashes that were not fatal.
Source: BITRE NCD (unpublished).

The following analysis of age group and gender are from the two perspectives: 1) vehicle controllers who died in run-off road crashes, 2) vehicle controllers involved in fatal run-off road crashes.

Table 2.3: Vehicle controllers - fatal run-off road crashes, 2016-2020

Year	Vehicle controllers died	Vehicle controllers involved
2016	404	483
2017	334	430
2018	333	420
2019	373	453
2020	336	404
Total	1,780	2,190

Source: BITRE NCD (unpublished).

It is clear that vehicle controllers who died are a subset of (81 per cent) vehicle controller involved. Vehicle controllers involved include vehicle controllers who died and vehicle controllers who survived in a crash when other road user(s) (for example, vehicle passengers) died in the same crash.

Out of a total 3,836 vehicle controllers who died on Australian roads between 2016 and 2020, near half (1,780) of them died in fatal run-off road crashes (Table 2.4.1). The number of vehicle controllers involved in fatal run-off road crashes was 2,190 while 5,675 vehicle controllers were involved in fatal non-run-off road crashes during the five years (Table 2.4.2).

The 40 to 64 age group accounted for the majority of vehicle controllers in both run-off road and non-run-off road crashes. However, vehicle controllers in fatal run-off road crashes are younger, with higher percentages in the 17 to 25 and 26 to 39 age groups.

Table 2.4.1: Vehicle controllers who are also fatalities - age group and gender

Age Group	RoR - No	RoR - Yes	Total	RoR - No	RoR - Yes	Overall
0 to 16	16	11	27	1%	1%	1%
17 to 25	336	430	766	16%	24%	20%
26 to 39	490	486	976	24%	27%	25%
40 to 64	755	582	1,337	37%	33%	35%
65 to 74	188	132	320	9%	7%	8%
Over 75	271	139	410	13%	8%	11%
Total	2,056	1,780	3,836	100%	100%	100%

Gender	RoR - No	RoR - Yes	Total	RoR - No	RoR - Yes	Overall
Female	440	260	700	21%	15%	18%
Male	1,616	1,520	3,136	79%	85%	82%
Total	2,056	1,780	3,836	100%	100%	100%

Source: BITRE NCD (unpublished).

Table 2.4.2: Vehicle controllers involved in fatal crashes - age group and gender

Age Group	RoR - No	RoR - Yes	Total	RoR - No	RoR - Yes	Overall
0 to 16	34	19	53	1%	1%	1%
17 to 25	965	574	1,539	17%	26%	20%
26 to 39	1,494	591	2,085	26%	27%	27%
40 to 64	2,263	689	2,952	40%	31%	38%
65 to 74	434	156	590	8%	7%	8%
Over 75	415	154	569	7%	7%	7%
Unknown	70	7	77	1%	0%	1%
Total	5,675	2,190	7,865	100%	100%	100%

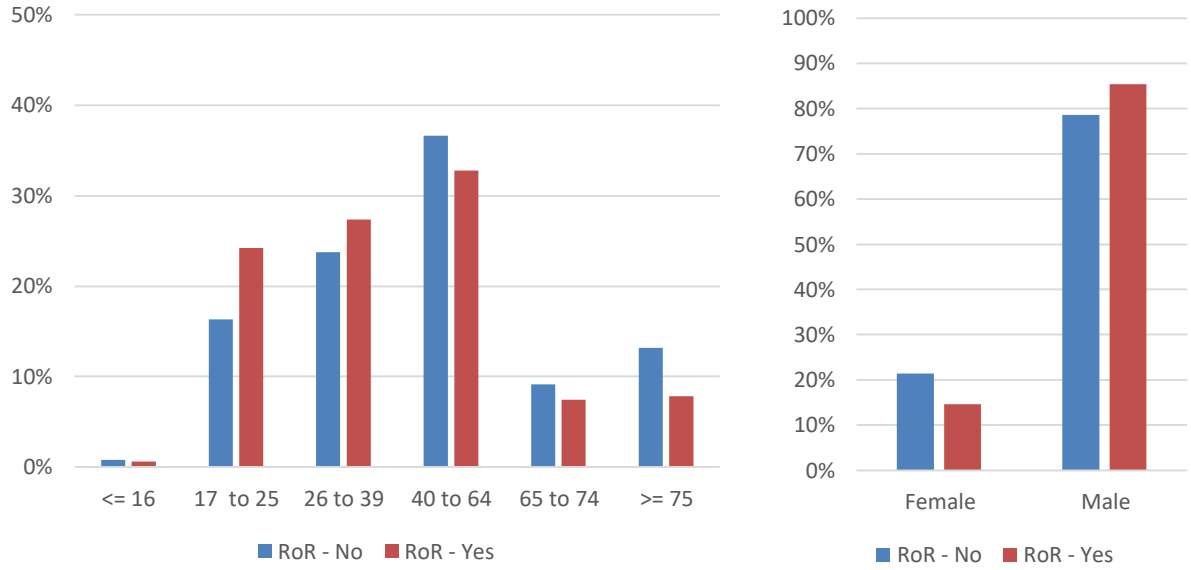
Gender	RoR - No	RoR - Yes	Total	RoR - No	RoR - Yes	Overall
Female	1,271	360	1,631	22%	16%	21%
Male	4,340	1,822	6,162	76%	83%	78%
Unknown	65	8	72	1%	0%	1%
Total	5,675	2,190	7,865	100%	100%	100%

Source: BITRE NCD (unpublished).

Around 80 per cent of vehicle controllers in all fatal crashes are male – this increases to 85 per cent for fatal run-off road crashes. Figure 2.2.1 and 2.2.2 summarise age group and gender differences for vehicle controllers who died and all vehicle controllers involved.

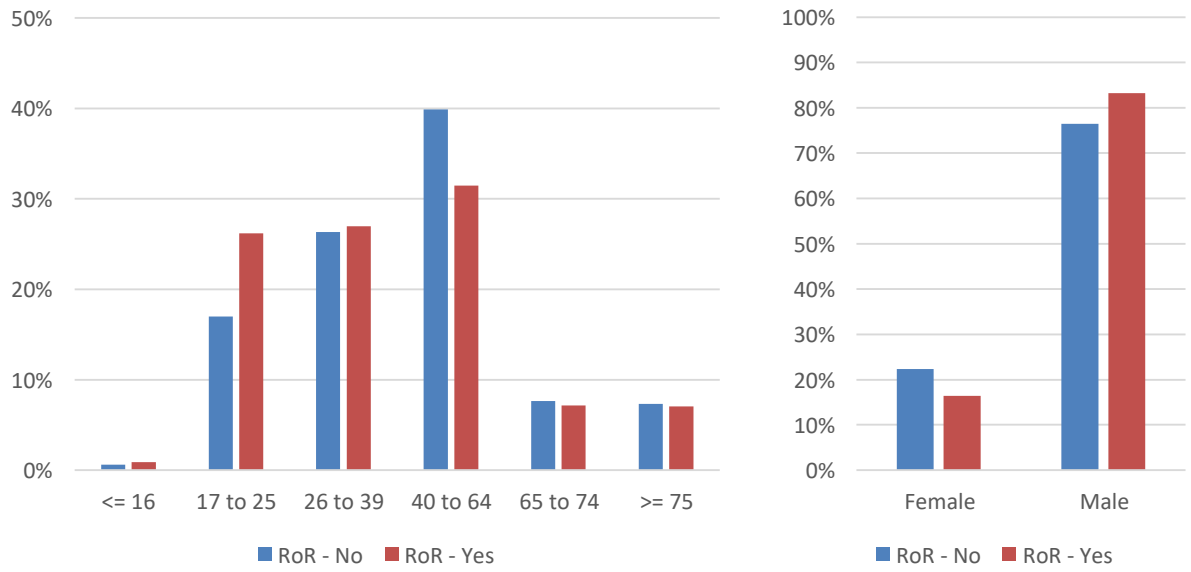
Figure 2.2.1 and 2.2.2 summarise age group and gender differences for vehicle controllers who died and all vehicle controllers involved.

Figure 2.2.1: Vehicle controllers died in fatal crashes - age group and gender



Source: BITRE NCD (unpublished).

Figure 2.2.2: Vehicle controllers involved in fatal crashes - age group and gender



Note: Percentages of "Unknown" (in both bar charts) are close to zero and not presented in the graph.
Source: BITRE NCD (unpublished).

Risky behaviours

While information on risky behaviours (including driving with excess alcohol or with illegal drugs in their system, driving without wearing a restraint or driving without a valid licence) are often not reported in crash data, where data is available it suggests that these are more common in fatal run-off road crashes than other crash types (Table 2.5).

Table 2.5: Risky behaviours in fatal crashes

	RoR - No	RoR - Yes	Road users involved	Exclusion	Unknown
Alcohol test - Fail	5%	19%	Driver, Motorcyclist	VIC, WA	28%
Valid licence - No	5%	12%	Driver, Motorcyclist	WA	11%
Restraint used - No	5%	20%	Driver, Passenger		33%
Helmet worn - No	8%	10%	Pedal cyclist, Motorcyclist, Motorcycle pillion passenger		3%
Drug test - Positive			Driver, Motorcyclist	VIC, WA, QLD	84%

Note: Alcohol test results exclude data from VIC and WA.
Licence status is unavailable from WA.
Restraint used is for drivers and vehicle passenger.
Helmet worn is for pedal cyclists, motorcyclists and motorcycle pillion passengers.
Drug test results in the NCD contain a large number of records with unknown values. In all fatal crashes - either run-off road or not - 84% of drug tests results (for vehicle controllers involved - excluding VIC, WA and QLD) are unknown. The percentage of unknown records of drug tests from fatal run-off road crashes is 75%.

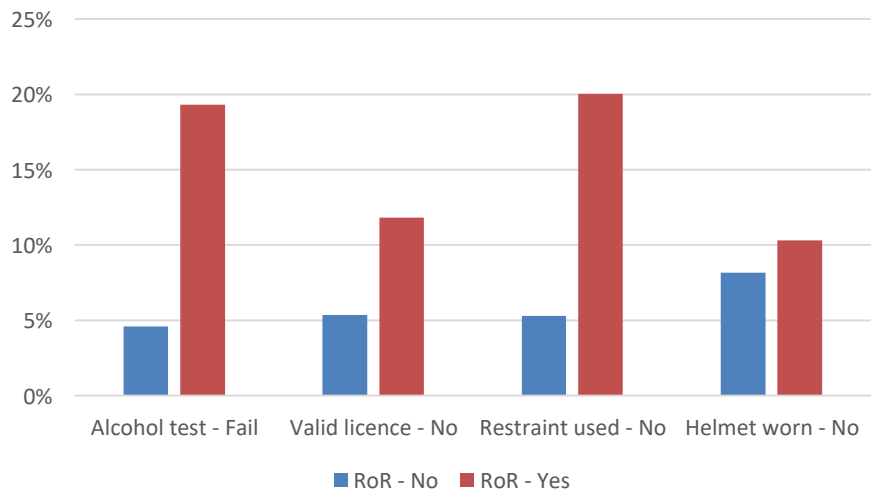
Source: BITRE NCD (unpublished).

When road users are involved in fatal non-run-off road crashes, approximately 5 per cent of road controllers or occupants have any of above risky behaviours. More than 8 per cent of pedal cyclists and motorcyclists (including pillion passengers) were not wearing a helmet. However, when road users are involved in fatal run-off road crashes, there can be more than one risk factor involved, such as drink driving, driving without a valid licence, not using restraint or not wearing helmet.

A vehicle controller in a fatal run-off road crash (Figure 2.3) was:

- Almost four times as likely to be over their alcohol limit or not wearing a restraint as controllers in other fatal but not run-off road crashes.
- More than twice as likely to be without a valid licence as for all other fatal but not run-off road crashes.

Figure 2.3: Risky behaviour - vehicle controller and/or occupants in fatal crashes, 2016-2020



Source: BITRE NCD (unpublished).

It was not possible in this study to investigate other risky behaviours, including driver fatigue, speeding and mobile phone using while driving, due to data limitations.

Vehicles

Light vehicles (passenger cars, motorcycles, and vans) are more likely to be involved in run-off road crashes (93.5%) than other crash types (83.8%) (Table 3.1). Figure 3.1 shows that trucks (heavy rigid and heavy articulated) and buses are less likely to be involved in run-off road crashes, and together account for less than 10 per cent of all vehicles involved in fatal run-off road crashes.

In terms of vehicle ages at the time of the fatal crash, two age groups - 0 to 5 years and 6 to 10 years - account for more than half of all vehicles involved in fatal non-run-off road crashes. In comparison, 46 per cent of all vehicles involved in fatal run-off road crashes fall into two vehicle age groups - 11 to 15 years and 16 to 20 years.

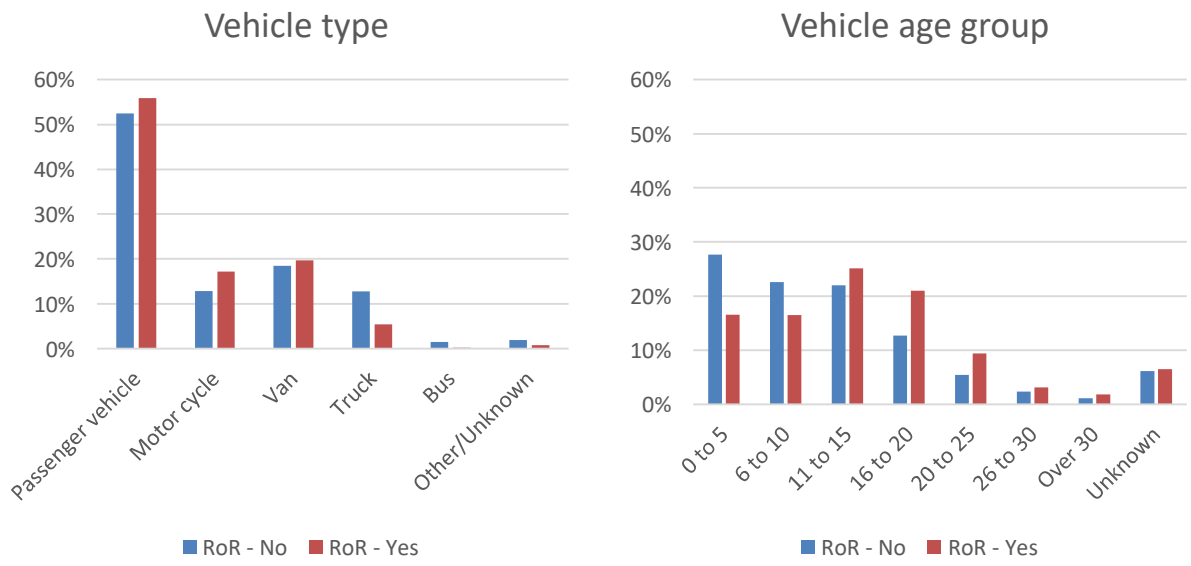
For fatal non-run-off road crashes, the percentages decrease as values of vehicle age groups increase. The majority (more than 70 per cent) of vehicles involved in fatal non-run-off road crashes are less than fifteen years old. For fatal run-off road crashes, vehicle age groups are skewed towards older age groups.

Table 3.1: Motor vehicles identified in fatal crashes, 2016-2020

	RoR - No	Proportion	RoR - Yes	Proportion
Passenger vehicle	3,013	52.5%	1,239	56.3%
Motor cycle	737	12.8%	381	17.3%
Van	1,060	18.5%	436	19.8%
Heavy Rigid	343	6.0%	51	2.3%
Heavy Articulated	391	6.8%	69	3.1%
Bus	86	1.5%	5	0.2%
Other	82	1.4%	13	0.6%
Unknown	27	0.5%	5	0.2%
Total	5,739	100%	2,199	100%

Note: Pedal cycles and pedestrians are excluded from this table as they are crash units but not motor vehicles. "Other" is a vehicle not categorised elsewhere. For example, a tractor.
Source: BITRE NCD (unpublished).

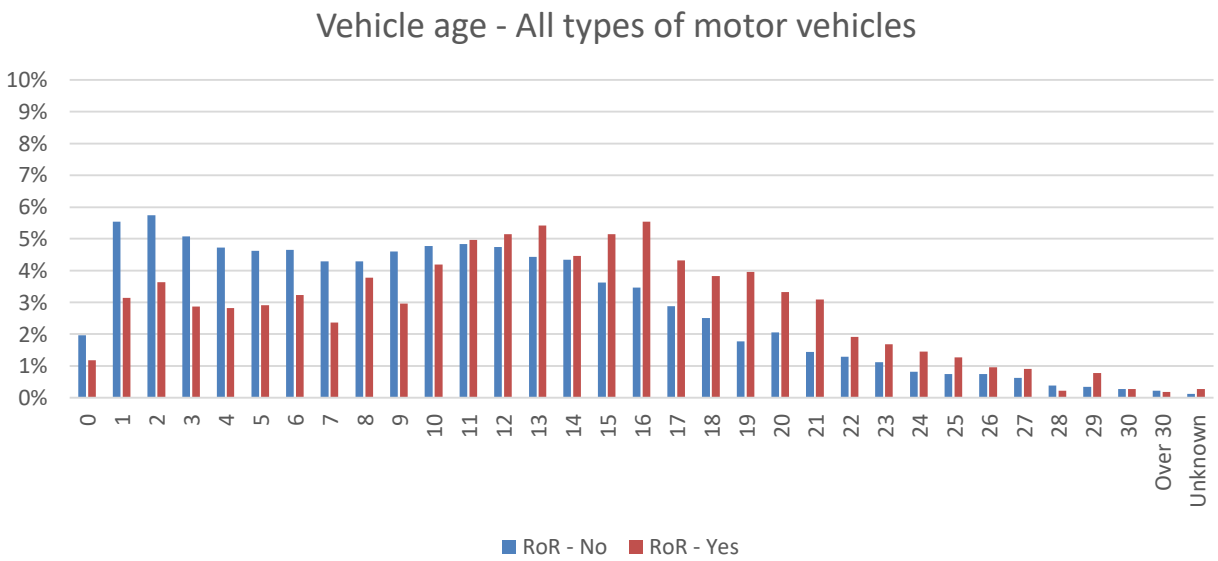
Figure 3.1: Vehicle types and vehicle age groups in fatal run-off road crashes, 2016-2020

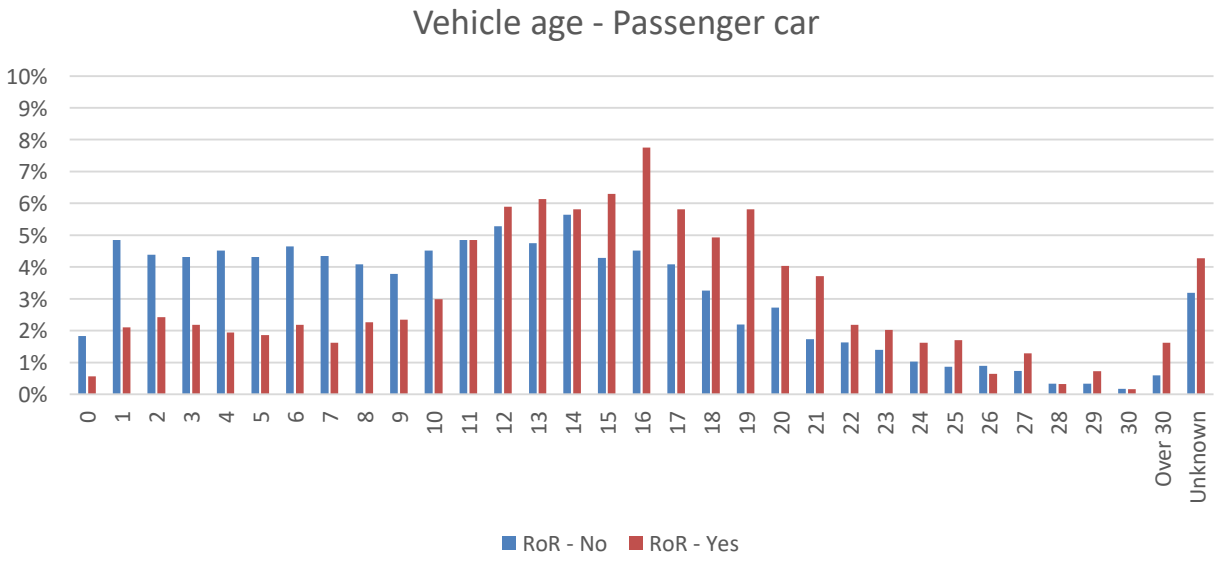


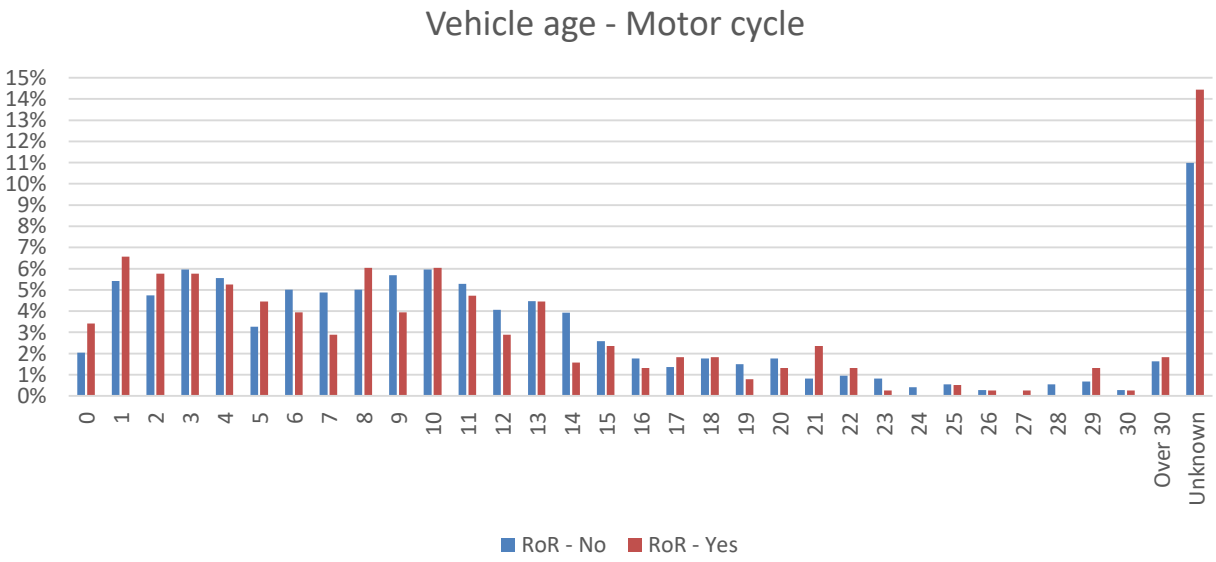
Note: Vehicle age is the age of vehicle at the time of crash, i.e. vehicle age = crash year – manufacture year of the vehicle.
Source: BITRE NCD (unpublished).

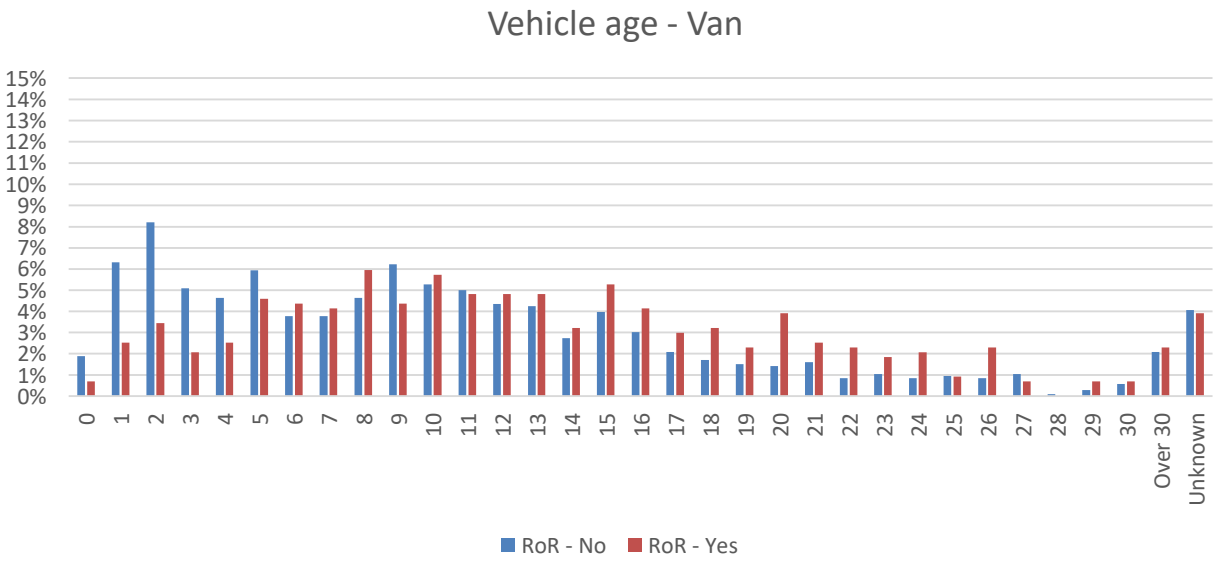
Figures 3.2 presents a distribution of vehicle age by vehicle type. It further confirms that vehicles involved in run-off road crashes are older than those in fatal non-run-off road crashes. However, passenger cars and motor cycles are usually older than commercial vehicles (vans, trucks and buses). Therefore, histograms on vehicle age of different types of vehicles are provided as well.

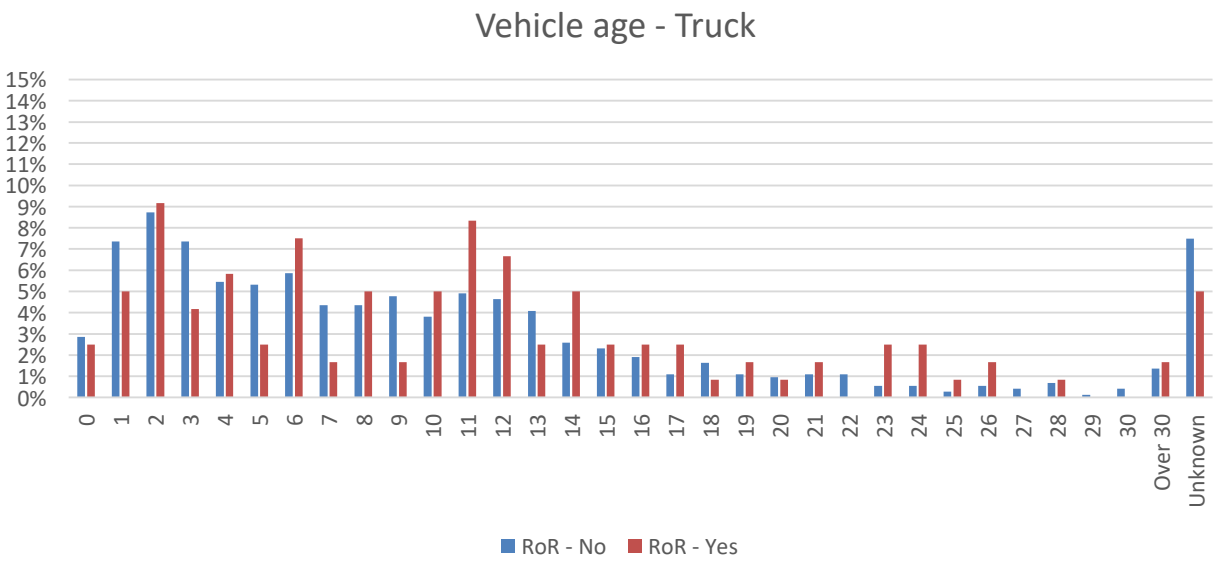
Figure 3.2: Histogram on vehicle age by vehicle type











Source: BITRE NCD (unpublished).

Crashes

The following table is repeated intentionally as a reminder of selected fields on crash level to readers:

Table 4.1: Selection of fields on crash level

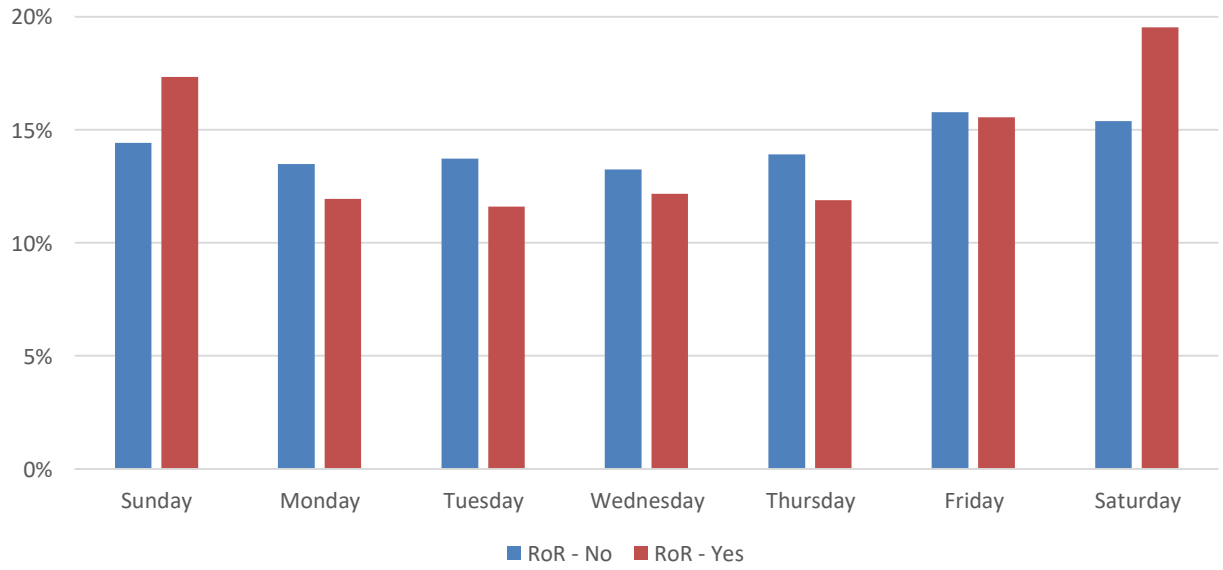
	Field	Description
Crashes	Day of week[1]	Sunday, Monday … Saturday. Day of week starts from midnight (12 am) to the following midnight.
	Weekday versus Weekend[1]	Weekend: Friday 6 pm - Monday 6 am
	Day versus Night[1]	6 am to 6 pm versus 6 pm to 6 am
	Hour[1]	0, 1, 2, … 23
	Speed limit zone[1]	<= 40 km/h, 50 km/h, 60 to 70 km/h, 80 to 90 km/h, 100 km/h, >= 110 km/h, Unknown
	Remoteness[1, 2]	Major Cities, Regional, Remote
	Road type[1, 3]	National or State Highway, Arterial Road, Sub-arterial Road, Collector Road, Local Road
	Alignment (Horizontal)[4]	Curved, Straight
	Alignment (Vertical) [4]	Crest, Dip, Grade, Level
	Lighting[4]	Daylight, Dawn/dusk, Darkness
	Road surface[4]	Dry, Wet
	Weather[4]	Fine/Clear, Raining

Note: 1. As reported by jurisdictions;
2. Grouping based on ABS Remoteness Structure;
3. Geoscape roads hierarchy (formerly PSMA);
4. State and territory open datasets.

Sources: BITRE NCD (unpublished); open datasets from jurisdictions.

Comparing fatal run-off road crashes with non-run-off road crashes, the former is more likely to occur on Saturday and Sunday.

Figure 4.1: Day of week - fatal crashes, 2016-2020



Source: BITRE NCD (unpublished).

A weekend is defined as starting from Friday afternoon (6 pm) and ending at Monday early morning (6 am). The remainder of a week (from 6 am on Monday to 6 pm on Friday) is defined here as weekdays. In terms of hours, a weekend includes 60 hours - approximately 36 per cent of a week.

Approximately 38 per cent of fatal non-run-off road crashes happened at the weekend while the corresponding percentage of fatal run-off road crashes is 45 per cent (Table 4.2).

Table 4.2: Weekday versus Weekend

	RoR - No	RoR - Yes
Weekday	62%	55%
Weekend	38%	45%
Total	100%	100%

Source: BITRE NCD (unpublished).

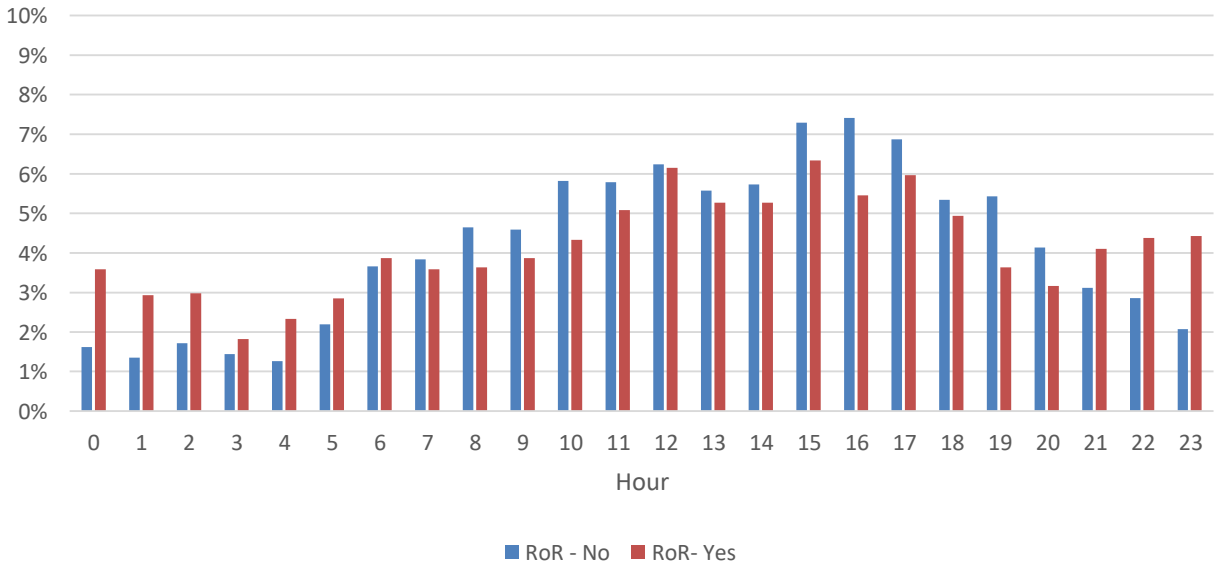
A day is considered to start from 6 am and ends at 6 pm and the remainder of a 24-hour cycle is considered as night. In other words, half of a 24-hour cycle is considered as a day and the other half as night. While only one third of fatal non-run-off road crashes happened during night time, over 40 per cent of fatal run-off road crashes happened after 6 pm (Table 4.3). Figure 4.2 provides crash counts by hour.

Table 4.3: Day versus Night

	RoR - No	RoR - Yes
Day	67%	59%
Night	33%	41%
Total	100%	100%

Source: BITRE NCD (unpublished).

Figure 4.2: Histogram of hours



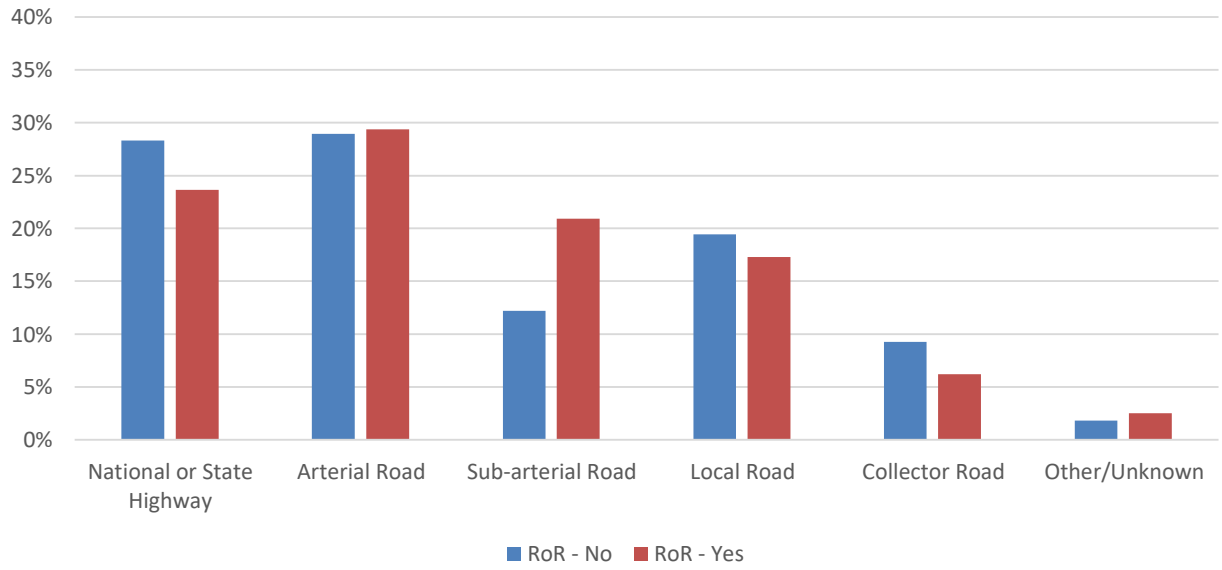
Source: BITRE NCD (unpublished).

Overall, fatal crashes occur mostly in the afternoon and morning. However, run off road fatal crashes are more likely to occur from dusk to dawn. This is consistent with previous analysis (Table 4.3). Fatal run-off road crashes often occurred when it's late and very early - from 9 pm to 6 am. During each of those hours, percentages of fatal run-off road are higher than percentages of fatal non-run-off road crashes. The difference is most obvious from 11 pm to 2 am.

Run-off road crashes are often reported in high speed areas in Australia. The following analysis focus on geographical features combined with speed limits.

Road types are classified and determined by matching the crash location to the Australian road network based on the Geoscape roads hierarchy.

Figure 4.3: Road types



Note: The chart excluded Queensland and Western Australia.
Queensland does not use the "Arterial" category.
Western Australia does not use the "Sub-arterial" and "Collector" categories.
Source: BITRE NCD (unpublished).

Overall, around 90 per cent of all fatal crashes occur on national or state highways, local roads, arterial roads and sub-arterial roads. National or state highways and arterial roads are the two main road types where more than half of fatal crashes occurred. However, the percentage of fatal run-off road crashes that happened on sub-arterial roads is much higher than that of fatal non-run-off road crashes.

In Australia, the States and Territories apply a default speed limits in the absence of a speed restriction signage. Outside of built up areas, there are speed limit of 100 km/h in the majority of jurisdictions and 110 km/h in Western Australia and the North Territory. Within built up areas, there is a speed limit of 50 km/h in all states and territories except for the North Territory (60 km/h).

Many national or state highways are zones with speed limits of 100 km/h or 110 km/h. Some arterial roads are zoned 80 km/h while many sub-arterial roads are zoned 60 km/h.

In the National Crash Database, "National Posted Speed Limit" is a standardised field based on values provided by states or territories.

It is also noteworthy that posted speed limit refers to the road environment, not the actual speed of a vehicle when a fatal crash happened.

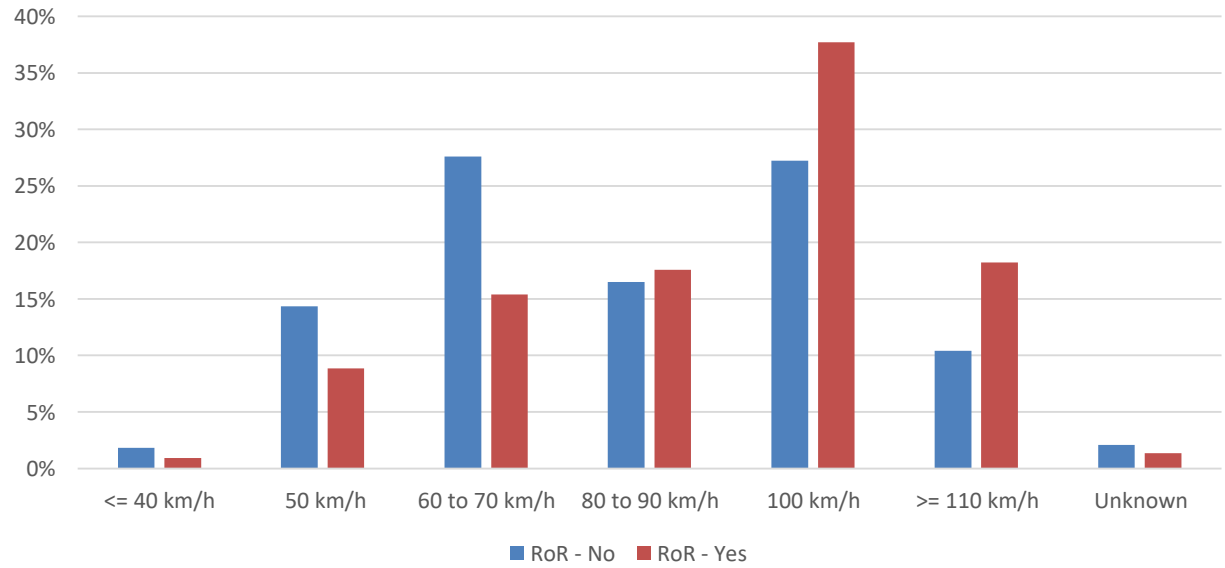
The following table provides information of posted speed limit zones on different roads based on all fatal crashes from 2016 to 2020 in Australia.

Table 4.4: Road types and distributions of posted speed limits, 2016-2020

Posted speed limit zone	National or State highway	Arterial road	Sub-arterial road	Local road	Collector road
<= 40 km/h	1%	1%	2%	2%	5%
50 km/h	1%	5%	4%	37%	23%
60 to 70 km/h	11%	31%	28%	21%	38%
80 to 90 km/h	16%	19%	21%	14%	12%
100 km/h	40%	32%	41%	17%	17%
>= 110 km/h	30%	11%	3%	7%	0%
Unknown	1%	1%	0%	2%	5%
Total	100%	100%	100%	100%	100%

Note: This table includes all jurisdictions in Australia.
Queensland does not use the “Arterial” category and Western Australia does not use the “Sub-arterial” and “Collector” categories.
Source: BITRE NCD (unpublished).

Figure 4.4: Posted speed limits



Source: BITRE NCD (unpublished).

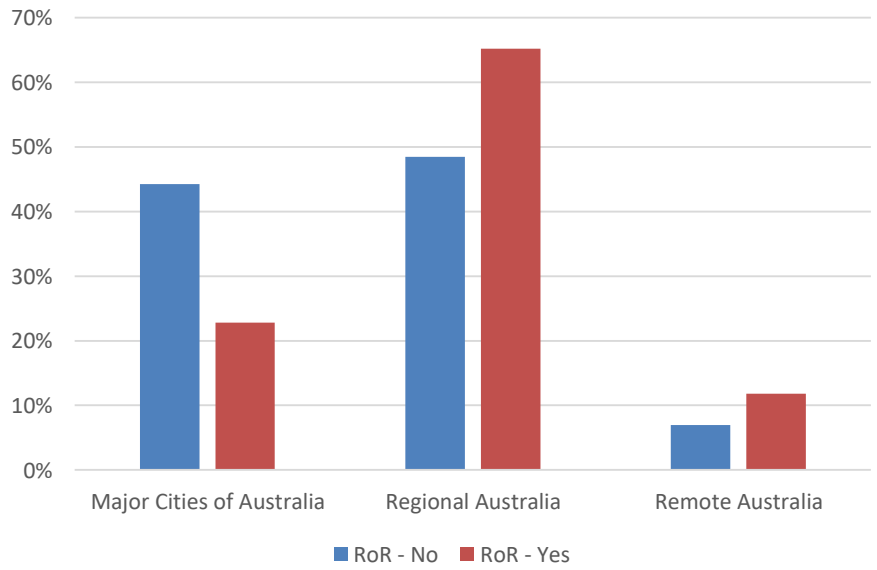
The percentage of fatal run-off road crashes occurring in high speed limit zones is much higher than the percentage of fatal but non-run-off road crashes. Almost 38 per cent of fatal run-off road crashes happened in high speed zones with a limit of 100 km/h. While only 10 per cent of other fatal crashes happened in zones with a speed limit above 110 km/h, the percentage of fatal run-off road crashes is 18 per cent.

The regional classification in the National Crash Database is based on the Australian Statistical Geography Standards (ASGS) of remoteness structure (Australian Bureau of Statistics 2016).

The ABS national remoteness structure has five categories which have been grouped into three main categories for this analysis. Grouping of remoteness categories does not affect data analysis on fatal crashes because it tells the same story before and after the grouping. This is also true when remoteness is further categorised with different posted speed limits.

Figure 4.5 shows that most fatal crashes happened in regional areas or major cities of Australia. For fatal run-off road crashes, the difference between regional Australia and major cities is quite significant - 65 per cent of fatal run-off road crashes happened in regional areas while the percentage of fatal non-run-off road crashes is less than 50 per cent. More than 40 per cent of fatal non-run-off road crashes happened in major cities while only about 20 per cent of fatal run-off road crashes happened in major cities.

Figure 4.5: Remoteness



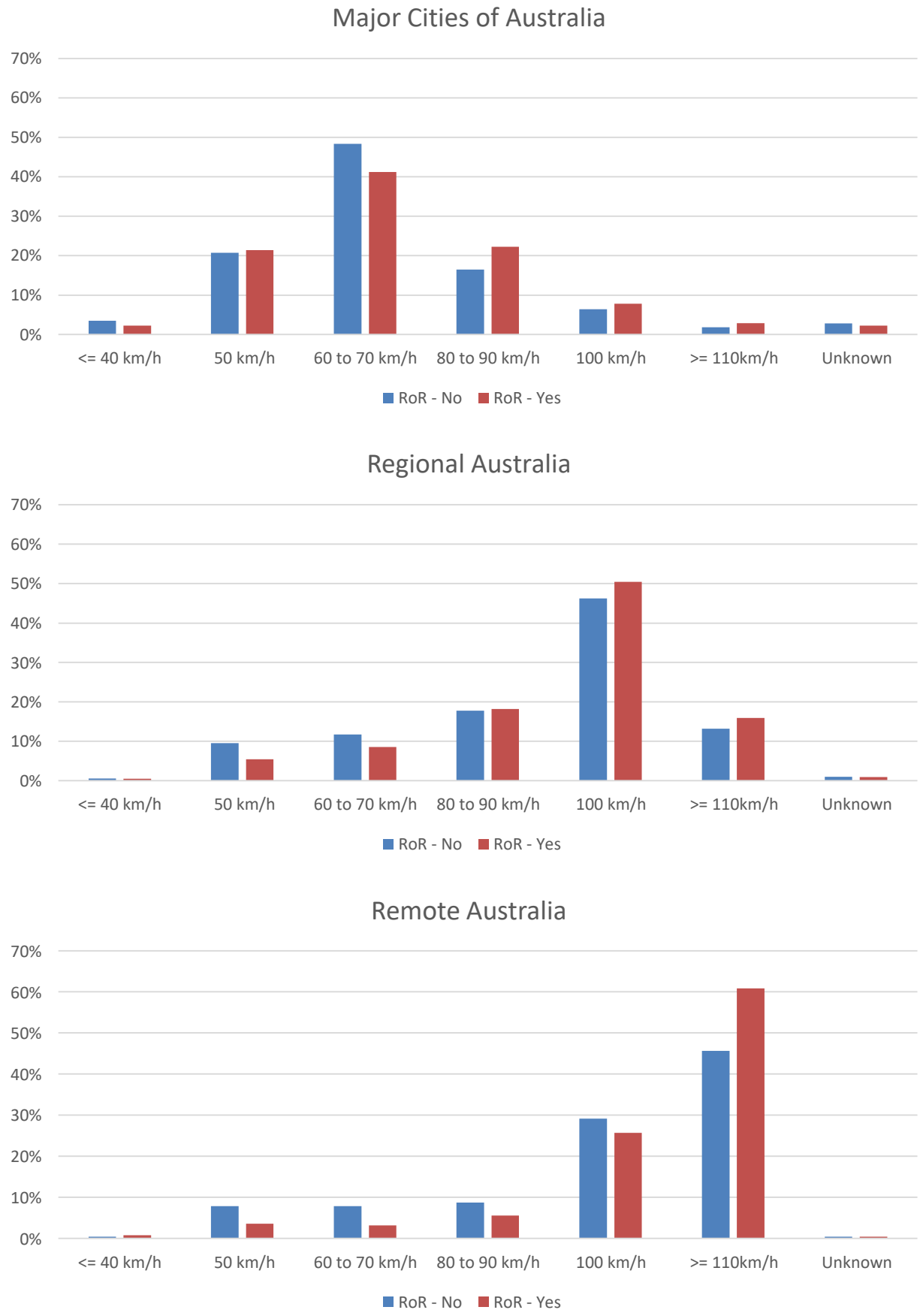
Source: BITRE NCD (unpublished).

Figure 4.6 provides a three-dimensional view by combining remoteness areas with speed limit zones and by categorising fatal crashes into run-off road and all other fatal crash types.

Most fatal crashes in major cities occurred where the posted speed limits was between 60 km/h and 90 km/h. Half of fatal crashes that happened in regional areas where the speed limit is 100 km/h. Many fatal crashes in remote areas were on roads with a posted speed limit of at least 110 km/h. There is a correlation between the posted speed limit and the remoteness of a crash location. The more remote the crash location, the more likely that the posted speed limit is higher.

When looking at fatal crashes only, run-off road crashes are associated more strongly with higher speed-limit zones (≥ 100km/h) than are non-run-off road crashes. This association with higher speed zones can be examined further by categorising the crash counts also by remoteness area. In major city locations, all speed zones above 80 km/h are associated with fatal run-off road crashes. In regional locations, only zones posted 100km/h or above have this association, and in remote areas, run-off road crashes occur more frequently at zones 110km/h or above.

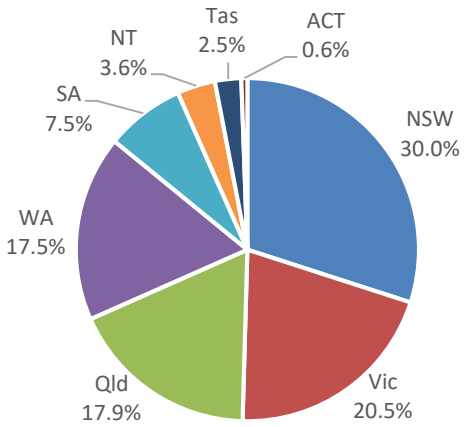
Figure 4.6: Remoteness and Posted speed limits



Source: BITRE NCD (unpublished).

Between 2016 to 2020, more than 85 per cent of fatal run-off road crashes happened in one of the four biggest states (in terms of population size) - New South Wales, Victoria, Queensland and Western Australia.

Figure 4.7: Fatal run-off road crashes by jurisdiction, 2016-2020



Source: BITRE NCD (unpublished).

Unexpected road curves, poor road surface conditions, poor natural lighting conditions or extreme weather conditions are risk factors contributing to fatal run-off road crashes. These fields are not included in the National Crash Database but are provided in open datasets published by some jurisdictions.

Six jurisdictions published datasets but only four big states provide geometric and/or atmospheric condition information in their datasets. South Australia's dataset does not contain Definitions for Classifying Accidents codes and it is not feasible to analyse this data for the purposes of this research.

The following analyses focuses on geometric features and atmospheric conditions with respect to run-off road crashes using datasets published by Queensland, News South Wales and Victoria. Apart from fatal crashes, crashes by jurisdiction reported injury levels are included in Table 4.5. The number of fatal crashes over the five year period in each jurisdiction is limited and may not be significant.

Table 4.5: Crashes by severity levels from States, 2016-2020

	Severity level	RoR - No	RoR - Yes
New South Wales	Fatal	2%	4%
	Serious injury	27%	39%
	Moderate injury	38%	44%
	Minor/Other injury	33%	13%
	Total	100%	100%
Victoria	Fatal accident	1%	3%
	Serious injury accident	26%	39%
	Other injury accident	73%	57%
	Total	100%	100%
Queensland	Fatal	1%	3%
	Hospitalisation	39%	61%
	Medical treatment	45%	27%
	Minor injury	15%	9%
	Total	100%	100%

Note: Jurisdiction definitions of 'serious injury' differ and are not directly comparable.
Sources: Open data from jurisdictions.

Table 4.6: Geometric and atmospheric conditions from States, 2016-2020

	Field	Description	RoR - No	RoR - Yes
New South Wales	Alignment	Curved	15%	44%
		Straight	85%	56%
	Lighting	Daylight	72%	56%
		Dawn/Dusk	10%	8%
		Darkness	18%	36%
	Surface	Dry	88%	79%
		Wet	12%	20%
		Other/Unknown	0%	1%
	Weather	Fine	86%	77%
		Raining	8%	14%
		Overcast	5%	7%
		Other/Unknown	1%	3%
Victoria	Lighting	Daylight	71%	60%
		Dawn/Dusk	6%	5%
		Darkness	20%	33%
		Unknown	3%	1%
	Surface	Dry	80%	74%
		Wet	13%	22%
		Other/Unknown	7%	4%
	Weather	Clear	80%	77%
		Raining	9%	15%
		Other/Unknown	11%	8%
Queensland	Alignment (Horizontal)	Curved - view obscured	3%	9%
		Curved - view open	16%	37%
		Straight	81%	54%
	Alignment (Vertical)	Crest	5%	6%
		Dip	3%	6%
		Grade	13%	18%
		Level	78%	70%
	Lighting	Daylight	75%	55%
		Dawn/Dusk	7%	7%
		Darkness	19%	38%
	Surface	Dry	90%	82%
		Wet	10%	18%
	Weather	Fine	93%	86%
		Raining	7%	12%
		Other	1%	1%

Sources: Open data from jurisdictions.

Road geometry is only available from datasets published by New South Wales and Queensland. In these two jurisdictions, curved alignment accounted for 44 per cent of run-off road crashes with casualties, comparing to 15 per cent of other crash types.

Natural lighting, which affects visibility, can also play a significant role in run-off road crashes. The percentage of run-off road crashes with casualties that occurred when it was dark was much higher than the percentage of non- run-off road crashes with casualties. At least a third of run-off road crashes with casualties occurred when it was dark, approximately twice the proportion for non-run-off road crashes with casualties.

Wet and slippery road surface can affect vehicle control and therefore contribute to the occurrence of road crashes with casualties. This was more evident in run-off road crashes - around 20 per cent of run-off road crashes with casualties occurred on wet roads, compared with 12 per cent of non-run-off road crashes.

Weather seems to be another risk factor, affecting visibility and ability to control a vehicle, for all crashes with casualties. Percentages of run-off road crashes with casualties when it was raining are more than 10 per cent. While for non-run-off road crashes with casualties, those percentages are less than 10 per cent.

Glossary

Road casualties

A **road crash** is a crash reported to police resulting from the movement of at least one road vehicle on a public road and involving death or injury of any person, or property damage.

A **fatal crash** is a road crash where there is at least one road death.

A **road death** or **fatality** is a person who dies within 30 days from injuries received in a road crash.

A **hospitalised injury** is a person involved in a road crash who requires medical treatment for injuries sustained in the crash and is confirmed as being admitted to hospital, irrespective of the length of stay, who does not die from their injuries within 30 days.

Other types of injury (requires medical treatment) are considered as injury-not hospitalised.

Road user classifications

A **driver** is a person in control of a vehicle (except a motor bike, pedal cyclist, animal or animal-drawn vehicle). Does not include a person pushing a motorised wheelchair.

A **vehicle occupant** is a vehicle driver or vehicle passenger.

A **motorcyclist** is a motorcycle rider or pillion passenger.

A **vehicle controller** is either a driver or motorcycle rider.

A **pedal cyclist** (also referred to as a cyclist or bicyclist) is a pedal cycle rider or pillion passenger.

A **pedestrian** is a person on foot, whether stationary or moving, or lying, sitting or working:

- in a motorised wheelchair that cannot travel at more over 10 kilometres an hour;
- in a pushing a non-motorised wheelchair;
- in or on a wheeled recreational device or wheeled toy;
- riding a skateboard, in a pram, or a cart.

Motor vehicle types

A **road vehicle** includes motor vehicles, pedal cycles, towed devices, machines and ridden animals, but excludes skateboard, carts, prams and non-motorised wheelchairs.

A **passenger vehicle** is a motor vehicle constructed for the carriage of persons and contains less than 10 seats.

A **motorcycle** is a two or three wheeled motor vehicle constructed for the carriage of one or two persons.

A **van** or **light commercial vehicle** is a motor vehicle constructed for the carriage of goods or specialised equipment which is no more than 4.5 tonnes of Gross Vehicle Mass (GVM).

A **heavy rigid truck** is a motor vehicle constructed with a load carrying area or fitted with special purpose equipment and greater than 4.5 tonnes of GVM.

An **articulated truck** is a motor vehicle constructed for load carrying or fitted with special purpose equipment, consisting of a prime mover that has no significant load carrying area but with a turntable device.

A **bus** is a motor vehicle constructed for the carriage of passengers with 10 or more seats.

Road types

National or State Highways are major interstate through route, and/or are principal connector roads between capitals and/or major regions and or key towns/commercial centres/inter-transport hubs.

Arterial roads are well maintained and widely used roads which are major connectors for national highways or state highways, major centres, key towns, or have major tourist importance or which main function is to form the principal avenue of communication for metropolitan traffic movement.

Sub-arterial roads act as connectors between highways and/or arterial roads, or as an alternative for arterial roads, or a principal avenue for massive traffic movements.

Local roads provide property access and include service roads that may share the same name as higher order roads.

Collector roads provide for traffic movement between sub-arterial and local roads or to distribute traffic to local street systems.

Other roads include access roads and pedestrian thoroughfares.

However, Queensland does not use the “Arterial” category. Western Australia does not use the “Sub-Arterial” and “Collector” categories.

Appendix A

The following table includes all selected Definitions for Classifying Accidents (DCA) or Road User Movement (RUM) codes for run-off road crashes of all Australian states and territories.

Table A1: Selection of DCA/RUM codes for run-off road crashes

NSW		Vic		Qld		SA		WA		Tas		NT		ACT	
70	80	170	180	700	800	170	180	70	80	170	180	70	80	70	80
71	81	171	181	701	801	171	181	71	81	171	181	71	81	701	801
72	82	172	182	702	802	172	182	72	82	172	182	72	82	702	802
73	83	173	183	703	803	173	183	73	83	173	183	73	83	703	803
	84			704	804			74	84				84	704	804
75	85	175				175				175		75	85		
	86			706	806			76					86	706	806
	87			707	807			77					87	707	807
79	89	179	189			179	189			179	189	79	89		

Note: For diagrams of each jurisdiction's DCA or RUM codes, please check reports from Austroads in references.
76 and 77 in the NCD are 706 and 707 in WA's diagram of RUM codes.
Source: BITRE NCD (unpublished).

Table A2: Availability of open datasets (by theme) from jurisdictions

	NSW	Vic	Qld	SA	WA	Tas	NT	ACT
Persons	Unavailable	Available	Available	Available	Unavailable	Unavailable	Unavailable	Unavailable
Vehicles	Available	Available	Available	Available	Unavailable	Unavailable	Unavailable	Unavailable
Crashes	Available	Available	Available	Available	Available	Unavailable	Unavailable	Available

Note: Geometric and/or atmospheric conditions are unavailable from Western Australia.
Sources: Open data from jurisdictions.

References

Australian Bureau of Statistics (ABS) 2021, *Australian Statistical Geography Standards (ASGS)*, cat. no. 1207.0.55.055, ABS, viewed 1 Nov 2021, <https://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/1270.0.55.005Main+Features1July%202016?OpenDocument>.

Australian Bureau of Statistics (ABS) 2021, Motor Vehicle Census, cat. no. 9309.0, ABS, viewed 1 Dec 2021, <https://www.abs.gov.au/statistics/industry/tourism-and-transport/motor-vehicle-census-australia/31-jan-2021#key-statistics>.

Austroads 2021, *Guide to Road Safety Part 2: Safe Roads*, AGRS02-21, Austroads, Sydney, NSW. Available from: < https://austroads.com.au/publications/road-safety/agrs02 >.

Austroads 2015, *Guide to Road Safety Part 8: Treatment of Crash Locations*, AGRS08-15, Austroads, Sydney, NSW.

Austroads 2014, *Improving Roadside Safety Summary Report*, AP-R437-14, Austroads, Sydney, NSW.

Austroads 2014, *Investigation of Key Crash Types - Run-off-road and Head-on Crashes in Urban Areas: Final Report*, AP-R450-14, Austroads, Sydney, NSW.

Austroads 2010, *Road Safety Engineering Risk Assessment Part 10: Rural Run-off-road Crashes*, AP-T155/10, Austroads, Sydney, NSW.

Bureau of Infrastructure and Transport Research Economics (BITRE) 2021, *Modelling road safety in Australian states and territories*, BITRE, Canberra, ACT.

Bureau of Infrastructure and Transport Research Economics (BITRE) 2021, *National Crash Database (unpublished)*, BITRE, Canberra, ACT.

Bureau of Infrastructure and Transport Research Economics (BITRE) 2021, The *National Crash Database Report Volume 2 - Structure and metadata (unpublished)*, BITRE, Canberra, ACT

Department of Transport Open Data Hub 2021, *Fatal Crashes - Lives Lost, Last 5 Years to Date*, Victoria State Government, viewed 22 Oct 2021, <https://opendata.transport.nsw.gov.au/dataset/nsw-crash-data>.

Department for Infrastructure and Transport 2021, *Road Crash Data*, Government of South Australia, viewed 25 Oct 2021, <https://data.sa.gov.au/data/dataset/road-crash-data>.

Infrastructure and Transport Ministers 2022, *National Road Safety Strategy 2021-30*, Department of Infrastructure, Transport, Regional Development and Communications, Canberra, ACT, viewed 28 Feb 2022, <https://www.roadsafety.gov.au/nrss>.

Main Roads Western Australia 2021, *Crash Information (Last 5 Years)*, The Government of Western Australia, viewed 26 Oct 2021, <https://portal-mainroads.opendata.arcgis.com/datasets/mainroads::crash-information-last-5-years/about>.

Sammells C. 2011, *An examination of ROR crashes in Western Australia*, State Traffic Operations, WA Police, Midland, WA

Transport and Main Roads, Open Data Portal 2021, Crash data from Queensland roads, Queensland Government, viewed 26 Oct 2021, <https://www.data.qld.gov.au/dataset/crash-data-from-queensland-roads>.

Transport Canberra and City Services, Open Data Portal 2021, *ACT Road Crash Data*, ACT Government, viewed 9 Nov 2021, <https://www.data.act.gov.au/Transport/ACT-Road-Crash-Data/6jn4-m8rx>.

Transport for NSW, Centre for Road Safety 2021, *NSW Road Crash Data - 2016-2020*, NSW Government, viewed 25 Oct 2021, <https://opendata.transport.nsw.gov.au/dataset/nsw-crash-data>.

ISSN 1440-9593

March 2022

Acknowledgement

This Information Sheet was prepared by Rachel Wu. The author thanks Tim Risbey, Peter R Johnston, Mark Cregan and Elly Jung for their contributions, and Road Safety Data Hub colleagues in the Office of Road Safety for their comments.

Use of the Coat of Arms

Contact us

Department of Infrastructure, Transport, Regional Development and Communications and the Arts
Bureau of Infrastructure and Transport Research Economics (BITRE)
GPO Box 501, Canberra ACT 2601, Australia

Phone: (international) +61 2 6274 7210
Fax: (international) +61 2 6274 6855
Email: bitre@infrastructure.gov.au
Website: www.bitre.gov.au