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Contents

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This report was written by Amanda Tovell at the AIHW NISU at Flinders University, with assistance from James Harrison and Stacey Avefua.

Abbreviations

ABS	Australian Bureau of Statistics
ASCIR	Australian Spinal Cord Injury Register
AIHW	Australian Institute of Health and Welfare
ASIA	American Spinal Injury Association
DIC	duration of initial care
ERP	estimated resident population
ICD-10-AM	International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification
ISNCSCI	International Standards for Neurological Classification of Spinal Cord Injury
LOS	length of stay
NISU	National Injury Surveillance Unit
RA	Remoteness Area
SCI	spinal cord injury
SU	spinal unit
WHO	World Health Organization

Symbols

CI	confidence interval
p	statistical significance p value
SD	standard deviation
SMR	standard mortality ratio

Summary

This 16th report in the *Spinal cord injury, Australia* series presents national statistics on spinal cord injury (SCI) using data from case registrations to the Australian Spinal Cord Injury Register for 2014–15.

There were 264 newly incident cases of traumatic SCI due to external causes reported for 2014–15. Of these cases, 254 resulted in persisting injury, 6 died and 4 had no long-term neurological injury. The neurological level of injury for all cases who died before discharge was C7 or higher (cervical level segments being C1–C8), and the time between injury and death ranged between 6 and 147 days.

The age-standardised rate of persisting traumatic SCI was estimated to be 12.8 cases per million population aged 15 and older. The age-specific rate was highest for ages 55–64 (19.9 cases per million), followed by 19.8 cases per million for ages 65–74.

Incidence rates of persisting traumatic SCI for males were higher across all age groups than those for females.

The median duration of initial care was longest for the most severe type of persisting traumatic SCI on admission—*Complete tetraplegia*. *Complete tetraplegia* is a neurological injury to the cervical spine, with no motor or sensory function preserved at the lowest sacral segments S4–S5. Half of these tetraplegia cases spent 219 days (approximately 7 months) or longer in hospital, from the time of injury to being discharged home from a specialist spinal unit.

Causes of spinal cord injury

Just over 2 in 5 (42%) traumatic SCI cases sustained in 2014–15 were due to a *Land transport crash* involving either a *Motor vehicle occupant* or an *Unprotected land transport user* such as a motor cyclist or pedestrian. Males accounted for 86% of traumatic SCI due to a *Land transport crash*. A further 40% of traumatic SCI were due to *Falls*.

Motor vehicle drivers (36 cases) and motorcycle drivers (36 cases) each contributed one-third of land transport-related SCI cases for this period. Pedal cyclists (13 cases; 12%) were the next most numerous type of land transport user injured, followed by motor vehicle passengers (12 cases; 11%). Cases involving quad-bikes accounted for 2% of all traumatic SCI sustained during 2014–15.

A *Low fall* from less than 1 metre, or a fall from an unspecified height, accounted for 20% of traumatic SCI cases in 2014–15. An equivalent proportion was reported as having sustained a *High fall* (20%). *Water-related* events, such as diving into shallow water or being dumped by a wave, accounted for 6% of cases during this period. Other reported mechanisms of injury included *Football*, including rugby codes (3%), *Heavy falling objects* (2%), and *Horse-related* events (2%). The remaining 6% of cases were due to *Other and unspecified causes*.

Just over one-third (35%) of traumatic SCI cases in 2014–15 were sustained while the person was participating in a *Sports or leisure* activity, and more than three-quarters (77%) were males. A further 10% of cases were injured *While working for income*, and all these cases were male. Nine truck drivers or operators of heavy machinery accounted for more than one-third (35%) of cases injured *While working for income*.

1 Introduction

Spinal cord injury (SCI) from traumatic causes imposes a heavy physical, psychological and economic burden on the injured people, their families and society because it often results in a high level of long-term disability and morbidity and an increased mortality risk. Hence, there is interest in national statistics on the incidence of traumatic SCI, the nature of people injured, the care provided to them, and the causes of the injuries. This report describes cases of traumatic SCI sustained between 1 July 2014 and 30 June 2015 that required admission to a specialist spinal unit (SU) in Australia. It uses data from the Australian Spinal Cord Injury Register (ASCIR).

Australian Spinal Cord Injury Register

The ASCIR was established in 1995 by the National Injury Surveillance Unit (NISU), a collaborating centre of the Australian Institute of Health and Welfare (AIHW) and Australian hospital spinal units specialising in acute management and rehabilitation of persons with an SCI. The ASCIR built on a register established a decade earlier by Mr John Walsh, AM.

Each year, approximately 300–400 newly incident cases of SCI from traumatic and non-traumatic causes are added to the register (See Box 1.1). This number underestimates the total number of incident (new) cases of SCI in Australia as it does not include people who were not admitted to a participating SU and those who did not consent to be included in the register. The 'Data quality statement' in Appendix A provides more information on the operation and management of the ASCIR and case ascertainment.

Annual reports on the incidence of SCI have been produced from the ASCIR since its inception. Early reports, based on data from the period 1995–96 to 1998–99, were published in the *Australian injury prevention bulletin*. Subsequent reports have been published in the AIHW Injury research and statistics series *Spinal cord injury, Australia*, and this is the 16th report of that type.

Estimated incidence of traumatic spinal cord injury

The estimated incidence of persisting traumatic SCI for Australian residents aged 15 and older, discharged alive, based on data reported to the ASCIR for the previous year, 2013–14, was 11.8 cases per million population (AIHW: Tovell 2018b). Population modelling using ASCIR data, supplementary data from the National Hospital Morbidity Database and data from Victoria's single paediatric trauma hospital, suggest that as at 30 June 2011, the lower estimate of traumatic SCI for all ages in Australia is 21.0 cases per million, while the upper estimate is 32.3 cases per million (New et al. 2015).

A recent study of the global incidence of traumatic spinal cord injuries estimated a global rate of 23 cases per million in 2007: nearly 180 thousand new traumatic SCI cases each year (Lee et al. 2014). The incidence rate for Australia based on the ASCIR data at a similar time period, 2007–08, was 15.0 cases per million aged 15 and older (AIHW: Norton 2010). The global study by Lee et al (2014) noted that estimated rates varied considerably by geographical region: for example, 40 cases per million for North America compared with 16 per million for Western Europe. An international comparison conducted for the World Health Organization (WHO) found country-specific rates that vary even more widely: 53 cases per million in Canada, compared with 13 cases per million for the Netherlands (Bickenbach et al. 2013). Caution needs to be applied to these estimates, however, as

inclusion criteria may differ (for example, the age ranges used, or where death occurs soon after injury), as may the types and quality of data sources on which they are based. For example, few countries have national compulsory registers. This caution also applies to the data reported for Australia, as the Australian Spinal Cord Injury Register does not have complete population coverage.

Mortality, life expectancy and estimated costs for traumatic SCI injury

People who acquire SCI and survive the early period with neurological deficits are, given current treatment options, likely to have a persisting condition (see Box 1.2). The level and extent of a neurological deficit are usually measured by the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) and includes the American Spinal Injury Association (ASIA) Impairment Scale, a practice followed in this report (see Glossary). These international standards were most recently revised in 2011 (Kirshblum et al. 2011).

Middleton et al. (2012) studied the mortality and life expectancy of people in NSW who acquired SCI in the 50 years from 1955 to 2006. Early mortality varied with level of injury: 8.2% of persons with tetraplegia (injury to the cervical segments C1–C8) and 4.1% of persons with paraplegia (injury to the lower spinal segments of thorax, lumbar and sacrum) died within 12 months of injury. Mortality in the first year declined over time. Comparing the period 1975–1984 with 1995–2006, mortality in the first year declined from 9.1% to 6.6% for all tetraplegia, while for all paraplegia it decreased from 4.1% to 2.8%. For those with complete high injury (C1–C4), first-year mortality dropped from 32.4% to 13.5%.

Mortality after the first year remained higher for people with SCI than for the general population. For those with tetraplegia who survived the first year, the subsequent mortality rate was twice that of the general population, with a standardised mortality ratio (*SMR*) of 2.2 (Middleton et al. 2012). Mortality after the first year for survivors with paraplegia was also higher than for the general population, though to a smaller extent (*SMR* 1.7).

Access Economics' analysis of the estimated cost of traumatic SCI in Australia, undertaken in 2009, remains the most comprehensive study to date. Total economic costs for tetraplegia amounted to A$1.3 billion, while those for paraplegia were close to A$690 million (Access Economics 2009). Individual lifetime costs were estimated to be A$9.5 million per case of tetraplegia and A$5 million per case of paraplegia. With medical advances and the positive trend in survival beyond 12 months, lifetime costs will become more significant as people live longer with SCI.

Structure of this report

The primary focus of this report is traumatic SCI, resulting from injurious events that occurred during the period 1 July 2014 to 30 June 2015 (abbreviated as '2014–15' in this report). It also includes information on trends in the period 1995–96 to 2014–15. The report is arranged as follows:

- **Chapter 2** presents an overview of all newly incident traumatic SCI cases that occurred in 2014–15 and had been registered by 31 January 2017.
- **Chapter 3** provides an analysis of newly incident cases of persisting traumatic SCI, in 2 parts. The first part looks at trends in rate of injury and median duration of initial care for cases injured since 1995–96. The second part looks at the demographic, social and clinical characteristics of cases with SCI onset in 2014–15. This chapter includes all

cases aged 15 and older who were discharged alive. This differs slightly from the reports for previous years, in which only Australian residents were included and non-residents were excluded. (See 'Appendix A: Data issues'.)

- **Chapter 4** provides information on external causes of injury and factors associated with the SCI event for all 2014–15 traumatic cases, irrespective of survival to discharge or persistence of deficit. Remoteness of place of injury is now included in this chapter.
- **Appendix A: Data issues** provides summary information on the ASCIR, estimates used to calculate population rates, analysis methods, and information on data quality.
- **Appendix B: Other SCI cases** provides summary information for non-traumatic SCI cases admitted to a participating SU during 2014–15 and complications of medical care SCI cases that occurred during 2014–15.
- **Appendix C: Additional tables** consists of data underpinning the figures presented in Chapter 3.

While a very small number of people under the age of 15 have been included in the ASCIR since its inception, children with SCI are generally treated in specialist paediatric hospitals, and are not reported to the register. For this reason, cases occurring under the age of 15 are not in scope for this report.

Box 1.1: Defining traumatic spinal cord injury

When the ASCIR was established, the *Guidelines for the surveillance of central nervous system injury* case definition of SCI was adopted. According to this source, SCI is:

…an acute, traumatic lesion of neural elements in the spinal canal (spinal cord and cauda equina) resulting in temporary or permanent sensory deficit, motor deficit, or bladder/bowel dysfunction (Thurman et al. 1995).

The term **spinal cord injury** has also been used to describe episodes where damage to the spinal cord has resulted from disease, tumour and congenital conditions or other underlying pathology. As such, SCI is now often described in terms of **traumatic** or **non-traumatic SCI** (Bickenbach et al. 2013).

Traumatic SCI is the term used to describe instances where the cause of injury was external to the person (for instance, a road crash, falling, or diving into shallow water).

Non-traumatic SCI is the term used to describe instances where the injury was due to disease.

Complication of medical care SCI is the term used to describe instances where the injury was due to medical or surgical intervention.

These latter 2 types of SCI are often reported to the ASCIR, but are not the main focus of this report.

Box 1.2: Describing types of neurological impairment for spinal cord injury

The neurological level of SCI is the lowest level (that is, the one furthest from the head) that has preservation of full neurological function, both motor and sensory.

Spinal cord injuries are generally classified by neurological level of injury and the extent of injury (Kirshblum et al. 2011). The neurological level of injury refers to loss of function at 1 of the **cervical** (C1–C8), **thoracic** (T1–T12), **lumbar** (L1–L5), or **sacral** (S1–S5) segments of the spine. From the top of the body, the cervical spine is the highest part of the spine and includes the neck. The sacral segments are the lowest and include the sacrum and coccyx. Injuries to the sacrum are the least common type of SCI, therefore for reporting purposes these cases are combined with lumbar cases and reported as 1 group: **lumbosacral**.

An injury to the spinal cord at the cervical level results in the reduction or loss of motor and/or sensory function in the arms as well as in the trunk, legs and pelvic organs. This type of impairment is referred to as **tetraplegia** (sometimes also called 'quadriplegia'). An injury to the thoracic, lumbar or sacral levels of the spinal cord may result in a reduction or loss of motor and/or sensory functions of the trunk, legs and pelvic organs. This type of impairment is referred to as **paraplegia**.

Extent of injury is reported as complete or incomplete injury. This refers to the preservation of sensory and motor functioning at different levels of the spine. **Complete injury** is the term used when there is an absence of sensory and motor function in the lowest sacral segments (S4–S5) (that is, no 'sacral sparing'). (Note: 'Completeness' of injury is a different concept to the neurological level of injury.) **Incomplete injury** is the term used when there is preservation of any sensory and/or motor function below the neurological level of injury that includes the lowest sacral segments S4–S5 (that is, presence of 'sacral sparing').

A complete injury of the spinal cord at a high cervical neurological level is considered the most severe type of SCI.

Spinal cord injuries may result in a temporary or persisting deficit. For the purposes of this report, cases are designated as **persisting traumatic** or **non-traumatic SCI**, based on a finding of an American Spinal Injury Association (ASIA) Impairment Scale grade of A, B, C or D either 90 days after injury, or on discharge from rehabilitation (ASIA 2003; Kirshblum et al. 2011); or presence of deficit on discharge was reported by the SU. A description of the ASIA Impairment Scale can be found in the Glossary.

Neurological level of injury at time of discharge is the measure used to describe the clinical characteristics of persisting traumatic SCI in Chapter 3. Neurological injury at time of admission is the measure used when describing external causes of traumatic SCI in Chapter 4.

Box 1.3: Other terminology used in this report

Length of stay (LOS) is a common index used in hospital and health reports and is measured in number of days between admission to, and discharge from, the SU. Median LOS is reported, because it is not greatly influenced by outliers. Fifth and 95th percentiles have also been reported, to provide an indication of the patterns of variation in LOS between types of impairment. LOS can be expected to vary between cases with the same level and completeness for many reasons, including the presence of other injuries and the health status and age of the person when injured. In addition, time may pass between completion of rehabilitation and discharge, because of lack of suitable accommodation or carers.

(continued)

Box 1.3 (continued): Other terminology used in this report

Duration of initial care (DIC) is a concept developed by the NISU for the purpose of measuring the period from the date of injury to the date of discharge from a participating SU to the person's previous home, or to a new home, nursing home or other accommodation. The DIC includes retrieval of the person from the scene of the injurious event; stabilisation; and all acute care and rehabilitation as an admitted patient. Part of the care—but often not all—is provided in an SU.

DIC is calculated as the difference, in days, between date of injury and date of discharge from SU, as recorded in the ASCIR. Three types of cases are omitted when calculating DIC:

- cases discharged from the SU to a place at which initial care as an admitted patient can be expected to continue. These cases are omitted because DIC is not complete and so cannot be calculated
- cases where death occurred in the SU. These cases are omitted because fatal and non-fatal cases have very different durations
- cases where the current episode in an SU is not, or cannot be established to be, part of the person's period of initial admitted patient care after onset of SCI.

As for LOS in a spinal unit, median DIC is reported, to reduce the effect of outliers.

Box 1.4: Classifying mechanism of injury for SCI cases

In keeping with previous reports, traumatic SCI due to *Transport-related* crashes is categorised into 2 main groups: cases due a *Land transport* crash or cases due to *Other transport* (including water, air or rail) crashes. Due to the large number of cases and diversity of types of land transport vehicles involved, *Land transport crash* cases are further divided into 2 groups*: Motor vehicle occupants* and *Unprotected land transport users*.

- *Motor vehicle occupants* includes drivers, passengers and unspecified occupants of sedans, station wagons, 4-wheel-drive vehicles, buses, vans, trucks, semi-trailers and other similar vehicles where the person is usually afforded some impact protection in the event of a traffic crash (for example, seatbelts and crumple zones).
- *Unprotected land transport users* include users of motor cycles, quad-bikes and bicycles as well as pedestrians. (This latter term, commonly used in road safety statistics, refers to the greater vulnerability to injury in a crash, of road users who are not occupants of a car or other large motor vehicle.)

Cases due to *Other transport crashes* (including water, air or rail) are included in the *Other and unspecified causes* category. *Other transport crashes* may include farm machinery, such as tractors, or heavy machinery, such as excavators.

SCI cases due to a *Fall* may be classified as either due to a *Low fall* (a fall on the same level or from a height of less than 1 metre), or a *High fall* (a fall from a height of 1 metre or more). In a small number of cases, details regarding the height of the fall are missing from the record. These cases are traditionally recorded as a *Low fall* in the ASCIR.

(continued)

Box 1.4 (continued): Classifying mechanism of injury for SCI cases

Water-related SCI cases are grouped following a search of descriptive injury text for terms related to events such as diving into shallow water; being dumped in the surf by a wave; or falling while water-skiing or while scuba diving.

There are generally sufficient cases reported each year to include additional external cause categories for *Heavy falling objects*, *Horse-related* and *Football* SCI. Any remaining cases are grouped into the residual category *Other and unspecified causes*.

More detailed information on how cases are assigned to a mechanism of injury category is included in 'Appendix A: Data issues'.

2 Traumatic SCI case registrations in 2014–15

This chapter provides an overview of traumatic SCI incident cases where the injurious event occurred between 1 July 2014 and 30 June 2015, and the case had been registered by 31 January 2017.

For the period 2014–15, a total of 264 incident cases were reported to the ASCIR by participating SUs (Table 2.1).

Table 2.1: Traumatic SCI cases aged 15 and older with onset in 2014–15 and reported to the ASCIR by 31 January 2017

	Australian residents		Non-residents		Total	
	Number	%	Number	%	Number	%
At discharge from spinal unit:						
Persisting deficit[(a)]	250	96	4	100	254	96
No ongoing neurological deficit	4	2	0	0	4	2
Died on ward	6	2	0	0	6	2
Total[(b)]	**260**	**100**	**4**	**100**	**264**	**100**

(a) Any persons over the age of 15 who sustained an SCI in 2014–15 due to trauma and who had a persisting neurological deficit on discharge from a participating SU. These cases are included in Chapter 3.

(b) Any persons over the age of 15 who sustained an SCI in 2014–15 due to trauma. These cases are included in Chapter 4.

The demographic, social and clinical characteristics of the 250 Australian residents and 4 non-residents discharged alive with a persisting traumatic SCI are the focus of Chapter 3. The total includes 6 Australian residents transferred to an Australian SU after incurring a spinal injury overseas.

External causes of injury and other factors related to the injury event are reported in Chapter 4 for all 264 traumatic SCI cases with onset in 2014–15, irrespective of survival to discharge or persistence of deficit.

There were 6 deaths—5 men and 1 woman. Cases ranged in age from 29 to 75. Three of these traumatic SCI cases were due to a *Fall*, and 3 were the result of a *Land transport crash*. Time between the injury and death ranged between 6 days and 147 days. The neurological level of injury for all cases who died was C7 or higher.

3 Persisting traumatic SCI

This chapter examines the characteristics of the 254 cases of persisting traumatic SCI sustained during 2014–15. It also presents summary information on new cases reported each year from 1995–96 to 2014–15.

The selection criteria for this year's report differ from previous annual reports, as non-residents of Australia were also included for the first time. This minor change allows for trends in the median duration of initial care (DIC) to be moved from an appendix to the main body of this report.

Records in the ASCIR that met the following criteria were included as persisting traumatic SCI cases:

- date of injury was in the reference year, ending 30 June
- aged 15 or older at onset
- reported to have a spinal cord deficit at discharge
- discharged alive.

Incidence rates were calculated using the estimated resident population of Australia aged 15 or older, as provided by the Australian Bureau of Statistics (ABS) (see 'Population denominators' in Appendix A). Direct age-standardisation was employed using the Australian population in 2001 as the reference (ABS 2003).

Trends of persisting traumatic SCI, 1995–96 to 2014–15

Incidence rates

In 2014–15, the age-standardised incidence rate of persisting traumatic SCI for cases aged 15 and older was 12.8 cases per million population.

Poisson regression based on the annual incidence rates, presented as a trend with 95% confidence intervals, is shown in Figure 3.1 (see also Table C1 in Appendix C and 'Use of confidence intervals' in Appendix A). According to this, the incidence rate of persisting SCI at age 15 and older declined since 1995–96 by an average of 2.2% per year (95% *CI*: –1.7%, –2.6%).

The trend was significant ($p = 0.000$), however caution is advised when interpreting this result due to the underestimation of SCI cases reported to the ASCIR. Known contributing factors in underestimation include cases where the person:

- did not consent to be included in the register
- was released from hospital without the need for inpatient rehabilitation
- was admitted to another rehabilitation unit that does not provide data to the ASCIR
- died before admission to an SU occurred.

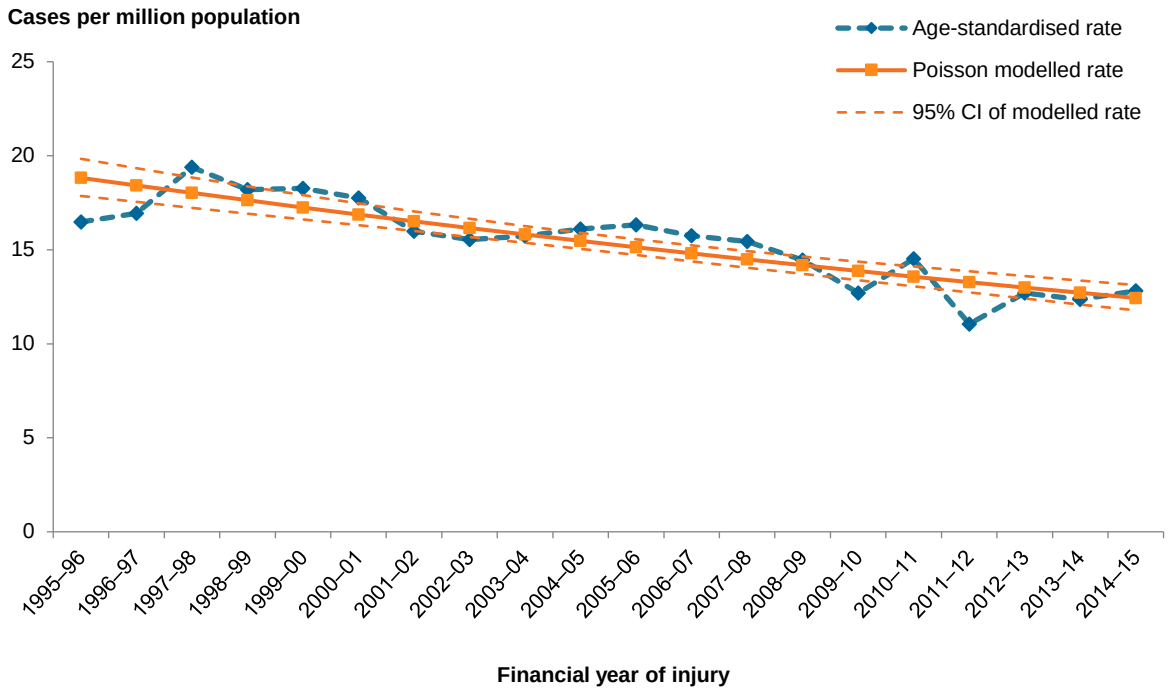


Figure 3.1: Trends in rates of persisting traumatic SCI cases aged 15 and older, by financial year of injury, 1995–96 to 2014–15

The trend in incidence rates by sex is shown in Figure 3.2 (and Table C2). The age-standardised rate of persisting traumatic SCI for males aged 15 and older has been consistently higher than for females aged 15 and older across the 20 years of the ASCIR data. The rate for females has shown little variation over this timespan, while there appears to have been a decrease in the rate of persisting traumatic SCI in Australia for males. The most recent dips, seen in the rate of injury for males in 2009–10 and 2011–12, will have been influenced by known under-reporting of cases to the ASCIR for those years (See 'Data quality statement' in Appendix A: Data issues).

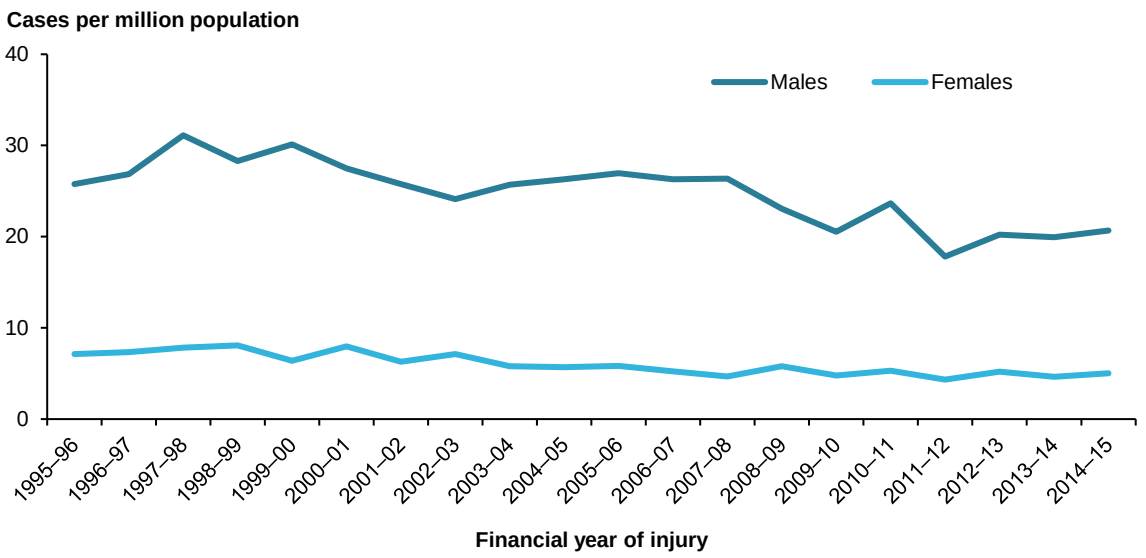


Figure 3.2: Trends in age-standardised rates of persisting traumatic SCI cases aged 15 and older, by financial year of injury, by sex, 1995–96 to 2014–15

Median duration of initial care for persisting traumatic SCI

The term **duration of initial care** (DIC) used in this chapter is consistent with the definition given in Box 1.3. The median DIC has been used as the summary measure because it is not greatly affected by outlier values. The data are presented by neurological level (cervical, thoracic, or lumbosacral); extent of lesion (complete or incomplete); and year of injury. Level and extent of lesion are as assessed on admission to a participating SU.

Cases with a complete injury on admission have consistently had the longest median DIC (Table 3.1). Cases admitted with *Complete tetraplegia* had the longest recorded stays, with median DIC generally ranging between 200 days to 260 days (or between 6.5 months to 8.5 months). Cases with *Complete paraplegia* at the thoracic level had the next longest stay on average, ranging between 134 days and 176 days (or roughly between 4.5 months and 5.5 months). The least severe neurological impairment—*Incomplete paraplegia* at the lumbosacral level—had the shortest median DIC, with a median DIC of less than 90 days or 3 months reported in most years. Cases of *Complete paraplegia* at the lumbosacral level were the least common, often fewer than 10 cases per annum. Hence the median DIC for this type of case should be interpreted cautiously.

Table 3.1: Median duration of initial care (days) for persisting traumatic SCI cases aged 15 and older, by financial year of injury, by neurological impairment at admission, 1995–96 to 2014–15

Financial year of injury	Tetraplegia		Paraplegia				Proportion included[(a)]
	Cervical		Thoracic		Lumbosacral		
	Complete	Incomplete	Complete	Incomplete	Complete	Incomplete	
1995–96	261	81	144	134	83	49	*89%*
1996–97	220	104	148	102	97	67	*86%*
1997–98	204	68	143	92	125	69	*93%*
1998–99	245	89	157	84	111	61	*90%*
1999–00	232	80	149	70	106	79	*91%*
2000–01	254	95	136	121	145	67	*88%*
2001–02	224	98	155	106	104	54	*90%*
2002–03	201	95	142	103	112	54	*92%*
2003–04	238	62	138	104	131	61	*88%*
2004–05	227	103	145	111	179	52	*86%*
2005–06	252	139	143	111	104	97	*88%*
2006–07	220	124	161	128	123	74	*91%*
2007–08	228	113	146	104	108	88	*93%*
2008–09	247	143	151	132	106	88	*93%*
2009–10	261	174	164	127	133	54	*87%*
2010–11	227	128	165	115	88	60	*85%*
2011–12	235	123	134	146	117	117	*90%*
2012–13	197	110	135	111	80	99	*86%*
2013–14	239	111	168	114	89	56	*88%*
2014–15	219	140	176	119	70	101	*91%*

(a) This proportion is calculated as the number of new cases for which DIC could be calculated (see Box 1.3), divided by the total number of new persisting traumatic SCI cases.

Note: Shading indicates median DIC has been calculated on fewer than 10 cases and therefore should be interpreted cautiously.

Demographic and social characteristics of persisting traumatic SCI in 2014–15

The remainder of this chapter focuses only on the newly incident cases of persisting traumatic SCI among people aged 15 and older with an injury date between 1 July 2014 and 30 June 2015.

Age and sex distribution

The majority (80%) of persisting traumatic SCI cases reported to the ASCIR for the 2014–15 period were male. More specifically, 202 male and 52 female cases were included in the register. The age-distribution of case counts and age-specific rates for new cases of persisting traumatic SCI are presented in Figure 3.3 and Table C3. Unlike most previous years, where the highest number of new SCI cases were seen among those aged 15–24, the largest number of cases reported for 2014–15 were aged 55–64 (54 cases or 21%). Cases aged 24–34 were the next most numerous (49 cases or 19%). The age-specific rate was

highest for ages 55–64 (19.9 cases per million population), followed by 19.8 cases per million for ages 65–74.

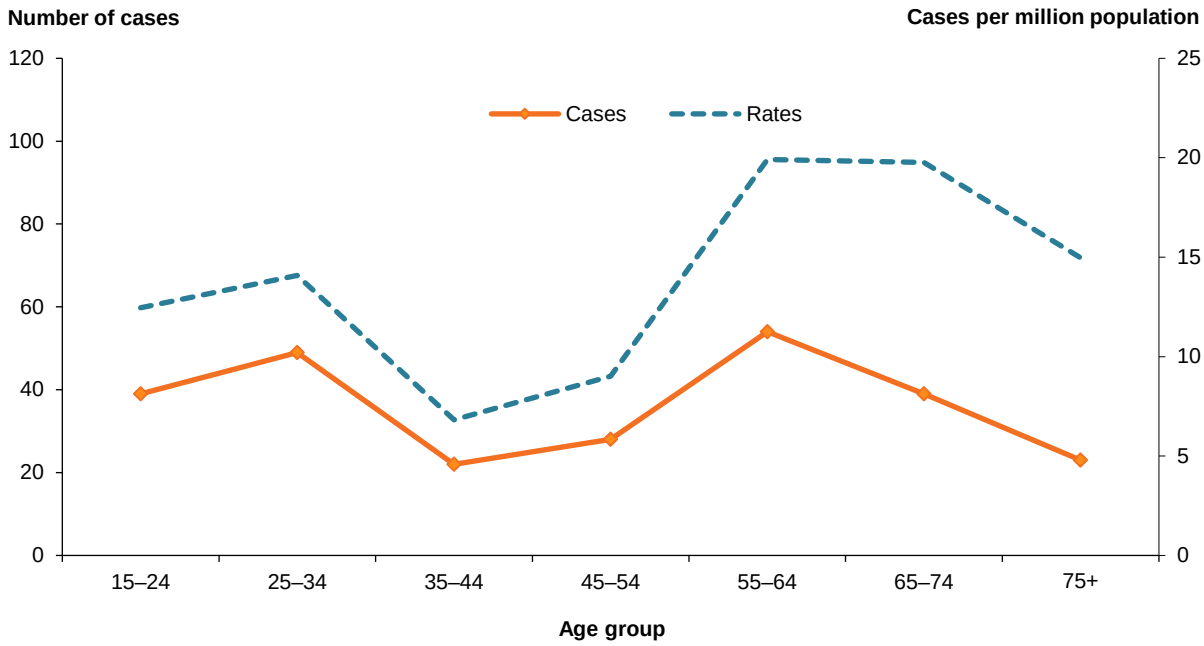


Figure 3.3: Counts and age-specific rates of persisting traumatic SCI cases aged 15 and older, by age group, 2014–15

Incidence rates for males were higher across all age groups than those for females (Figure 3.4 and Table C4). Again, unlike previous years where the greatest disparity between the sexes was observed in the youngest age group 15–24, in 2014–15 the greatest gender difference is observed for cases aged 55–64. The rate for males aged 55–64 was 33.7 cases per million, compared with 6.5 cases per million for females aged 55–64. The overall rate for men was 21.4 cases per million compared with 5.4 for women, a male:female ratio of 4:1.

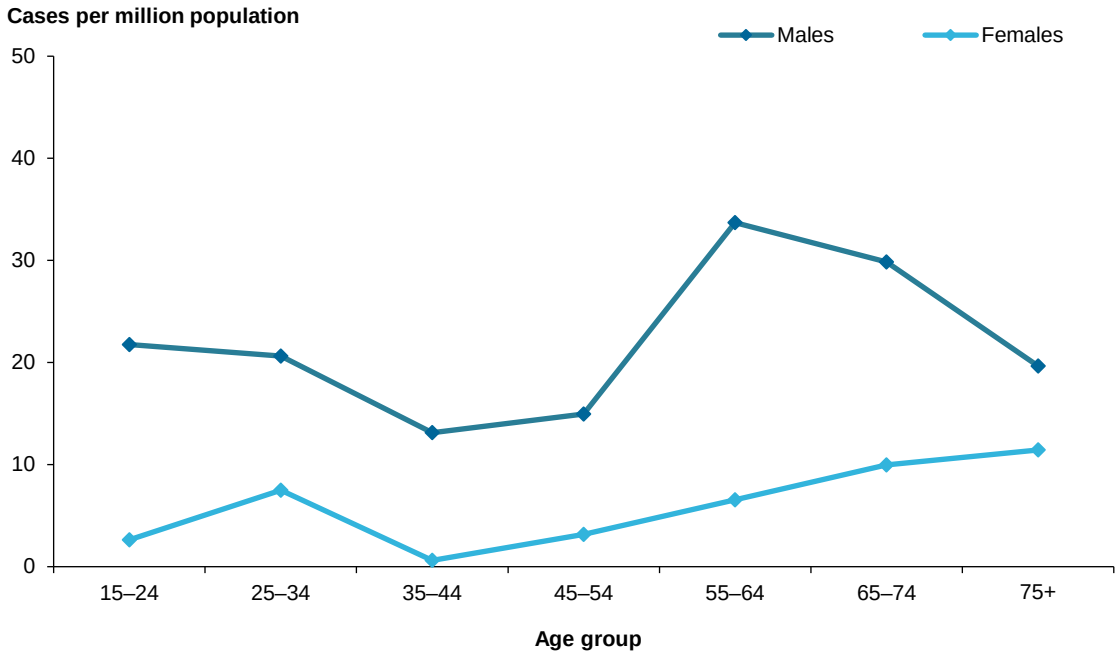
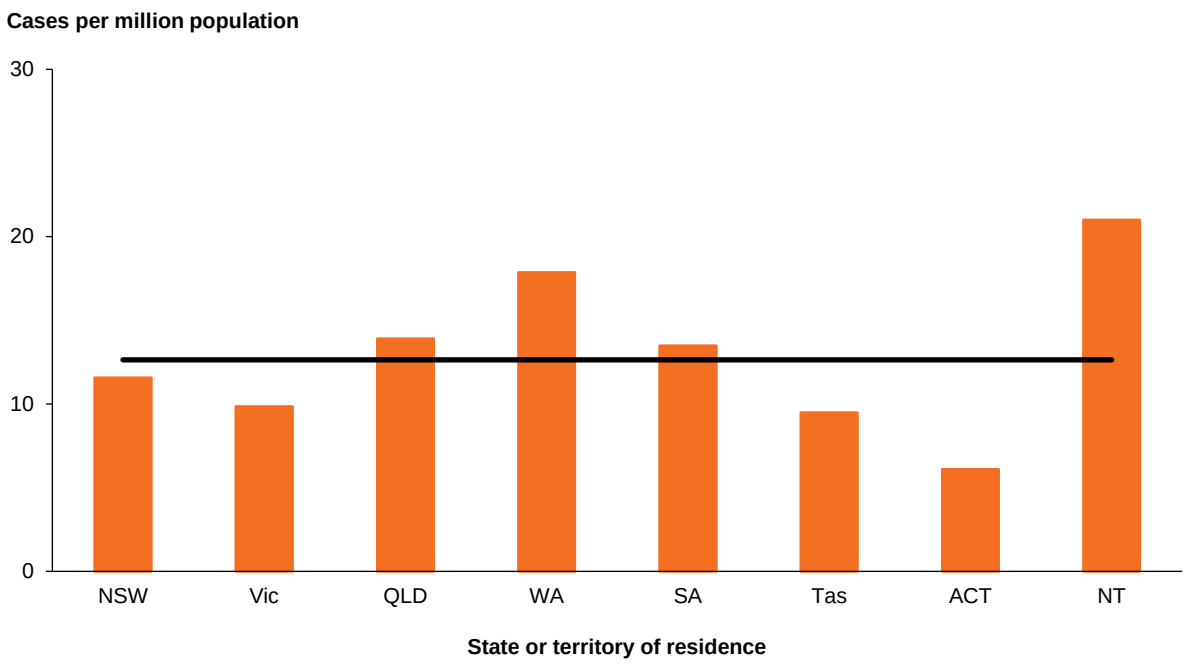


Figure 3.4: Age-specific rates of persisting traumatic SCI cases aged 15 and older, by age group, by sex, 2014–15

State and territory of usual residence

Age-standardised incidence rates of persisting traumatic SCI, by state and territory of usual residence, are presented in Figure 3.5 and Table C5. Due to the small number of cases in some jurisdictions, rates were based on the aggregated state or territory case counts for the 3-year period 2012–13 to 2014–15.

Despite that, the rates are based on quite low numbers of cases (fewer than 20 cases each) for the smaller-population jurisdictions of Tasmania, South Australia, and the 2 territories. Rates based on such small numbers should be expected to fluctuate considerably from year to year. The 3-year rate for residents of the Australian Capital Territory was the lowest (6.1 cases per million), while the rate for residents of the Northern Territory was the highest (21.0 cases per million). The 3-year rate of persisting traumatic SCI for New South Wales, Victoria, Tasmania and the Australian Capital Territory were lower than the national rate, at 12.6 cases per million.

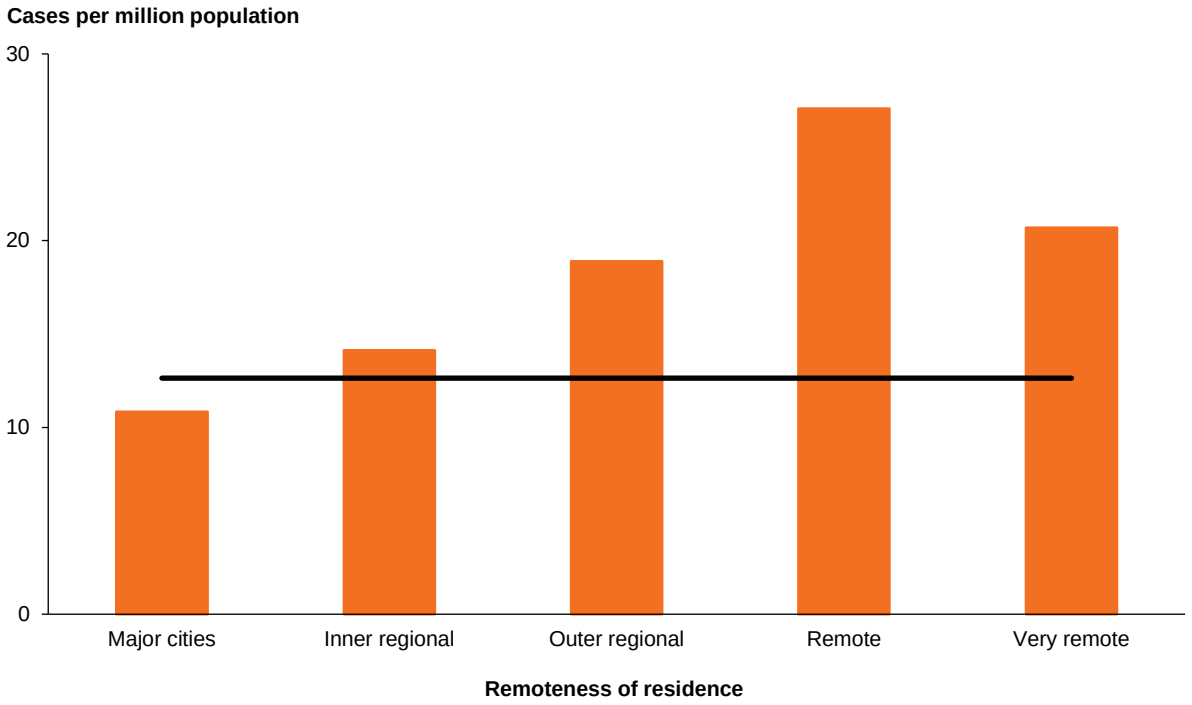


Note: The 3-year Australia rate is shown as the solid horizontal line. The rate for Australia is calculated on 725 cases, including 14 non-residents.

Figure 3.5: Age-standardised 3-year rates of persisting traumatic SCI cases aged 15 and older, by state or territory of usual residence, 2012–13 to 2014–15

Remoteness of residence

Three-year incidence rates were calculated for cases grouped according to remoteness of usual residence for the period 2012–13 to 2014–15 (Figure 3.6 and Table C6) (See 'Assignment to remoteness area' in Appendix A). The 3-year incidence rate for persisting traumatic SCI was highest for residents of *Remote Australia* (27.1 cases per million population) and lowest for residents of *Major cities* (10.8 cases per million). Only residents of *Major cities* had a 3-year rate lower than the 3-year Australia rate (12.6 cases per million). However, caution should be applied to interpreting the rates for residents of *Outer regional Australia* and more remote areas, due to case numbers of less than 100. The 3-year rate for residents of *Very remote Australia* is based on fewer than 20 cases and should be expected to vary to a considerable extent from year to year.



Note: The 3-year Australia rate is shown as the solid horizontal line. Included when calculating the Australia rate—but not in the specific remoteness zones—were 14 non-residents injured in Australia and 1 Australian resident whose place of residence was unknown.

Figure 3.6: Age-standardised 3-year rates of persisting traumatic SCI cases aged 15 and older, by remoteness of residence, 2012–13 to 2014–15

Socioeconomic characteristics

Approximately 1 in 2 (49%) of people were married or in a de facto relationship at the onset of their persisting traumatic SCI (Table 3.2). All except 3 of these were aged 25 or older. Ninety per cent of cases in the 15–24 age group had never been married, while just over one-quarter (26%) of those aged 25–64 had never been married. Only 6% of cases had no marital status reported.

Table 3.2: Marital status at onset of persisting traumatic SCI, by 3 age groups, 2014–15

	15–24 years		25–64 years		65+ years		All ages	
Marital status	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Never married	35	90	40	26	4	6	79	31
Widowed	0	0	3	2	9	15	12	5
Divorced	0	0	9	6	6	10	15	6
Separated	0	0	7	5	1	2	8	3
Married (including de facto)	3	8	84	55	37	60	124	49
Not reported	1	3	10	7	5	8	16	6
Total[(a)]	**39**	**100**	**153**	**100**	**62**	**100**	**254**	**100**

(a) Percentages may not equal 100, due to rounding.

The majority (56%) of people who sustained a persisting traumatic SCI during 2014–15 were employed at the time of injury, with people aged 25–64 accounting for 80% of these cases (Table 3.3). (Note: 'Pensioner' status in this context includes age and disability support pension recipients as well as self-funded retirees.) Study commitments and home duties were the primary reasons provided for not being available for employment. Employment status at time of injury was recorded for all except 12 cases (5%).

Table 3.3: Employment status at onset of persisting traumatic SCI, by 3 age groups, 2014–15

	15–24 years		25–64 years		65+ years		All ages	
Employment status	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Employed	19	49	113	74	10	16	142	56
Pensioner	0	0	13	8	40	65	53	21
Unemployed	6	15	12	8	2	3	20	8
Not available for employment	10	26	10	7	7	11	27	11
Not reported	4	10	5	3	3	5	12	5
Total[(a)]	**39**	**100**	**153**	**100**	**62**	**100**	**254**	**100**

(a) Percentages may not equal 100, due to rounding.

'Highest available education level at onset' was not reported in 41% of persisting traumatic SCI cases for 2014–15 (Table 3.4). Of the 150 cases who did have a highest education level reported, 53% had a post-school qualification. An equal number of cases were reported as having a completed tertiary/postgraduate education (29 cases) or a trade qualification/ apprenticeship (29 cases). Not surprisingly, a larger proportion of cases aged 15–24 were still at school or engaged in higher education at the time of injury, compared with the other 2 age groups.

Table 3.4: Highest educational level attained at onset of persisting traumatic SCI, by 3 age groups, 2014–15

	15–24 years		25–64 years[(a)]		65+ years		All ages	
Education level	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Tertiary/postgraduate	3	8	18	12	8	13	29	11
Trade qualification/apprenticeship	7	18	19	12	3	5	29	11
Diploma or certificate	2	5	9	6	1	2	12	5
Other post-school study	0	0	6	4	3	5	9	4
Highest available secondary school level	9	23	14	9	1	2	24	9
Did not complete secondary school	7	18	26	17	8	13	41	16
Still at school/higher education	4	10	1	1	0	0	5	2
Not reported	7	18	59	39	38	61	104	41
Total[(b)]	**39**	**100**	**153**	**100**	**62**	**100**	**254**	**100**

(a) Total includes 1 case who never attended school.

(b) Percentages may not equal 100, due to rounding.

Clinical characteristics of persisting traumatic SCI in 2014–15

Information on the neurological level of SCI, extent of injury to the cord, and the degree of impairment is routinely reported by SUs during the initial hospitalisation for the SCI, and at discharge from rehabilitation. These clinical characteristics provide an indirect indication of the degree of support required by people with a SCI at discharge from hospital.

The neurological level of SCI is the lowest level (that is, the one furthest from the head) that has preservation of full neurological function, both motor and sensory. Further information on neurological level and how it is assessed is provided in Box 1.2 and the Glossary.

The period of hospitalised admitted care for people with persisting traumatic SCI is often prolonged. It is not uncommon for people injured in 1 financial year to not be discharged until the following financial year, and sometimes later.

Neurological level of injury at discharge

The distribution of neurological level of persisting traumatic SCI at discharge is presented in Figure 3.7 and Table C7.

Three out of 5 cases (60%) of persisting traumatic SCI sustained during 2014–15 had a neurological injury at one of the cervical segments, C1–C8 (151 cases). The impairment resulting from this neurological level is referred to as tetraplegia.

The most common neurological levels of injury were C4 and C5, which accounted for 54% of cervical cases and 32% of cases at any level.

Thirty-four per cent of cases had a neurological level of injury at a thoracic segment (T1–T12) and 7% at a lumbar segment (L1–L5). No sacral cases (S1–S5) were reported for this year. The impairment resulting from injury at the thoracic or lumbosacral neurological levels is referred to as paraplegia.

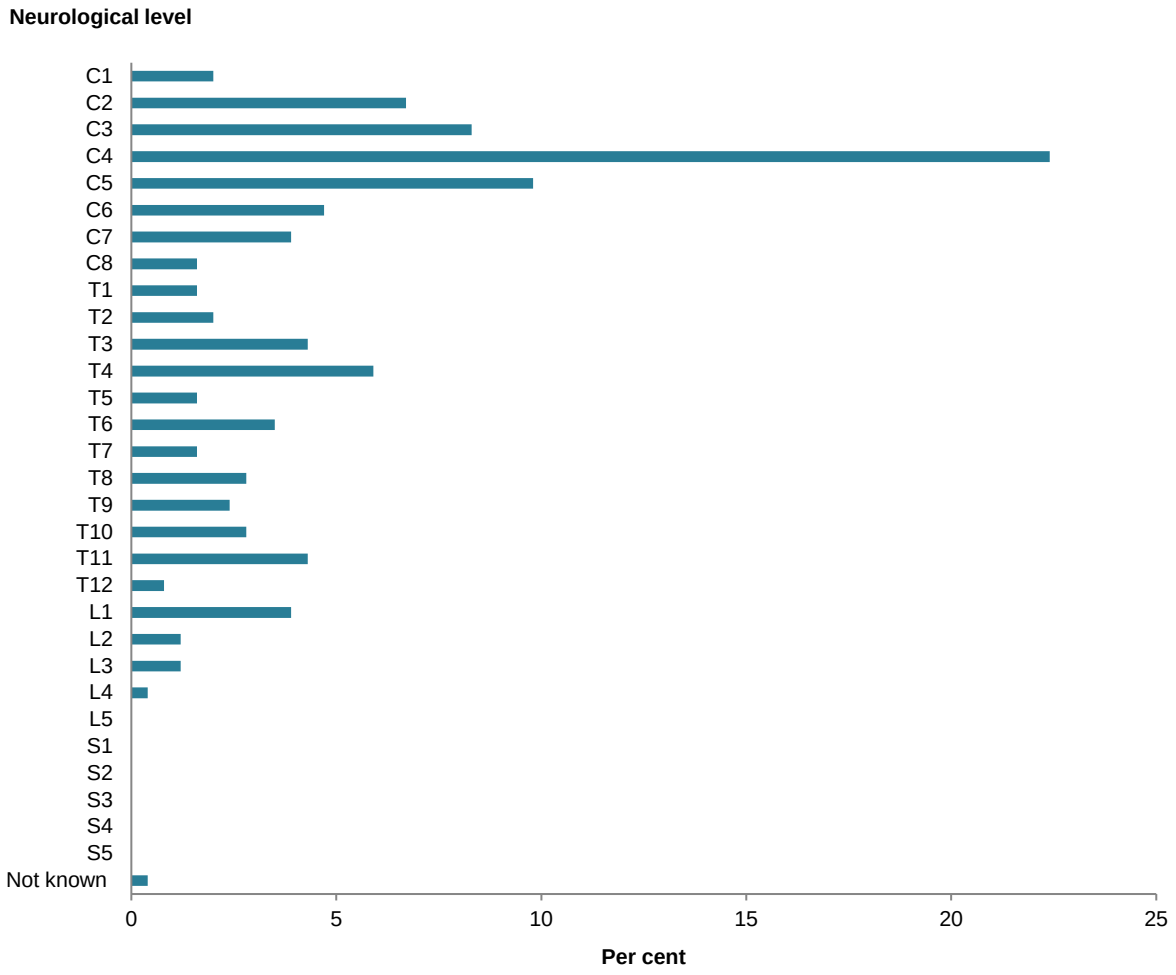


Figure 3.7: Neurological level of injury at discharge for persisting traumatic SCI cases aged 15 and older, 2014–15

Neurological impairment at discharge

Approximately half (49%) of all persisting traumatic SCI cases reported to the ASCIR for 2014–15 were categorised as *Incomplete tetraplegia* on discharge (Table 3.5). Cases in this category had been assessed as having a cervical level injury, and an ASIA Impairment Scale grade of either B (some sensory but no motor function preserved), C or D (some motor function preserved).

The next most common impairment at discharge was *Complete paraplegia* at the thoracic level (19%). Cases of this type had been assessed as having a neurological level of injury between T1 and T12, with an ASIA Impairment Scale grade A (no sensory or motor function at S4–S5—that is, no sacral sparing).

All except 4 of the 17 cases involving the lumbosacral region were discharged with *Incomplete paraplegia*.

Table 3.5: Neurological impairment at discharge for persisting traumatic SCI cases aged 15 and older, 2014–15

Neurological impairment	Number of cases	%
Tetraplegia		
Cervical	151	60
Complete tetraplegia	*27*	*11*
Incomplete tetraplegia	*124*	*49*
Paraplegia		
Thoracic	85	34
Complete paraplegia	*48*	*19*
Incomplete paraplegia	*37*	*15*
Lumbosacral	17	7
Complete paraplegia	4	2
Incomplete paraplegia	13	5
Total[(a)(b)]	**254**	**100**

(a) Neurological level and completeness of SCI was not available for 1 case.

(b) Percentages may not equal 100, due to rounding.

Length of stay in spinal unit

Table 3.6 presents the median length of stay (LOS) in an SU for persisting traumatic SCI cases in 2014–15, by neurological impairment at discharge. The 5th and 95th percentiles are also provided, to give an indication of the patterns of variation in LOS between types of impairment.

The median LOS in an SU was roughly 4.5 months for cases with neurological impairment at either the cervical or thoracic level (median LOS of 138 days and 147 days respectively). Median LOS was just under 3 months (85 days) for cases with a neurological impairment at the lumbosacral level.

The median LOS in an SU was shorter for cases with an incomplete SCI than those with complete SCI at each neurological level.

Complete cases at cervical level (*Complete tetraplegia*) had the longest median LOS in an SU, at 203 days (or approximately 6.5 months), with 5th and 95th percentiles of 66 and 377 days.

Table 3.6: Length of stay in a spinal unit for persisting traumatic SCI cases aged 15 and older, by neurological impairment at discharge, 2014–15

Neurological impairment at discharge	Number of cases	Median LOS (days)	5th Percentile (days)	95th Percentile (days)
Tetraplegia				
Cervical	151	138	15	353
Complete tetraplegia	*27*	*203*	*66*	*377*
Incomplete tetraplegia	*124*	*123*	*15*	*305*
Paraplegia				
Thoracic	85	147	37	433
Complete paraplegia	*48*	*166*	*48*	*456*
Incomplete paraplegia	*37*	*120*	*25*	*417*
Lumbosacral	17	85	38	230
Complete paraplegia	*4*	*124*	*41*	*230*
Incomplete paraplegia	*13*	*77*	*38*	*223*
Total[(a)]	**254**	**138**	**25**	**361**

(a) Total includes 1 case where neurological impairment at discharge was unknown.

4 External causes of SCI in 2014–15

In addition to recording information on the incidence of traumatic SCI, the ASCIR records information about the event which resulted in injury: the mechanism, role of human intent, type of place where the injury occurred, and the type of activity the person was involved in at the time of injury. Information on the factors associated with occurrence of traumatic SCI is important for injury prevention.

This chapter includes all 264 cases of traumatic SCI with onset in 2014–15 that were treated in participating SUs and had been reported to the ASCIR by 31 January 2017. This includes the 254 cases of persisting traumatic SCI that are the subject of Chapter 3; the 4 cases in which a person admitted to a spinal unit had no neurological deficit at discharge (that is, had an ASIA Impairment Scale of E); and the 6 cases where the person died while an admitted patient of a participating SU (see Table 2.1).

Mechanism of injury

Just over 2 in 5 (42%) of traumatic SCI cases sustained in 2014–15 were due to a land transport crash involving either a *Motor vehicle occupant* or an *Unprotected land transport user* such as a cyclist or pedestrian (Table 4.1). A further 40% were due to falls. Characteristics of the cases due to each of the mechanisms shown in Table 4.1 are presented in succeeding sub-sections. The method for grouping cases by mechanism is described in Appendix A: Data issues.

Table 4.1: Mechanism of injury of all traumatic SCI, by sex, 2014–15

	Males		Females		Total	
Mechanism of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**
Land transport crash						
Motor vehicle occupant	36	17	13	24	49	19
Unprotected land transport user	58	28	2	4	60	23
Fall						
Low fall (same level or <1 metre)[(a)]	34	16	19	35	53	20
High fall (≥1 metre)	40	19	12	22	52	20
Water-related	14	7	2	4	16	6
Heavy falling object	3	1	1	2	4	2
Horse-related	4	2	2	4	6	2
Football	7	3	0	0	7	3
Other and unspecified causes	14	7	3	6	17	6
Total[(b)]	**210**	**100**	**54**	**100**	**264**	**100**

(a) Includes falls from unspecified heights.

(b) Percentages may not equal 100, due to rounding.

For cases aged 15–24, one-third (33%) involved *Unprotected land transport users* (Table 4.2). Similarly, this mechanism of injury was the leading cause (26%) for cases aged 25–64, while a *Low fall* accounted for nearly half (46%) of the traumatic SCI among cases aged 65 or older. Further data on the age-distribution of cases is presented in each relevant subsection.

Table 4.2: Mechanism of injury of all traumatic SCI, by 3 age groups, 2014–15

	15–24 years		25–64 years		65+ years		All ages	
Mechanism of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Land transport crash								
Motor vehicle occupant	5	13	34	21	10	15	49	19
Unprotected land transport user	13	33	42	26	5	8	60	23
Fall								
Low fall (same level or <1 metre)[(a)]	2	5	21	13	30	46	53	20
High fall (≥1 metre)	7	18	31	19	14	22	52	20
Water-related	5	13	9	6	2	3	16	6
Heavy falling object	1	3	3	2	0	0	4	2
Horse-related	0	0	5	3	1	2	6	2
Football	3	8	4	3	0	0	7	3
Other and unspecified causes	3	8	11	7	3	5	17	6
Total[(b)]	**39**	**100**	**160**	**100**	**65**	**100**	**264**	**100**

(a) Includes falls from unspecified heights.

(b) Percentages may not equal 100, due to rounding.

Just over 3 in 5 (63%) of the 264 traumatic SCI cases reported for 2014–15 were admitted to an SU with a neurological injury to the cervical spine, or tetraplegia (Table 4.3). Among the 167 cervical cases, *Low fall* (43 cases) was the most frequent mechanism, followed by 34 *Motor vehicle occupant* cases injured in land transport crashes. All except 1 of the 16 *Water-related* SCI cases were admitted with a cervical level injury.

Neurological injury at the thoracic level accounted for 32% of traumatic SCI cases, with *Unprotected land transport user* cases contributing the greatest portion at this level (33 cases, or 39%). People who had a *High fall* sustained half (50%) of the 12 lumbosacral level injuries.

Table 4.3: Mechanism of injury for all traumatic SCI, by neurological level of injury at admission, 2014–15

	Tetraplegia		Paraplegia					
	Cervical		Thoracic		Lumbosacral		Total	
Mechanism of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Land transport crash								
Motor vehicle occupant	34	20	13	15	2	17	49	19
Unprotected land transport user	25	15	33	39	2	17	60	23
Fall								
Low fall (same level or <1 metre)[(a)]	43	26	10	12	0	0	53	20
High fall (≥1 metre)	27	16	19	22	6	50	52	20
Water-related	15	9	1	1	0	0	16	6
Heavy falling object	1	1	3	4	0	0	4	2
Horse-related	4	2	2	2	0	0	6	2
Football	7	4	0	0	0	0	7	3
Other and unspecified causes	11	7	4	5	2	17	17	6
Total[(b)]	**167**	**100**	**85**	**100**	**12**	**100**	**264**	**100**

(a) Includes falls from unspecified heights.

(b) Percentages may not equal 100, due to rounding.

Land transport crashes

As shown in Table 4.1, 42% of traumatic SCI cases reported to the ASCIR for 2014–15 were due to *Land transport crashes*. Motor vehicle drivers (36 cases) and motorcycle drivers (36 cases) each contributed one-third of land transport-related SCI cases for this period (Table 4.4). Males accounted for 86% of traumatic SCI due to a land transport crash. All except 2 female cases were *Motor vehicle occupants*, with similar numbers of female drivers (7 cases) and passengers (6 cases) reported.

Other modes of land transport that contributed to traumatic SCI in 2014–15 included quad-bikes (6 cases) and heavy machinery equipment (1 case). All except one of the traumatic SCI cases involving a quad-bike were males. Cases involving quad-bikes amounted to 10% of *Unprotected land transport users* and 2% of all traumatic SCI cases in 2014–15. This remains similar to the proportions reported for quad-bike SCI cases in recent years: 10% and 2% in 2012–13 (AIHW: Tovell 2018a) and 13% and 3% in 2013–14 (AIHW: Tovell 2018b).

Table 4.4: Land transport user types for all traumatic SCI, 2014–15

	Males		Females		Total	
Land transport user type	**Number**	**%**	**Number**	**%**	**Number**	**%**
Motor vehicle driver	29	31	7	47	36	33
Motor vehicle passenger	6	6	6	40	12	11
Motorcycle driver	35	37	1	7	36	33
Pedal cyclist or pedal cycle passenger	13	14	0	0	13	12
Pedestrian	5	5	0	0	5	5
Other land transport[(a)]	6	6	1	7	7	6
Total[(b)]	**94**	**100**	**15**	**100**	**109**	**100**

(a) Other land transport cases includes quad-bikes and heavy equipment machinery.

(b) Percentages may not equal 100, due to rounding.

The mean age at onset for traumatic SCI for *Motor vehicle occupants* in 2014–15 was 49 (*SD* = 19), while for *Unprotected land transport users*, the mean age was younger, at 38 (*SD* = 16).

Information on the use of seatbelts and the circumstances surrounding land transport crashes—including rollovers, ejection, and impact with another vehicle or roadside hazard—is not always available to the staff who complete the case registration forms for the ASCIR. Of the *Motor vehicle occupants* who sustained a spinal injury in 2014–15, 43% were reported to have worn a seatbelt at the time of the crash (21 cases). Information on the use of seatbelts was not available in a further 43% of cases.

The most common type of crash event reported for *Motor vehicle occupants* was a vehicle rollover, with 20 stated cases (41%). Impact with roadside hazards, such as trees and kangaroos, was stated for 19 cases (39%). Twelve (24%) of *Motor vehicle occupant* cases also reported impact with another motor vehicle. Being ejected from a motor vehicle was reported for 5 traumatic SCI cases in 2014–15. These types of events are not mutually exclusive and more than 1 event may have been reported for the same person. For instance, in this reporting period, 3 of the 5 people who were ejected from their motor vehicle had experienced a vehicle rollover.

More than two-thirds (69%) of *Motor vehicle occupant* SCI cases in 2014–15 had a neurological injury at the cervical level on admission (Table 4.3). Twenty-three of these 34 cases resulted in *Incomplete tetraplegia* at discharge.

In addition to the 6 quad-bike cases, 36 motorcycle drivers, 13 pedal cyclists and 5 pedestrians made up the 60 *Unprotected land transport users* who sustained a traumatic SCI during 2014–15. Only 2 of these cases were female.

Impact with a motor vehicle was reported in 32% of SCI cases sustained by *Unprotected land transport users.* Eleven (58%) of these 19 cases were motorcyclists and 3 cases (16%) were pedal cyclists. Thirteen of the 36 motorcyclists who sustained a traumatic SCI in 2014–15 reported a collision with a road hazard such as a tree, kangaroo or fence. A search of the descriptive text for these 13 motorcyclist cases found 8 cases where the motorcycle struck the roadside hazard before or during the crash. The remaining 5 cases were less clear as to whether it was the motorcycle or the rider who struck the roadside hazard.

The majority (67%) of motorcyclist cases were admitted with a thoracic level injury (24 of 36 cases). In contrast, 77% of pedal cyclist cases were injured at the cervical level (10 of 13 cases). An equal number of cervical and thoracic level injuries were sustained by the 6

quad-bike riders and 3 of the 5 pedestrians who sustained a traumatic SCI were admitted with thoracic level injuries.

While 45 of 49 (91%) of *Motor vehicle occupants* were injured on a public road, the types of places where *Unprotected land transport users* were injured were more varied and included public recreation areas, race tracks, farms and bushland; only 30 (50%) occurred on public roads.

Falls

In 2014–15, 2 out of every 5 (40%) of traumatic SCI cases reported to the ASCIR were due to *Falls*. Overall, equal proportions (20% each) were due a fall on the same of level, from less than 1 metre or from an unspecified height (hereafter referred to as a *Low fall)* or due to a fall from a height of 1 metre or more (hereafter referred to as a *High fall*) (Table 4.1). Falling from a roof was the most common type of *High fall* reported for 2014–15, followed by falling down multiple stairs/steps (11 and 9 cases, respectively). Other types of *High fall* cases reported for this period included falls from ladders, verandahs and balconies, walls, scaffolding and trampolines. Falling while intoxicated was mentioned in the narrative of 8 *Low fall* and 7 *High fall* cases.

A fall of some description accounted for more than half (57%) of all female traumatic SCI cases in 2014–15, compared with 35% for male cases. A higher proportion of female cases were due to a *Low fall* than that for males (35% for females versus 16% for males). The proportion of *High fall* SCI cases reported to the ASCIR were similar for males and females (19% and 22% respectively).

The mean age at onset for traumatic SCI due to a *Low fall* was 66, while it was considerably younger, at 50, for a *High fall*. The age range for each fall type was very similar, with *Low fall* cases ranging in age from 16 to 85, and *High fall* from 16 to 86.

While most fall cases appear to have been unintentional, 4 *High fall* SCI cases were attributed to acts of intentional self-harm and intent was unclear or unspecified for a further 2 *High fall* cases.

The majority (43 of 53, or 81%) of *Low fall* SCI cases had a neurological injury at the cervical level (tetraplegia) on admission to the SU (Table 4.3). Two of these cervical cases resolved (that is, were assessed as ASIA Impairment Scale grade E) at the time of discharge, and 1 no longer had dysfunction at the cervical level but had dysfunction at the thoracic level.

Cervical level injuries on admission were also frequent for *High fall* SCI cases (27 of 52 cases or 52%), but to a lesser extent than for *Low fall* (Table 4.3). Twenty of these cervical cases were discharged with *Incomplete tetraplegia*, and 2 cases no longer had dysfunction at the cervical level but had dysfunction at the thoracic level.

Water-related

The 14 male and 2 female W*ater-related* SCI cases made up 6% of traumatic SCI cases reported to the ASCIR for 2014–15 (Table 4.1). After *Land transport crashes* and *Falls*, *Water-related* events were the third most frequent cause of traumatic SCI in Australia.

More than half (56%) of these cases involved diving into shallow water, either in a pool (6 cases) or at the beach (3 cases). Five (31%) of cases involved board or body surfing. Other *Water-related* SCI cases involved while water-skiing or riding a water-slide.

The mean age for *Water-related* SCI in 2014–15 was 37, and the age range was 19 to 66.

All except 1 of the 16 W*ater-related* SCI cases sustained a neurological injury to the cervical spine (Table 4.3), and of these, 14 were discharged with *Incomplete tetraplegia*.

Heavy falling objects

A small proportion (2%) of the traumatic SCI cases sustained in 2014–15 involved being struck by a *Heavy falling object* (Table 4.1). All except one of these cases involved being struck by a tree branch.

Three of the 4 *Heavy falling object* cases reported to the ASCIR were males (75%).

The mean age for traumatic SCI due to a *Heavy falling object* was 36, with an age range between 22 and 60.

Three of the 4 cases were admitted with an injury at the thoracic level (Table 4.3).

Horse-related

Four males and 2 females sustained a *Horse-related* SCI in 2014–15 (Table 4.1). These cases accounted for 2% of traumatic SCI overall. Five (83%) of these *Horse-related* SCI cases involved falling or being thrown from a horse, while the remaining case involved falling from a horse-drawn cart.

Horse-related SCI cases in 2014–15 ranged in age from 43 to 67. This was the only mechanism-of-injury category for 2014–15 for which no cases were recorded for people aged 15–24 (Table 4.2).

Horse-related SCI was most often at the cervical level (4 cases, or 67%) (Table 4.3), and of these, 3 were discharged with *Incomplete tetraplegia*.

Football

Football SCI accounted for 3% of traumatic SCI cases overall in 2014–15 (Table 4.1). All but 1 of these 7 injuries were sustained while playing rugby.

All cases were males, and the mean age at injury was 31 (a range of 17 to 46). As has been the case in previous years, this is the lowest mean age reported among the mechanisms of injuries included in this report.

All 7 *Football* SCI cases were admitted with cervical level injuries (Table 4.3). Four (57%) of these cases were discharged with *Complete tetraplegia*; 2 (or 29%) with *Incomplete tetraplegia*; and 1 case had resolved (that is, an ASIA Impairment Scale grade of E at discharge).

Other and unspecified causes

A further 14 male and 3 female cases reported to the ASCIR for 2014–15 had a mechanism of injury other than those described above. This residual category, *Other and unspecified causes,* accounted for 6% of traumatic SCI cases overall (Table 4.1).

Causes of traumatic SCI cases in this category included 4 assault cases; 3 cases due to bull-riding or other interaction with cattle; 2 cases involving other types of transport/machinery; and 2 cases following intervention by legal authorities.

The mean age for *Other and unspecified causes* of SCI in 2014–15 was 47, and cases in this residual category ranged in age from 18 to 76.

A cervical level injury at admission was most common (65%) for these *Other and unspecified cause* cases (Table 4.3). Of these 11 cervical injury at admission cases, 3 were discharged with *Complete tetraplegia*; 6 with *Incomplete tetraplegia*; 1 case had resolved; and the remaining case had improved neurological function to include some of the thoracic spine.

Activity at time of injury

The classification system for reporting type of activity when injury occurred is based on the one used in the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM) (NCCC 2013). It includes the following categories: W*hile engaged in sports or leisure; While working for income; While engaged in other types of work* (such as unpaid home maintenance)*; While resting, sleeping, eating or engaging in other vital activities* (hereafter referred to as *While engaged in a personal activity*); or *While engaged in other or unspecified activity*.

The types of activity being undertaken at the time of injury, together with the mechanism of injury, are shown in Table 4.5.

Thirty-five per cent of traumatic SCI cases reported to the ASCIR for 2014–15 occurred while the person was *Engaged in sports or leisure* activities, and 77 (85%) of these cases were males. *Unprotected land transport users*, including 15 motorcyclists, 12 pedal cyclists and 3 quad-bike riders made up the greatest proportion of sporting and leisure activity cases (33%). *Water-related* events (18%) and *High fall* (17%) are the next most frequent causes of traumatic SCI during sports and leisure. All of the *Football* cases and 4 of 6 *Horse-related* SCI cases are included in this activity group. Other sporting activities during which cases occurred included motor-racing, canyoning, kiteboarding and roller-skating. Young men aged 15–24 accounted for 1 in 4 cases in this activity group (23 cases or 25%), while a further 19% were males aged 24–34 (17 cases). Alcohol was noted as a contributing factor in almost one-quarter (23%) of sport and leisure SCI cases.

The next most common type of specified activity during which traumatic SCI occurred was W*hile working for income,* at 10%. All 26 cases in this activity group were male, and half of these were aged 55–64 (13 cases). Nine truck drivers or heavy machine operators made up just over one-third (35%) of cases injured *While working for income*. Another 3 cases occurred when the person was travelling to work, and 2 cases involved falling from a horse or horse-drawn cart. Forty-two per cent of cases that were sustained *While working for income* occurred on a public road or highway (11 cases). Five cases (19%) occurred on an industrial or construction site, and a further 12% (3 cases) occurred on a farm.

A further 8% of cases occurred while the person was engaged in unpaid work (Table 4.5). More than three-quarters (82%) of these were male (18 of 22 cases). Included in this activity group were 6 cases of falling from a ladder, 5 falls from a roof, and 3 cases where the person was struck by a falling tree branch while pruning. The majority (86%) of cases injured while performing unpaid work were aged 55 or older (19 cases). The remaining 3 cases were aged between 15 and 34. Fifteen cases occurred in and around the home, a further 2 cases occurred on a farm and 1 case occurred on a public road.

All except 1 of the 14 traumatic SCI cases sustained while the person was *Engaged in a personal activity* (such as eating, sleeping or self-care) were due to a *Low fall*. Cases in this activity group included falls while in the bathroom, bedroom or kitchen, as well as falling down stairs or from or after rising from a chair. Nine males accounted for 64% of cases in this activity group, and all male and female cases were aged 45 or older. Cases that occurred while *Engaged in a personal activity* made up 5% of traumatic SCI cases overall.

Thirty-four of the remaining 111 cases had no activity recorded at the time of injury. This amounted to 31% of cases in the residual category *While engaged in other or unspecified activity*. *Land transport* cases accounted for 57% of this activity category, including 39 *Motor vehicle occupants* and 24 *Unprotected land transport users.* A further 37% were attributable to a fall, including 24 *Low fall* and 17 *High fall* cases. The majority (88%) of traumatic SCI cases in this activity group were due to unintentional events, while 5 cases were due to *Intentional self-harm* (5%), 3 were due to *Assault* (3%), and 2 were due to a *Legal intervention* (2%). Intent was unknown in the remaining 3 cases. Close to 1 in 3 (30%) of the 63 *Land transport* crash SCI cases were aged 25–34 (15 male and 4 female cases). Close to half (48%), or 53 of the 111 traumatic SCI cases in this activity category occurred on a public road, and a further 23% occurred in or around the home (25 cases). Shops, parks and other recreational areas are just a few of the other types of places where traumatic SCI cases in this activity category occurred.

Table 4.5: Traumatic SCI, by mechanism of injury, by type of activity, 2014–15

	Sports and leisure		Working for income[a]		Other type of work		Personal activity		Other and unspecified activity		Total	
Mechanism of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Land transport crash												
Motor vehicle occupant	3	3	7	27	0	0	0	0	39	35	49	19
Unprotected land transport user	30	33	5	19	1	5	0	0	24	22	60	23
Fall												
Low fall (same level or <1metre)[b]	11	12	3	12	2	9	13	93	24	22	53	20
High fall (≥1 metre)	15	16	6	23	13	59	1	7	17	15	52	20
Water-related	16	18	0	0	0	0	0	0	0	0	16	6
Heavy falling object	0	0	0	0	4	18	0	0	0	0	4	2
Horse-related	4	4	2	8	0	0	0	0	0	0	6	2
Football	7	8	0	0	0	0	0	0	0	0	7	3
Other and unspecified causes	5	5	3	12	2	9	0	0	7	6	17	6
Total[c]	**91**	**100**	**26**	**100**	**22**	**100**	**14**	**100**	**111**	**100**	**264**	**100**

(a) Includes travel to and from work.

(b) Includes falls from unspecified heights.

(c) Percentages may not equal 100, due to rounding.

Remoteness of place of injury

Approximately 2 out of 5 traumatic SCI cases (43%) reported to the ASCIR had insufficient detail recorded for place of injury to enable assignment to an Australian remoteness zone (Table 4.6). A further 2% of cases were sustained by an Australian resident while visiting another country. Of the remaining 145 cases (including 4 non-residents of Australia), 57% of traumatic SCI cases occurred in *Major cities of Australia.* The number of traumatic SCI cases decreased with increasing remoteness. For cases involving non-residents of Australia, 1 case each was recorded for *Major cities*, *Inner regional*, *Outer regional*, and *Remote Australia*.

Table 4.6: Remoteness zone for place where traumatic SCI occurred, 2014–15

Remoteness zone	Number	%
Major cities	82	31
Inner regional	37	14
Outer regional	20	8
Remote	6	2
Very remote	0	0
Australia, place not specified	113	43
Overseas	6	2
Total	**264**	**100**

Appendix A: Data issues

Data quality statement

This data quality statement provides information relevant to interpretation of the Australian Spinal Cord Injury Register (ASCIR).

Summary of key data quality issues

- The Australian Institute of Health and Welfare (AIHW) National Injury Surveillance Unit (NISU) compiles the ASCIR using data provided by participating spinal units (SUs) in hospitals in Australia.
- The ASCIR is estimated to cover a large proportion of adult cases of spinal cord injury (SCI) due to trauma.
- The ASCIR database changes over time, adding new records and improving the quality of existing records as new information becomes available. Reported information on the ASCIR records may therefore change from year to year.

Description

The ASCIR is an opt-in national register of incident cases of SCI which occur in Australia and overseas to Australian residents if they are treated in an SU in Australia. The ASCIR has operated as a cooperative venture of the directors of the participating SUs in Australia and the AIHW through the AIHW NISU, since 1995. The ASCIR is part of the NISU program, which is managed and operated by the Research Centre for Injury Studies (RCIS) at Flinders University. The ASCIR is based on the national register originally established in 1986 by Mr John Walsh, AM.

The ASCIR is managed by a Board of Directors comprising the directors of the SUs; the Director of NISU; and invited specialists in epidemiology, paediatric rehabilitation and other fields of relevance.

The registration process begins in the SU after patient stabilisation. The director at each participating SU is responsible for data collection and patient consent arrangements in their unit. The registration process and reporting to the NISU differs between SUs: some SUs use a 2-phase registration and reporting process, on admission and on discharge, while others may register and report at the time of discharge only.

Institutional environment

The AIHW is a major national agency set up by the Australian Government under the *Australian Institute of Health and Welfare Act 1987* (the AIHW Act) to provide reliable, regular and relevant information and statistics on Australia's health and welfare. It is an independent, corporate Commonwealth entity established in 1987, governed by a management board, and accountable to the Australian Parliament through the Health portfolio.

The AIHW aims to improve the health and wellbeing of Australians through better health and welfare information and statistics. It collects and reports information on a wide range of topics and issues, ranging from health and welfare expenditure, hospitals, disease and injury, and mental health, to ageing, homelessness, disability and child protection.

The AIHW also plays a role in developing and maintaining national metadata standards. This work contributes to improving the quality and consistency of national health and welfare

statistics. The AIHW works closely with governments and non-government organisations to achieve greater adherence to these standards in administrative data collections, to promote national consistency and comparability of data and reporting.

One of the main functions of the AIHW is to work with the states and territories to improve the quality of administrative data and, where possible, to compile national datasets based on data from each jurisdiction, to analyse these datasets and to disseminate information and statistics.

The AIHW Act, in conjunction with compliance to the *Privacy Act 1988* (Cth), ensures that the data collections managed by the AIHW are kept securely and under the strictest conditions with respect to privacy and confidentiality. For further information, see the AIHW website <www.aihw.gov.au>.

The AIHW is the Data Custodian for the ASCIR data, through the NISU. The Data Custodian ensures that the analysis and dissemination of the data are in accord with purposes approved by the AIHW Ethics Committee, as well as security provisions required by Section 29 of the AIHW Act. The NISU is responsible for the security, proper operation, access to and use of the ASCIR data. The Director, Professor James Harrison, is responsible to the AIHW for ensuring that the operation of the ASCIR and the use of ASCIR data comply with AIHW policies and procedures.

The following SUs, all based in public hospitals, contribute data to the ASCIR:

- New South Wales State Spinal Cord Injury Services at:
  - Prince of Wales Hospitals (Sydney)
  - Royal North Shore Hospital (Sydney)
  - Royal Rehabilitation Centre (Sydney)
- Queensland Spinal Cord Injury Service, Princess Alexandria Hospital (Brisbane)
- South Australian Spinal Cord Injury Service, Hampstead Rehabilitation Unit (Adelaide)
- Victorian Spinal Cord Services, Austin Health (Melbourne)
- Western Australian State Rehabilitation Service, Fiona Stanley Hospital (Perth) (formerly Royal Perth Hospital's Shenton Park campus).

Timeliness

The reference period for this report is 2014–15.

The main focus for reporting is incident cases of persisting traumatic SCI. 'Persisting' cases are those in which the ASIA Impairment Scale is A to D at 90 days after injury, or at discharge from rehabilitation. Long periods in rehabilitation are not unusual. Finalising register data, particularly for cases that arise late in the reference year, requires follow-up for a period after the end of the reference year.

The date of closure for case registrations for 2014–15 data was 31 January 2017. Data corrections from spinal units up to 24 April 2017 are included in this report. A snapshot file of the ASCIR was taken on 14 June 2017.

Accessibility

The AIHW provides the published annual epidemiological *Spinal cord injury, Australia* series based on the ASCIR. These products may be accessed on the AIHW website <www.aihw.gov.au>.

Additional data requests can also be made on an ad hoc basis, facilitated through AIHW.

Aggregated jurisdictional data may be released with the permission of the AIHW Data Custodian and the relevant SU director(s). Aggregated national data may be released with the permission of the AIHW Data Custodian.

Interpretability

The annual publications include a glossary and an appendix on data issues, as well as inclusion and exclusion criteria for each chapter or subsection.

Further information on the ASCIR is available, on request, by email <nisu@flinders.edu.au>.

Relevance

The Australian Spinal Cord Injury Register contains records of newly incident adult cases of spinal cord injury which occur in Australia and overseas to Australian residents (who received treatment in an Australian SU) since 1995 and up to 2014–15. Cases for 2015–16 onwards are currently being registered.

The scope of the ASCIR includes patients who are admitted to 1 of the 7 specialised SUs in Australia chiefly responsible for care and rehabilitation of people with this condition.

The ASCIR keeps a record of patient demographic information; assessment of level of SCI at admission; a description of the event that led to their SCI; details of clinical status at discharge; and any complications during the course of treatment and rehabilitation.

Although the ASCIR is a valuable source of information on the incidence of SCI care characteristics and trends, the data have limitations. Notably, the system does not include cases that are not treated at any of the participating units, which includes paediatric cases and some others. Also, the current system does not capture detailed information on the period from injury to admission to an SU, and does not obtain follow-up data after discharge from an SU.

Accuracy

The participating SUs are primarily responsible for the quality of the data they provide. However, the NISU undertakes extensive validations on receipt of data. Data are checked for valid values, logical consistency and historical consistency. Potential errors and gaps in data are queried with the relevant SU, and corrections and resubmissions may be made in response to these queries. Despite these processes, values of some variables remain unspecified, due to information not having been volunteered or recorded. The number of records for which data on tabulated variables were not available is generally stated in tables and footnotes. The NISU does not adjust data to account for possible data errors or missing or incorrect values, except as stated in reports.

Ideally, all cases would be added to the ASCIR during the initial period of hospitalisation following injury. However, in practice there has often been a substantial time lag between a patient's admission and the start of the case registration process. Each SU has a different system for completing and compiling case registrations before submission to the NISU, and delays at different stages of the process occur from time to time.

The ASCIR is continuously updated. Sometimes information comes to hand after the closure of a reporting period. Closure of a reporting period usually occurs following an audit/review period extending for at least 1 year after the reporting period ends. This allows for sometimes long periods of admitted patient care. As a result, analysis of data from the register over longer periods of time will reflect these changes to data on cases that occurred in earlier years, and will not necessarily match the results of analyses in previous reports.

Known contributing factors in underestimation include that the person:

- did not consent to be included in the register
- was released from hospital without the need for admitted patient rehabilitation
- was admitted to another rehabilitation unit that does not provide data to the ASCIR
- died before admission to a specialist SU occurred.

Coherence

The ASCIR includes data for each year from 1995–96 to 2014–15.

The data reported for 2014–15 are broadly consistent with data reported for the ASCIR for previous years.

Extensive checking of the ASCIR records was undertaken in 2014 and 2015. This revealed some errors and inconsistencies, mostly mistakes in transcription from paper records. In most instances, these were able to be corrected on the basis of stored register forms or by consultation with the submitting SU.

In addition, it was found that the assignment of external causes of traumatic SCI on the basis of short text descriptions in submitted registration data was not always consistent. A revised method was implemented, based more directly on the available text and aligned more closely with the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification* (ICD-10-AM) and the previous version of the classification (ICD-9-CM). The main effect of this is that, in reports covering cases occurring in 2008–09 and later, *Land transport* cases have not been sub-divided into traffic and non-traffic cases, as available text was not sufficient to make this distinction reliably in many cases. In reports covering cases from 2011–12 and later, cases of SCI due to complications of medical care have been reported with non-traumatic cases in Appendix B. Formerly, some such cases were reported as non-traumatic while others, reported as traumatic, were included in the body of the annual reports (see Box A.1). This change makes clearer how complications of care cases are now handled and better aligns ASCIR statistical reports with other AIHW reports on injury.

Box A.1: Change in definition of traumatic spinal cord injury

The case definition of ‘traumatic spinal cord injury’ has been changed slightly for new case registrations reported for 2011–12 onwards.

According to ICD-10-AM, some complications of surgical and medical care are codable to disease-specific chapters of the classification, while the remainder are codable to a section of the injury chapter *T80–T88 Complications of surgical and medical care, not elsewhere classified*.

By longstanding convention, AIHW reports on injury generally do not include cases coded to T80–T88. This is because T80–T88 includes a poorly defined part of all complications of medical care cases, and because circumstances of occurrence differ greatly between these cases and other injuries which occur in the community rather than the special circumstances of clinical care.

(continued)

Box A.1 (continued): Change in definition of traumatic spinal cord injury

Beginning with the data year 2011–12, this practice has been applied to the reporting of the ASCIR data. The effect is that small numbers of cases (2 to 5 in most years), which would previously have been reported in the *Other and unspecified causes* category of the 'External causes' chapter in the annual *Spinal cord injury, Australia* series, are now included in an appendix with non-traumatic cases.

Time series presentations may be affected by changes in admission practices and/or in reporting of cases to the ASCIR. This applies particularly to the least severe cases, namely those that were admitted to 1 of the participating SUs but were later found to have no ongoing neurological injury (that is, ASIA Impairment Scale grade of E). Such cases were more numerous in the decade from 1995–96 than more recently.

Funding for the ASCIR was not provided in 2008–09 and 2009–10. During this period, case registration and compilation slowed considerably. When funding was reinstated, some SUs experienced difficulties in retrospectively achieving full case registration.

For the financial year of injury 2011–12, fewer cases from 1 SU were registered than normal. In most years, this unit contributes an average of 20% of newly incidence cases, but for 2011–12, it contributed only 13%.

Further information on the ASCIR dataset is available on request by email <nisu@flinders.edu.au>.

Population denominators

Population data were obtained from the Australian Bureau of Statistics (ABS) (ABS 2016). Incidence rates have been calculated as cases per million of the estimated resident population (ERP) of Australia.

Annual rates to 31 December were manually calculated by adding the ERPs for the first and second year and dividing by 2.

Direct standardisation was employed, taking the Australian population in 2001 as the standard (ABS 2003).

This report adopts the ABS definition of *Place of usual residence* as:

> *…that place where each person has lived or intends to live for six months or more from the reference date for data collection* (ABS 2012).

As with Australian Census data, place of residence at the time of injury for the ASCIR is self-reported, and some visitors to Australia may have reported an address in Australia as their place of residence, rather than apply this technical distinction. This may have resulted in some non-residents being assigned *Australian resident* status in this report. Unlike previous reports in the *Spinal cord injury, Australia* series, this 2014–15 report includes both residents and non-residents when calculating rates. This change has made little difference to the annual rates as shown in Table A1 below.

Table A1: Comparison of annual rate of persisting traumatic SCI for Australian residents only, and for Australian residents and non-residents of Australia.

	Australian residents only		Australian residents and non-residents	
Financial year of injury	Number of cases[a]	Age-standardised rate per million population	Number of cases[b]	Age-standardised rate per million population
1995–96	238	16.1	245	16.5
1996–97	243	16.5	249	16.9
1997–98	279	18.7	289	19.4
1998–99	264	17.7	272	18.2
1999–00	269	17.8	276	18.3
2000–01	258	17.0	270	17.8
2001–02	231	15.0	247	16.0
2002–03	236	15.1	243	15.5
2003–04	242	15.3	249	15.7
2004–05	244	15.2	258	16.1
2005–06	254	15.6	265	16.3
2006–07	255	15.4	260	15.7
2007–08	255	15.0	262	15.4
2008–09	238	13.9	248	14.4
2009–10	219	12.4	224	12.7
2010–11	256	14.3	260	14.5
2011–12	201	10.9	203	11.1
2012–13	230	12.4	235	12.7
2013–14	231	12.1	236	12.4
2014–15	250	12.6	254	12.8

(a) Age at onset of persisting traumatic SCI was missing for 1 case.

(b) Age at onset of persisting traumatic SCI was missing for 3 cases.

Use of confidence intervals

The ASCIR is designed to register new cases of SCI at ages 15 and older, so sampling errors do not apply to these data. However, the time period used to group the cases (a financial year) is arbitrary. Use of another period (for example, January to December) would result in different rates.

Where case numbers are small, the effect of chance variation on rates can be large. Confidence intervals (95%, based on a Poisson assumption about the number of cases in a time period) have been placed around rates in Figure 3.1 as a guide to the size of this variation. Chance variation alone would be expected to lead to a rate outside the interval only once in 20 occasions.

Assignment to reported mechanism of injury

Cases were assigned to 1 of the following mechanism of injury categories:

- Land transport crashes
  - Motor vehicle occupants
  - Unprotected land transport users
- Falls
  - Low falls (same level or <1 metre) (includes falls from an unspecified height)
  - High falls (≥1 metre)
- Water-related
- Heavy falling object
- Horse-related
- Football.

The method for allocating cases into mechanism of injury categories shown in Table A2 was a 3-step process as follows:

- Step 1: Draft allocation to the *Land transport crashes*, *Falls* and *Horse-related* SCI on the basis of the numeric code values in the 'Main External Cause A' data field.
- Step 2: Draft allocation to the next 3 categories on the basis of the presence of keywords or phrases in the 'Description of the traumatic SCI event' data field.
- Step 3: Cases were reviewed for errors and inconsistencies, and re-assigned if these were found. If a case met criteria for more than 1 row, then it was assigned to the 1 occurring highest in the table.

Table A2: Assignment to reported mechanism of injury

Reported mechanism of injury	Assignment according to the ASCIR field 'Main External Cause A' numeric code or content of the ASCIR field 'Description of the traumatic SCI event'
Motor vehicle occupants	1. Motor vehicle: driver 2. Motor vehicle: passenger *(includes unspecified occupants)*
Unprotected land transport users	3. Motorcycle: driver 4. Motorcycle: passenger *(includes unspecified occupants)* 5. Pedal cyclist or pedal cycle passenger *(includes unspecified occupants)* 6. Pedestrian 7. Other or unspecified transport-related circumstance, if record also contains reference to quad-bike, go-kart or other similar land transport vehicle
Low falls (same level or <1 metre)	9. Fall: low (on same level, or <1 metre drop) (also includes fall from an unspecified height)
High falls (≥1 metre)	10. Fall: high (drop of 1 metre or more)
Water-related	Records searched for mention of: dive, diving, swim, surf, pool, shallow, water-skiing, wakeboarding, snorkelling
Heavy falling object	Records searched for mention of: branch fell, tree fell, pinned by, bales slid, falling telephone pole, clay fell, hit by a metal ramp, metal falling off truck
Horse-related	8. Horse-related (fall from, struck or bitten by)
Football	Records searched for mention of: football, AFL, rugby, soccer
Other and unspecified causes	Any remaining records not assigned to a mechanism above

Assignment to Remoteness Area

The ABS Remoteness Structure is a common measurement used in Australian health data and provides a classification system which gives an indication of road distances people may have to travel to access their nearest service centres. The Remoteness Structure was developed by the Australian Government in 1997 and had a methodology update in 2011 (ABS 2013b). The classification of Remoteness Areas (RA) remain the same however and include:

- *Major cities of Australia*
- *Inner regional Australia*
- *Outer regional Australia*
- *Remote Australia*
- *Very remote Australia.*

In this report, remoteness classifications for place of residence and place of injury were assigned using 2 interactive map look-up tools.

The first step involved converting postcodes recorded in the ASCIR to an RA using Table 3 in the Postcode 2012 to Remoteness Area 2011 Data Cube (ABS 2013a) for cases with an injury date between 1 January 2012 and 31 December 2014, or 2015 Postcode to Remoteness Area 2011 Data Cube (ABS 2016, pers. comm., 22 June) for cases with an injury date on or after 1 January 2015.

Where a postcode had more than one RA assigned, and 95% or more of the postcode area was in one RA, then cases were assigned to that RA. Otherwise, the street address or location recorded in the ASCIR was used to search the Department of Health DoctorConnect website <doctorconnect.gov.au/internet/otd/Publishing.nsf/Content/locator> and the case was assigned to a RA on that basis.

Appendix B: Other SCI cases

Two types of SCI cases reported to the ASCIR are not included in the main part of this report. They are cases caused by a disease process ('non-traumatic SCI') and cases in which the onset of SCI was a complication of medical care for a disease. These cases are summarised here.

Cases that are a complication of medical care usually have a well-defined date of onset, which allows the cases to be reported according to the year of occurrence. Non-traumatic SCI cases often have a gradual onset. Accordingly, these non-traumatic SCI cases are reported according to year of admission.

Non-traumatic SCI cases

Sixty males (53%) and 54 females with a non-traumatic SCI were admitted to a participating SU between 1 July 2014 and 30 June 2015, and consented to being included in the ASCIR.

The mean age of non-traumatic SCI cases admitted in this period was 55 (*SD* = 16). The median length of stay in the SU was 79 days (5th percentile 8 days; 95th percentile 241 days).

Three cases died before being discharged (3%), 44 cases were discharged to their previous home (39%), 30 to a new home (26%) and 17 were discharged to another acute hospital (15%).

Complication of medical care SCI cases

Cases included here arose in the course of surgery or as a result of other medical care, commonly during repair of an abdominal aortic aneurysm, laminectomy or spinal decompression, where the record states the onset of paralysis was post intervention.

Eighteen male (82%) and 14 female cases with a date of SCI onset between 1 July 2014 and 30 June 2015 were reported to the ASCIR as meeting the criteria for complication of medical care case. The mean age at onset for these cases was 56 (*SD* = 16).

Median length of stay was 92 days (5th percentile 8 days; 95th percentile 273 days). Eighteen (82%) of the 22 complication of medical care SCI cases were discharged to a private home, while the remaining 4 were transferred to a hospital or supported nursing/accommodation setting.

Appendix C: Additional tables

The data included in these additional tables underpin the figures presented in Chapter 3. As a reminder, the inclusion criteria for Chapter 3 was that the SCI must have occurred between 1 July 1995 and 30 June 2015, and the person must have been:

- aged 15 or older at onset
- reported to have a spinal cord deficit at discharge
- discharged alive.

Table C1: Trends in rates of persisting traumatic SCI cases aged 15 and older, by financial year of injury, 1995–96 to 2014–15

Financial year of injury	Age-standardised rate per million population	Poisson modelled rate per million population	Upper 95% CI	Lower 95% CI	Number of cases[(a)]
1995–96	16.5	18.8	19.8	17.9	245
1996–97	16.9	18.4	19.3	17.5	249
1997–98	19.4	18.0	18.8	17.2	289
1998–99	18.2	17.6	18.4	16.9	272
1999–00	18.3	17.3	17.9	16.6	276
2000–01	17.8	16.9	17.5	16.3	270
2001–02	16.0	16.5	17.0	16.0	247
2002–03	15.5	16.2	16.6	15.7	243
2003–04	15.7	15.8	16.3	15.4	249
2004–05	16.1	15.5	15.9	15.0	258
2005–06	16.3	15.1	15.6	14.7	265
2006–07	15.7	14.8	15.2	14.4	260
2007–08	15.4	14.5	14.9	14.1	262
2008–09	14.4	14.2	14.6	13.7	248
2009–10	12.7	13.9	14.4	13.4	224
2010–11	14.5	13.6	14.1	13.1	260
2011–12	11.1	13.3	13.8	12.7	203
2012–13	12.7	13.0	13.6	12.4	235
2013–14	12.4	12.7	13.4	12.1	236
2014–15	12.8	12.4	13.1	11.8	254

(a) Age at onset of persisting traumatic SCI was missing for 3 cases.

Table C2: Trends in age-standardised rates of persisting traumatic SCI cases aged 15 and older, by financial year of injury, by sex, 1995–96 to 2014–15

	Males		Females	
Financial year of injury	Number of cases	Age-standardised rate per million population	Number of cases	Age-standardised rate per million population
1995–96	191	25.8	53	7.1
1996–97	195	26.8	54	7.3
1997–98	231	31.1	58	7.8
1998–99	211	28.3	61	8.1
1999–00	226	30.1	49	6.4
2000–01	208	27.5	62	8.0
2001–02	197	25.8	49	6.3
2002–03	186	24.1	57	7.1
2003–04	202	25.7	47	5.8
2004–05	210	26.3	47	5.7
2005–06	218	27.0	47	5.8
2006–07	216	26.3	44	5.2
2007–08	222	26.4	40	4.7
2008–09	199	23.1	49	5.8
2009–10	182	20.6	42	4.8
2010–11	211	23.7	49	5.3
2011–12	163	17.8	40	4.3
2012–13	186	20.2	49	5.2
2013–14	189	20.0	47	4.6
2014–15	202	20.7	52	5.0

Table C3: Counts and age-specific rates of persisting traumatic SCI cases aged 15 and older, by age group, 2014–15

Age group	Cases	Rate per million population
15–24	39	12.4
25–34	49	14.1
35–44	22	6.8
45–54	28	9.0
55–64	54	19.9
65–74	39	19.8
75+	23	15.0

Table C4: Age-specific rates of persisting traumatic SCI cases aged 15 and older, by age group, by sex, 2014–15

Age group	Cases	Rate per million population
Males		
15–24	35	21.8
25–34	36	20.6
35–44	21	13.1
45–54	23	15.0
55–64	45	33.7
65–74	29	29.8
75+	13	19.7
Females		
15–24	4	2.6
25–34	13	7.5
35–44	1	0.6
45–54	5	3.2
55–64	9	6.5
65–74	10	10.0
75+	10	11.4

Table C5: Age-standardised 3-year rates of persisting traumatic SCI cases aged 15 and older, by state or territory of usual residence, 2012–13 to 2014–15

State or territory	Cases	3-year rate per million population
New South Wales	214	11.6
Victoria	141	9.9
Queensland	156	13.9
Western Australia	111	17.9
South Australia	60	13.5
Tasmania	11	9.5
Australian Capital Territory	6	6.1
Northern Territory	12	21.0
Australia[(a)]	**725**	**12.6**

(a) The 3-year Australia rate includes 14 non-residents of Australia cases.

Table C6: Age-standardised 3-year rates of persisting traumatic SCI cases aged 15 and older, by remoteness of residence, 2012–13 to 2014–15

Remoteness of residence	Cases	3-year rate per million population
Major cities of Australia	440	10.8
Inner regional Australia	147	14.1
Outer regional Australia	91	18.9
Remote Australia	21	27.1
Very remote Australia	11	20.7
Australia[(a)]	**725**	**12.6**

(a) The 3-year Australia rate includes 1 Australian resident case with insufficient address details to assign a remoteness zone and 14 non-residents of Australia cases.

Table C7: Neurological level of injury at discharge for persisting SCI cases aged 15 and older, 2014–15

Neurological level	Frequency	%[a]
C1	5	2
C2	17	7
C3	21	8
C4	57	22
C5	25	10
C6	12	5
C7	10	4
C8	4	2
T1	4	2
T2	5	2
T3	11	4
T4	15	6
T5	4	2
T6	9	4
T7	4	2
T8	7	3
T9	6	2
T10	7	3
T11	11	4
T12	2	1
L1	10	4
L2	3	1
L3	3	1
L4	1	0
L5	0	0
S1	0	0
S2	0	0
S3	0	0
S4	0	0
S5	0	0
Not known	1	0
Total	**254**	**100**

(a) Percentages may not equal 100, due to rounding.

Glossary

ASIA Impairment Scale: The International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) (revised 2011) uses the American Spinal Injury Association Impairment Scale, also known as the ASIA Impairment Scale or AIS, to classify spinal injuries using a combination of measurements of motor and sensory function (ASIA 2003; Kirshblum et al. 2011). This scale is a modification of an earlier classification system known as the Frankel Scale, which was commonly used between 1969 and 1992 (Frankel et al. 1969). To avoid confusion with the more widely known Abbreviated Injury Scale (AIS) classification system, this report has adopted the term 'ASIA Impairment Scale'. The following ASIA Impairment Scale categories are used to grade the degree of impairment:

> ***A = Complete.*** *No sensory or motor function is preserved in the sacral segments S4–S5, meaning there is 'no sacral sparing'. This is measured by light touch, pin prick at S4–S5, or deep anal pressure.*
>
> ***B = Sensory Incomplete.*** *Sensory but not motor function is preserved below the single neurological level of injury and includes the sacral segments S4–S5 (that is there is 'sacral sparing'), AND no motor function is preserved more than 3 levels below the motor level on either side of the body.*
>
> ***C = Motor Incomplete.*** *Motor function is preserved at the most caudal sacral segments for voluntary anal contraction OR the patient meets the criteria for sensory incomplete status (sensory function preserved at the most caudal sacral segments (S4–S5) as measured by light touch, pin prick at S4–S5, or deep anal pressure), and has some sparing of motor function more than 3 levels below the ipsilateral motor level on either side of the body. For a grade of C, less than half of the key muscle functions below the single neurological level of injury should have a muscle grade equal to or greater than 3, which is defined as having 'active movement, and full range of motion against gravity'.*
>
> ***D = Motor Incomplete.*** *Motor incomplete status as defined above, with at least half or more of key muscle functions below the single neurological level of injury having a muscle grade equal to or greater than 3.*
>
> ***E = Normal.*** *If sensation and motor function as tested with the ISNCSCI are graded as normal in all segments, and the patient had prior deficits, then the ASIA Impairment Scale grade is E* (Kirshblum et al. 2011).

complete injury: An SCI case with a complete injury is assessed as ASIA Impairment Scale grade A.

duration of initial care: The period from the date of injury to the date of discharge from a participating spinal unit to a person's previous home, or to a new home, nursing home or other accommodation. This period includes retrieval of the person from the scene of the injurious event; stabilisation; and all acute care and rehabilitation as an admitted patient. Part of the care, but usually not all, is provided in an SU.

extent of SCI: The extent of neurological damage, which is either 'complete' or 'incomplete'. If partial preservation of sensory and/or motor functions is found below the neurological level and includes the lowest sacral segment, the injury is defined as 'incomplete'. The term 'complete injury' is used when there is an absence of sensory and motor function in the lowest sacral segment (see **ASIA Impairment Scale**, above).

incident case of SCI: A person who suffers a temporary or permanent (persisting) spinal cord injury, as defined by the US Centers for Disease Control, during a reporting period.

incomplete injury: An SCI case with an incomplete injury is assessed as an ASIA Impairment Scale grade of B, C or D.

neurological level of SCI: The most caudal segment of the spinal cord with normal sensory and motor function on both sides of the body (that is, the level furthest from the head that has full function—see **ASIA Impairment Scale**, above). Neurological level of SCI is often described according to the region of the spine injured (cervical, thoracic, lumbar or sacral). These regions include the:

- **cervical** spine, consisting of segments C1–C8
- **thoracic** spine, consisting of segments T1–T12
- **lumbar** spine, consisting of segments L1–L5
- **sacral** spine, consisting of segments S1–S5. ('**Lumbosacral**' is the combined region consisting of segments L1–L5 and S1–S5.)

paraplegia: An impairment or loss of motor and/or sensory function in the thoracic, lumbar or sacral (but not cervical) segments of the spinal cord, due to damage of neural elements within the spinal canal.

persisting spinal cord injury: An ASIA Impairment Scale grade of A, B, C or D either 90 days after injury, or at discharge from rehabilitation, or a deficit on discharge was advised by the SU.

tetraplegia: An impairment or loss of motor and/or sensory function in the cervical segments of the spinal cord due to damage of neural elements within the spinal canal. This term is etymologically more appropriate than 'Quadriplegia', combining *tetra* + *plegia*, both from Greek, rather than *quadri* + *plegia*, a Latin/Greek amalgam. 'Tetraplegia' is generally preferred outside the US.

unprotected land transport users: A pedestrian, pedal cyclists, motorcycle rider or a quad-bike rider. By contrast, occupants of cars, trucks and most other motor vehicles are afforded some protection from injury by the vehicle in the case of a crash.

References

ABS (Australian Bureau of Statistics) 2003. Population by age and sex, Australian states and territories, 2001 Census edition–final. ABS cat. no. 3201.0. Canberra: ABS.

ABS 2012. Census: data quality statements: Person: Place of usual residence. Last updated 24 October 2012. Canberra: ABS. Viewed 21 August 2014, <http://www.abs.gov.au/websitedbs/censushome.nsf/home/statementspersonpurp?opendocument&navpos=450>.

ABS 2013a. Australian Statistical Geography Standard (ASGS): Correspondences, July 2011: Postcode 2012 to Remoteness Area 2011. ABS cat. no. 1270.0.55.006C190. Canberra: ABS.

ABS 2013b. Australian Statistical Geography Standard (ASGS): Volume 5—Remoteness Structure, July 2011. ABS cat. no. 1270.0.55.005. Canberra: ABS.

ABS 2016. Australian Demographic Statistics, September 2016. ABS cat. no. 3101.0. Canberra: ABS.

Access Economics 2009. The economic cost of spinal cord injury and traumatic brain injury in Australia: report by Access Economics Pty Limited for the Victorian Neurotrauma Initiative. Canberra: Access Economics.

AIHW (Australian Institute of Health and Welfare): Norton L 2010. Spinal cord injury, Australia, 2007–08. Injury research and statistics series no. 52. Cat. no. INJCAT128. Canberra: AIHW.

AIHW: Tovell A 2018a. Spinal cord injury, Australia, 2012–13. Injury research and statistics series no. 99. Cat. no. INJCAT 175. Canberra: AIHW.

AIHW: Tovell A 2018b. Spinal cord injury, Australia, 2013–14. Injury research and statistics series no. 107. Cat. no. INJCAT 183. Canberra: AIHW.

ASIA (American Spinal Injury Association) 2003. Reference manual for the International Standards for Neurological Classification of Spinal Cord Injury. Chicago: ASIA.

Bickenbach J, Officer A, Shakespeare T, von Groote P, World Health Organization (WHO) & The International Spinal Cord Society (eds) 2013. International perspectives on spinal cord injury. Geneva: WHO Press.

Frankel HL, Hancock DO, Hyslop G, Melzak J, Michaelis LS, Ungar GH et al. 1969. The value of postural reduction in the initial management of closed injuries of the spine with paraplegia and tetraplegia. Paraplegia 7(3):179–92.

Kirshblum SC, Burns SP, Biering-Sørensen F, Donovan W, Graves DE, Jha A et al. 2011. International standards for neurological classification of spinal cord injury (revised 2011). The Journal of Spinal Cord Medicine 34(6):535–46.

Lee BB, Cripps RA, Fitzharris M & Wing PC 2014. The global map for traumatic spinal cord injury epidemiology: update 2011, global incidence rate. Spinal Cord 52(2):110–16.

Middleton JW, Dayton A, Walsh J, Rutkowski SB, Leong G & Duong S 2012. Life expectancy after spinal cord injury: a 50-year study. Spinal Cord 50(11):803–11.

NCCC (National Casemix and Classification Centre) 2013. International Statistical Classification of Diseases and Related Health Problems, tenth revision, Australian Modification (ICD-10-AM). 8th edn. Sydney: NCCC, The University of Wollongong.

New PW, Baxter D, Farry A & Noonan VK 2015. Estimating the incidence and prevalence of traumatic spinal cord injury in Australia. Archives of Physical Medicine and Rehabilitation 96(1):76–83.

Thurman DJ, Sniezek JE, Johnson D, Greenspan A & Smith SM 1995. Guidelines for surveillance of central nervous system injury. Atlanta: US Department of Health and Human Services, Centers for Disease Control and Prevention.

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Related publications

This report, *Spinal cord injury, Australia 2014–15*, is part of an annual series. Earlier editions and any published subsequently can be downloaded without cost from the AIHW website <www.aihw.gov.au>.

In 2014–15, 264 newly incident cases of traumatic spinal cord injury (SCI) due to external causes were reported to the Australian Spinal Cord Injury Register. Males accounted for 4 in 5 (80%) of traumatic SCI cases. Land transport crashes (42%) were the leading mechanism of injury for cases of traumatic SCI sustained in 2014–15, followed by Falls (40%). Around one-third (35%) were sustained during sports or leisure activities.

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