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Contents

Summary

This 17th 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 2015–16.

There were 253 newly incident cases of traumatic SCI due to external causes reported for 2015–16. Of these cases, 241 resulted in persisting injury; 8 died; 3 had no long-term neurological injury; and 1 case was still to be discharged. All those who died were aged over 65, and the time between injury and death ranged between 3 days and 233 days. Neurological level of injury was assessed in 6 cases prior to their deaths and all were at C6 or higher (the highest region being cervical spine segments C1–C8).

The age-standardised rate of persisting traumatic SCI was estimated to be 12.1 cases per million population aged 15 and older. The age-specific rate was highest for ages 65–74 (20.0 cases), followed by 15.9 cases for ages 75 or older.

Consistent with most years, the 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 *Complete tetraplegia* cases spent 212 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

Almost 1 in 2 (48%) of traumatic SCI cases sustained in 2015–16 were due to a *Fall* of some kind. A further 39% were due to a *Land transport crash*.

A *Low fall* from less than 1 metre, or a fall from an unspecified height, accounted for 28% of traumatic SCI cases in 2015–16. *Unprotected land transport users,* such as motor/pedal-cyclists or pedestrians, had the next highest portion of traumatic SCI cases, at 24%. *High falls* (20%) rounded out the top 3 causes of traumatic SCI cases sustained during 2015–16.

The leading cause of traumatic SCI differed between male and female cases. For males, *Land transport crashes* involving *Unprotected land transport users* (29%) were most common, followed by *Low fall* (22%) and *High fall* (21%) cases. Whereas, for females, approximately half (49%) of traumatic SCI cases were due to a *Low fall*, followed by a *Land transport crash* involving a *Motor vehicle occupant* (29%), and 16% were due to a *High fall*.

Water-related events, such as diving into shallow water or being dumped by a wave, accounted for 5% of all traumatic SCI cases during this period. Other reported mechanisms of injury included *Football*, including rugby codes; *Heavy falling objects*; and *Horse-related* events.

Just over one-quarter (26%) of traumatic SCI cases in 2015–16 were sustained while the person was participating in a *Sports or leisure* activity, and the majority (89%) were males. A further 12% of cases were injured *While working for income*, and close to half (45%) of these were due to a *High fall* (14 cases).

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 causes of the injuries, and the care provided to them. This report describes cases of traumatic SCI sustained between 1 July 2015 and 30 June 2016 that required admission to a specialist spinal unit 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 was 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 (see Box 1.1) are added to the register including Australian residents transferred to an Australian spinal unit after incurring a spinal injury overseas and overseas visitors who sustained an injury while in Australia. This number underestimates the total number of incident (new) cases of SCI in Australia, as the 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 a spinal unit occurred.

The data quality statement in Appendix A provides more information on the operation and management of the ASCIR and on 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 17th report of that type.

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 cause of 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.

Estimated incidence of traumatic spinal cord injury

Based on data reported to the ASCIR for 2014–15, the estimated incidence of persisting traumatic SCI in Australia, for people aged 15 and older and who were discharged alive, was 12.8 cases per million population (AIHW: Tovell 2018c). 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 population, while the upper estimate is 32.3 cases per million population (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 population in 2007: nearly 180,000 new traumatic SCI cases each year (Lee et al. 2014). The incidence rate for Australia based on ASCIR data at a similar time period, 2007–08, was 15.0 cases per million population 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 population 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, concerning age, or cases 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 applies to the data reported for Australia as the ASCIR 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 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).

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 spinal unit.

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.

Middleton et al. (2012) studied the mortality and life expectancy of people in New South Wales 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 cases, while for all paraplegia cases 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 (an *SMR* of 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.

Sports-related spinal injuries

In a recent analysis of sports-related injuries, some 100 people were admitted to hospital for an SCI; that is, an *International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification* (ICD-10-AM) code of S14.1, S24.1 or S33.1 was recorded as the principal diagnosis (AIHW: Kreisfeld et al. 2017). A further 1,407 were admitted due to some other type of spine injury, such as a fracture, dislocation of the spinal column, or concussion and oedema of the spinal cord.

The 3 sports most often associated with a sport-related spinal injury were *Water sports*, *Wheeled motor sports* and *Equestrian activities*.

The average acute-care cost of the first acute admission record for a cervical SCI (principal diagnosis code S14.1) was $67,523, and was the highest of any type of sport-related injury analysed in the report. A thoracic-lumbosacral SCI (principal diagnosis code S24.1 or S33.1) was the second most expensive type of sport-related injury, at an average cost of $37,797 per person.

Structure of this report

The primary focus of this report is traumatic SCI, resulting from injurious events that occurred during the period 1 July 2015 to 30 June 2016 (abbreviated as '2015–16' in this report). It also includes information on trends in the period 1995–96 to 2015–16. The report is arranged as follows:

- **Chapter 2** presents an overview of all newly incident traumatic SCI cases that occurred in 2015–16 and had been registered by 31 January 2018.
- **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 2015–16. This chapter includes all cases aged 15 and older who were discharged alive.

- **Chapter 4** provides information on external causes of injury and factors associated with the SCI event for all 2015–16 traumatic cases, irrespective of survival to discharge or persistence of deficit. Remoteness of place of injury is also included in this chapter.
- **Appendix A: Data quality statement** provides summary information on the ASCIR and information on data quality.
- **Appendix B: Technical notes** provides information on the estimates used to calculate population rates; use of confidence intervals; and methods used to assign mechanism of injury and Remoteness Area.
- **Appendix C: Other SCI cases** provides summary information for non-traumatic SCI cases admitted to a participating spinal unit during 2015–16, and complications of medical care SCI cases that occurred during 2015–16.
- **Appendix D: Supplementary tables** consists of data underpinning the figures presented in Chapter 3.

Information regarding other terminology and classifications used in this report is summarised in boxes 1.3 and 1.4.

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 spinal unit. 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.

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 spinal unit 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 a spinal unit.

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

- cases discharged from the spinal unit 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 spinal unit. These cases are omitted because fatal and non-fatal cases have very different durations
- cases where the current episode in a spinal unit 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 crashes* (including water, air or rail). Due to the large number of cases and to the 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, semitrailers 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 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 due either to a *Low fall* (a fall on the same level or from a height of less than 1 metre), or to 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.

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 B: Technical notes’.

2 Traumatic SCI case registrations in 2015–16

This chapter provides an overview of traumatic SCI incident cases where the injury event occurred between 1 July 2015 and 30 June 2016, and the case had been registered by 31 January 2018.

For the period 2015–16, a total of 253 incident cases were reported to the ASCIR by participating spinal units (Table 2.1).

Table 2.1: Traumatic SCI cases aged 15 and older with onset in 2015–16 and reported to the ASCIR by 31 January 2018, by residency status

	Australian residents		Non-residents		Total	
	Number	%	Number	%	Number	%
At discharge from spinal unit:						
Persisting deficit[a]	238	95.6	3	75.0	241	95.3
No ongoing neurological deficit	2	0.8	1	25.0	3	1.2
Died on ward	8	3.2	0	0.0	8	3.2
Total[(b))c)]	[d]**249**	**100**	**4**	**100**	**253**	**100**

(a) Any persons over the age of 15 who sustained an SCI in 2015–16 due to trauma and had a persisting neurological deficit on discharge from a participating spinal unit. These cases are included in Chapter 3.

(b) Any persons over the age of 15 who sustained an SCI in 2015–16 due to trauma. These cases are included in Chapter 4.

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

(d) One Australian resident injured in 2015–16 was still an inpatient in the spinal unit at the time this report was prepared and has been included in this total.

Source: AIHW Australian Spinal Cord Injury Register.

The demographic, social and clinical characteristics of the 238 Australian residents and 3 non-residents discharged alive with a persisting traumatic SCI are the focus of Chapter 3. The total includes 15 Australian residents transferred to an Australian spinal unit 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 253 traumatic SCI cases with onset in 2015–16, irrespective of survival to discharge or persistence of deficit.

There were 8 deaths—5 men and 3 women—all aged over 65. Six of these traumatic SCI cases were due to a *Fall* (75%). Time between the injury and death ranged between 3 and 233 days. The neurological level of injury was not available for 2 cases who died, while the neurological level of injury for the remaining 6 cases who died was C6 or higher on admission.

3 Persisting traumatic SCI

This chapter examines the characteristics of the 241 cases of persisting traumatic SCI sustained during 2015–16. It also presents summary information on new cases reported each year from 1995–96 to 2015–16.

Records in the ASCIR that met all of 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 B). Direct age-standardisation was employed using the Australian population in 2001 as the reference (ABS 2003).

Trends of persisting traumatic SCI, 1995–96 to 2015–16

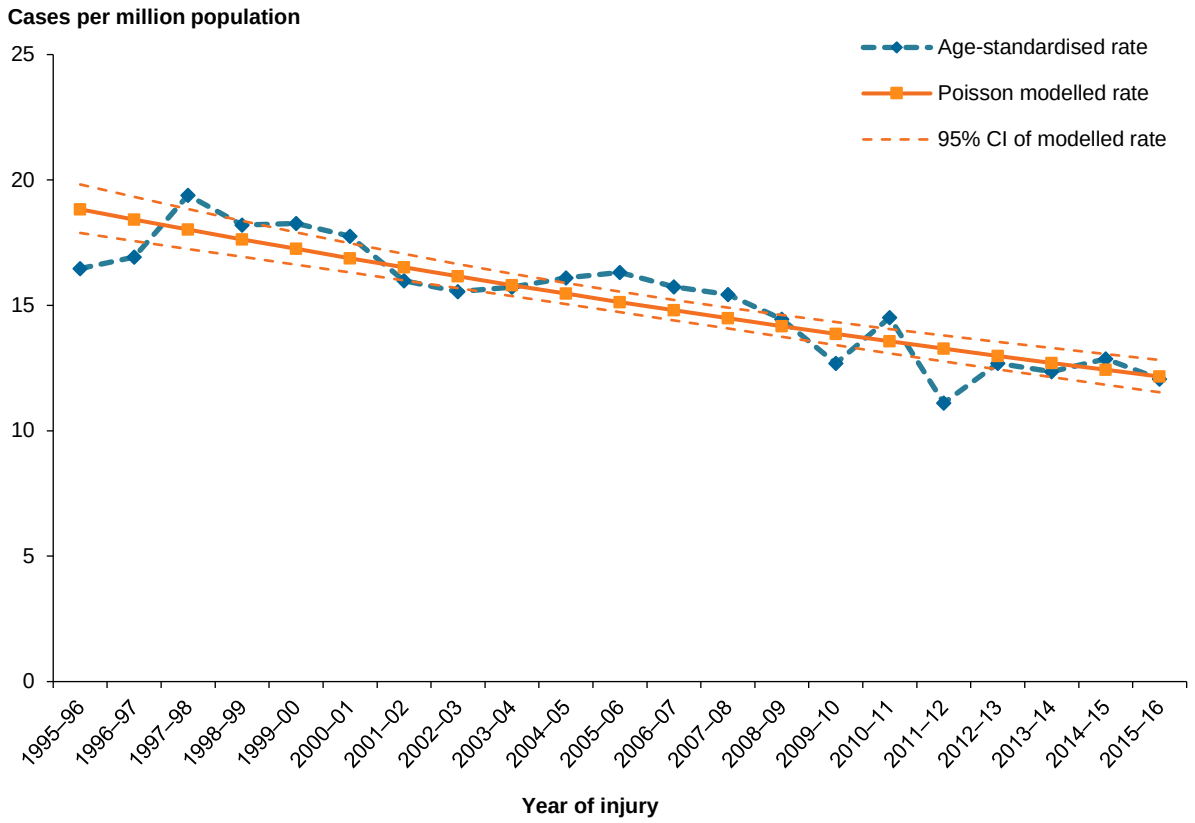
Incidence rates

In 2015–16, the age-standardised incidence rate of persisting traumatic SCI for cases aged 15 and older was 12.1 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 D3.1 in Appendix D and 'Use of confidence intervals' in Appendix B). According to this, the incidence rate of persisting SCI at age 15 and older has 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 as discussed in Chapter 1.

Figure 3.1: Trends in rates of persisting traumatic SCI cases aged 15 and older, by year of injury, 1995–96 to 2015–16

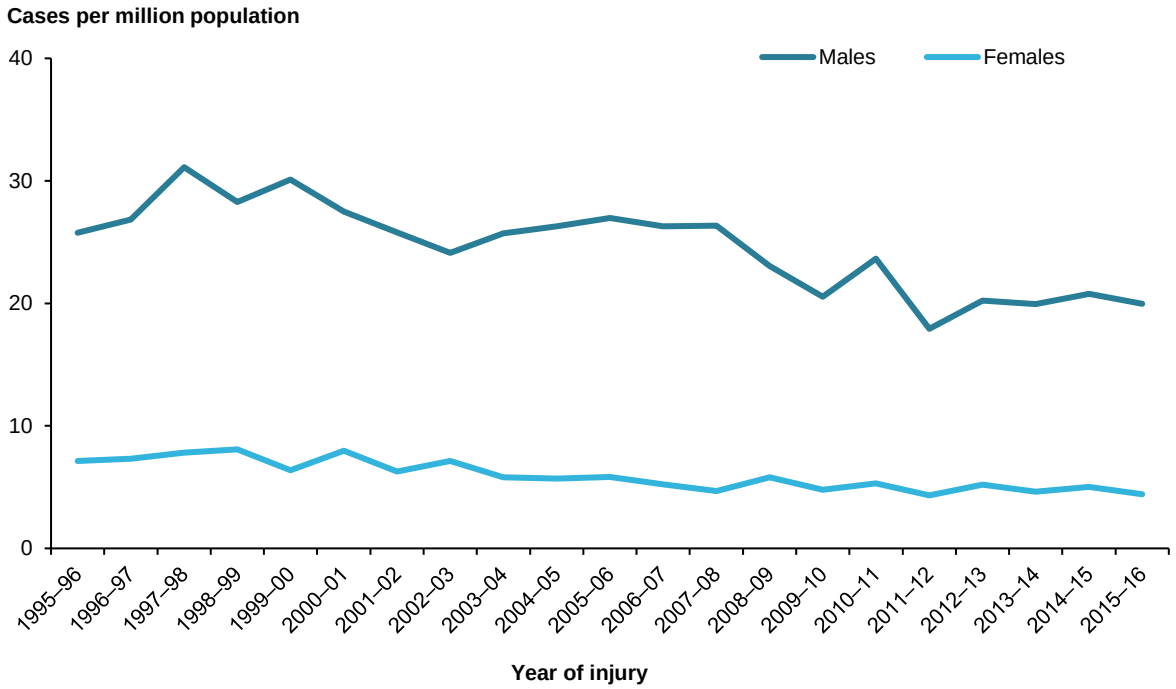


Source: AIHW Australian Spinal Cord Injury Register; Supplementary table D3.1.

The trend in incidence rates, by sex, is shown in Figure 3.2. Across the 21 years of the ASCIR data, 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. 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 Appendix A: Data quality statement).

The highest rate of persisting traumatic SCI observed for males during this 21-year period was 31.1 cases per million men in 1997–98, while the highest rate for females was 8.1 in the following year, 1998–99.

Figure 3.2: Trends in age-standardised rates of persisting traumatic SCI cases aged 15 and older, by sex, by year of injury, 1995–96 to 2015–16



Source: AIHW Australian Spinal Cord Injury Register; Supplementary table D3.2.

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 spinal unit.

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 to 260 days (or between 29 and 37 weeks). Cases with *Complete paraplegia* at the thoracic level had the next longest stay on average, ranging between 130 and 179 days (or roughly between 19 and 26 weeks). 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 13 weeks reported in most years. Cases of *Complete paraplegia* at the lumbosacral level were the least common—often fewer than 10 cases per annum—so 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 year of injury, by neurological impairment at admission, 1995–96 to 2015–16

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	*89*
2012–13	197	110	135	111	80	99	*86*
2013–14	239	111	168	114	89	56	*88*
2014–15	219	140	179	119	70	101	*91*
2015–16	212	106	130	143	70	67	*90*

(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.

Source: AIHW Australian Spinal Cord Injury Register.

Demographic and social characteristics of persisting traumatic SCI in 2015–16

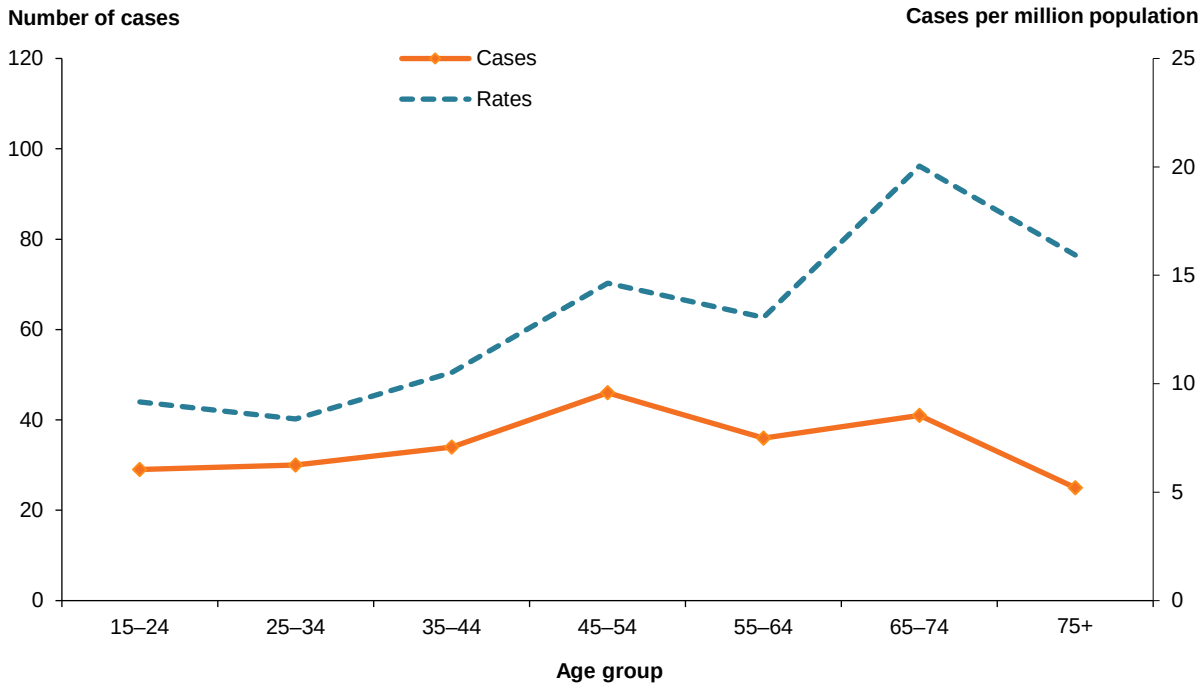
The remainder of this chapter focuses on the 241 newly incident cases of persisting traumatic SCI among people aged 15 and older with an injury date between 1 July 2015 and 30 June 2016.

Age and sex distribution

Four out of 5 (80%) of cases of persisting traumatic SCI reported to the ASCIR for the 2015–16 period were male (194 cases). A total of 47 female cases were included in the register for this same period. The age-distribution of case counts and age-specific rates for new cases of persisting traumatic SCI are presented in Figure 3.3. The largest number of cases reported for 2015–16 were aged 45–54 (46 cases, or 19%). Cases aged 65–74 were the next most numerous (41 cases, or 17%). The age-specific rate was highest for ages

65–74 (20.0 cases per million population), followed by 15.9 cases per million for ages 75 or older.

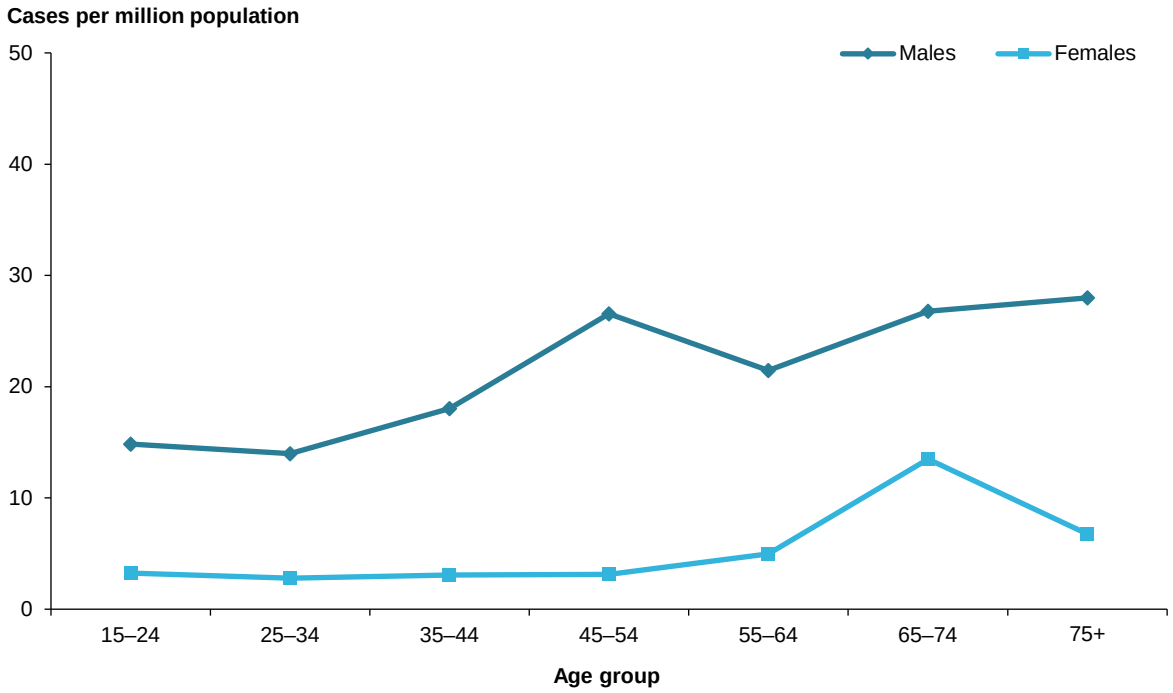
Figure 3.3: Counts and age-specific rates of persisting traumatic SCI cases aged 15 and older, by age group, 2015–16



Source: AIHW Australian Spinal Cord Injury Register; Supplementary table D3.3.

Incidence rates for males were higher across all age groups than those for females (Figure 3.4). The greatest gender difference for persisting traumatic SCI was observed for cases aged 45–54. The rate for males aged 45–54 was 26.6 cases per million, compared with 3.1 cases per million for females in the same age group. The overall rate for men was 20.2 cases per million compared with 4.7 for women—a male:female ratio of over 4:1.

Figure 3.4: Age-specific rates of persisting traumatic SCI cases aged 15 and older, by age group, by sex, 2015–16



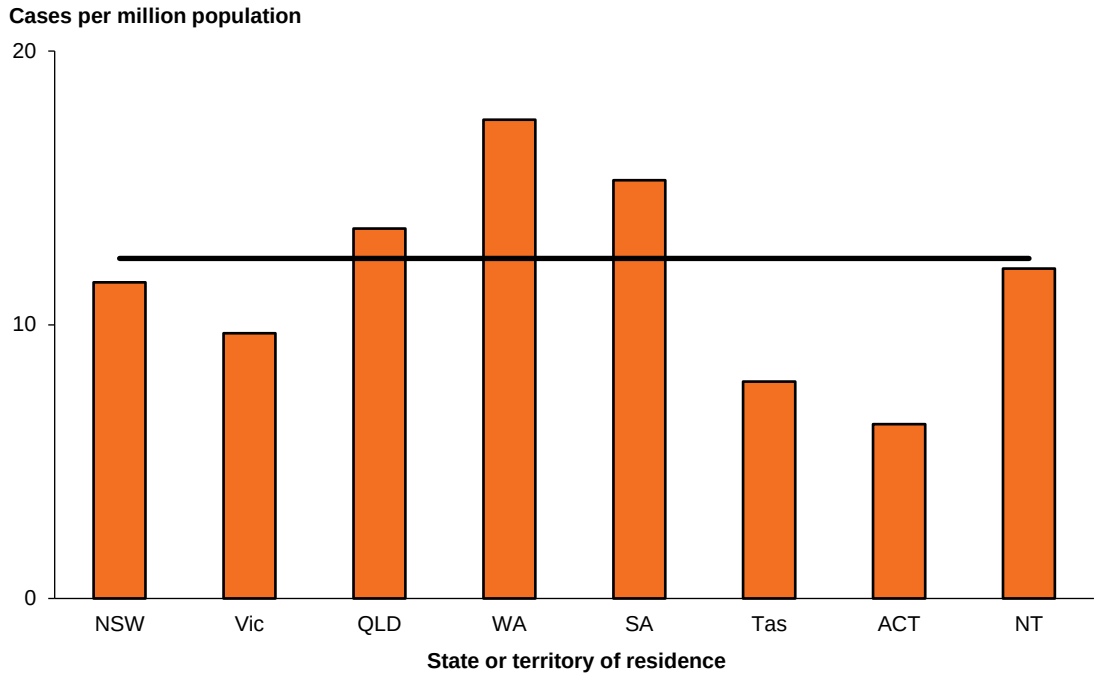
Source: AIHW Australian Spinal Cord Injury Register; Supplementary table D3.4.

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. 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 2013–14 to 2015–16.

Despite that, the rates are based on low numbers of cases (fewer than 10 cases each) for the less populous jurisdictions of Tasmania 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 (6.4 cases per million), while the rate for residents of Western Australia was the highest (17.5 cases per million). The 3-year rate of persisting traumatic SCI for Queensland, Western Australia and South Australia were higher than the national rate, which was 12.4 cases per million.

Figure 3.5: Age-standardised 3-year rates of persisting traumatic SCI cases aged 15 and older, by state or territory of usual residence, 2013–14 to 2015–16



Notes

1. Rates were calculated using an aggregated 3-year period due to small case counts for the less populous states and territories.
2. The 3-year Australia rate is shown as the solid horizontal line. The rate for Australia is calculated on 732 cases, including 12 non-residents.

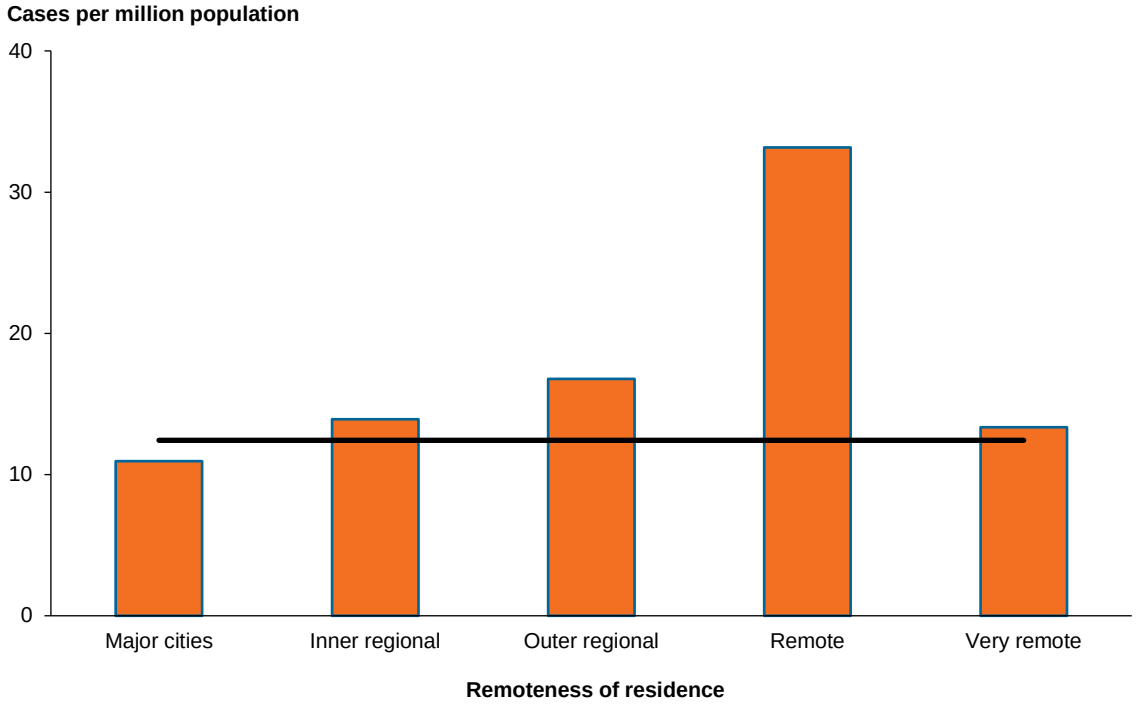
Source: AIHW Australian Spinal Cord Injury Register; Supplementary table D3.5.

Remoteness of residence

Three-year incidence rates were calculated for cases grouped according to remoteness of usual residence for the period 2013–14 to 2015–16 (Figure 3.6) (see 'Assignment to remoteness area' in Appendix B).

The 3-year incidence rate for persisting traumatic SCI was highest for residents of *Remote Australia* (33.2 cases per million population) and lowest for residents of *Major cities* (10.9 cases per million). Only residents of *Major cities* had a 3-year rate lower than the 3-year Australia rate (12.4 cases per million). However, caution should be used in interpreting the rates for residents of *Outer regional Australia* and more remote areas, due to case numbers less than 100.

Figure 3.6: Age-standardised 3-year rates of persisting traumatic SCI cases aged 15 and older, by remoteness of residence, 2013–14 to 2015–16



Notes

1. Rates were calculated using an aggregated 3-year period due to small case counts for some remoteness areas.
2. The 3-year Australia rate is shown as the solid horizontal line. Included when calculating the Australia rate, but not the specific remoteness zones, were 12 non-residents injured in Australia and 1 resident with insufficient details to determine remoteness zone.

Source: AIHW Australian Spinal Cord Injury Register; Supplementary table D3.6.

Socioeconomic characteristics

Just under half (47%) of people who sustained a persisting traumatic SCI during 2015–16 were married or in a de facto relationship at the time of injury (Table 3.2). The vast majority (93%) of cases in the 15–24 age group had never been married, while just over 1 in 5 (21%) of cases aged 25–64 had never been married. Ten per cent of cases had no marital status reported.

Table 3.2: Marital status at onset of persisting traumatic SCI, by 3 age groups, 2015–16

	15–24 years		25–64 years		65+ years		All ages	
Marital status	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Never married	27	93	30	21	3	5	60	25
Widowed	0	0	3	2	14	21	17	7
Separated or divorced	0	0	21	14	5	8	26	11
Married (including de facto)	0	0	73	50	40	61	113	47
Not reported	2	7	19	13	4	6	25	10
Total[(a)]	**29**	**100**	**146**	**100**	**66**	**100**	**241**	**100**

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

Source: AIHW Australian Spinal Cord Injury Register.

Just over half (51%) of those who sustained a persisting traumatic SCI during 2015–16 were employed at the time of injury (Table 3.3). Being employed was reported in 48% of cases in the 15–24 age group and 66% of cases aged 25–64, while 65% of cases aged 65 or older reported being a pensioner. (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 not recorded for 25 cases (10%).

Table 3.3: Employment status at onset of persisting traumatic SCI, by 3 age groups, 2015–16

	15–24 years		25–64 years		65+ years		All ages	
Employment status	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Employed	14	48	96	66	13	20	123	51
Pensioner	0	0	5	3	43	65	48	20
Unemployed	4	14	20	14	2	3	26	11
Not available for employment	9	31	5	3	5	8	19	8
Not reported	2	7	20	14	3	5	25	10
Total[(a)]	**29**	**100**	**146**	**100**	**66**	**100**	**241**	**100**

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

Source: AIHW Australian Spinal Cord Injury Register.

'Highest available education level at onset' was not reported in 51% of persisting traumatic SCI cases for 2015–16 (Table 3.4). Of the 117 cases who did have a highest education level reported, 59% had a post-school qualification. A similar number of cases were reported as having completed a tertiary or postgraduate education (26 cases) or a trade qualification or apprenticeship (27 cases). Around 1 in 5 (21%) of cases aged 15–24 were still at school or engaged in higher education at the time of injury.

Table 3.4: Highest educational level attained at onset of persisting traumatic SCI, by 3 age groups, 2015–16

	15–24 years		25–64 years		65+ years		All ages	
Education level	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Tertiary/postgraduate	3	10	17	12	6	9	26	11
Trade qualification/apprenticeship	4	14	19	13	4	6	27	11
Diploma or certificate	1	3	3	2	5	8	9	4
Other post-school study	1	3	4	3	2	3	7	3
Highest available secondary school level	4	14	14	10	2	3	20	8
Did not complete secondary school	1	3	15	10	6	9	22	9
Still at school/higher education	6	21	0	0	0	0	6	2
Not reported	9	31	74	51	41	62	124	51
Total[(a)]	**29**	**100**	**146**	**100**	**66**	**100**	**241**	**100**

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

Source: AIHW Australian Spinal Cord Injury Register.

Clinical characteristics of persisting traumatic SCI in 2015–16

Information on the neurological level of SCI, extent of injury to the cord, and the degree of impairment is routinely reported by spinal units 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 an 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 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 reporting period to not be discharged until the following reporting period, sometimes later.

Neurological level of injury at discharge

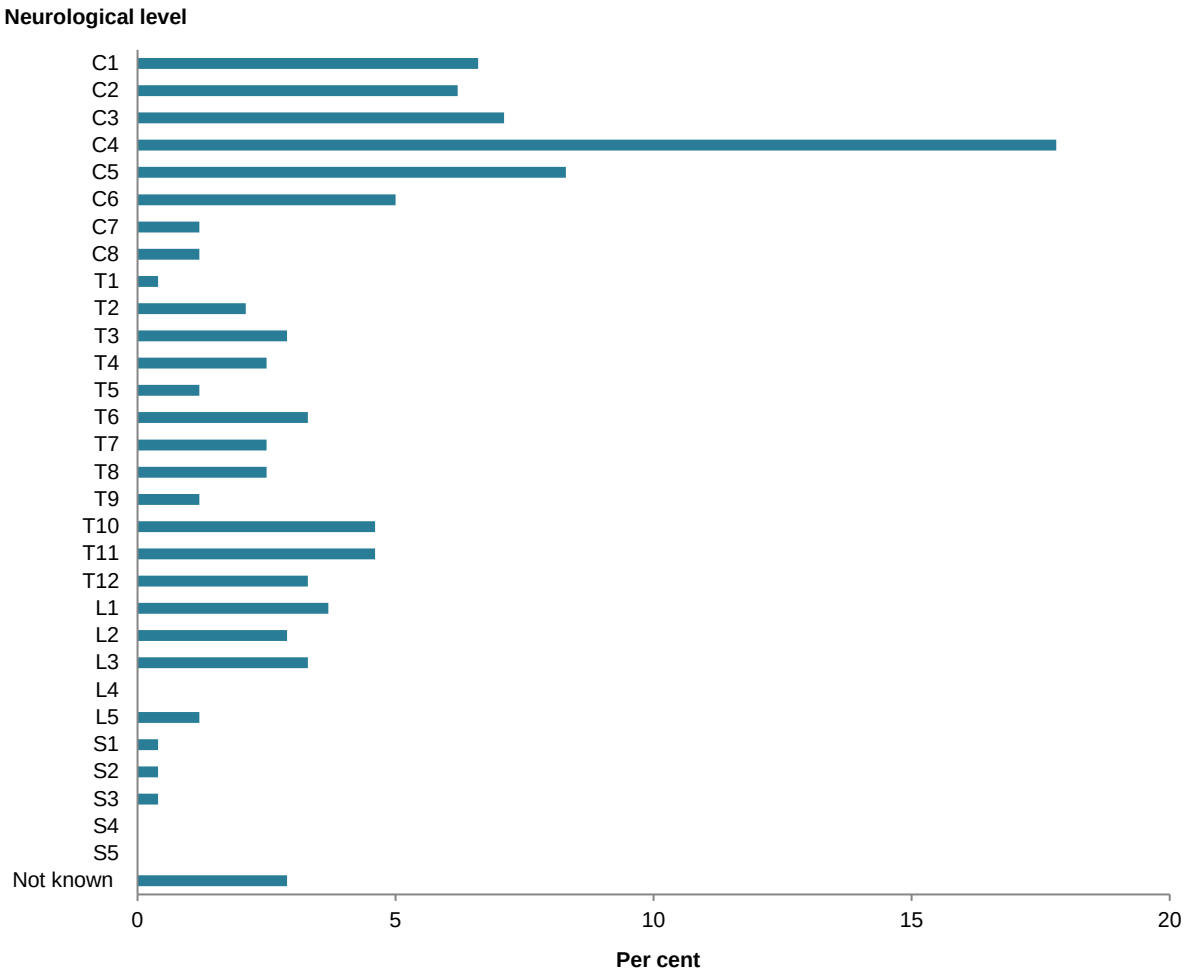
The distribution of neurological level of persisting traumatic SCI at discharge is presented in Figure 3.7.

Neurological level of persisting traumatic SCI at discharge was not known for 7 cases (3%). Of the remaining 234 cases, 55% had a neurological injury at 1 of the cervical segments, C1–C8 (129 cases). The impairment resulting from this neurological level is referred to as *Tetraplegia*.

The most common neurological level of injury was C4, which accounted for one-third (33%) of cervical cases and 18% of the 234 cases with an identified level of injury.

Thirty-one per cent of all cases had a neurological level of injury at a thoracic segment (T1–T12), 11% at a lumbar segment (L1–L5), and 1% at a sacral segment (S1–S5). 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, 2015–16



Source: AIHW Australian Spinal Cord Injury Register; Supplementary table D3.7.

Neurological impairment at discharge

For all persisting traumatic SCI cases reported to the ASCIR for 2015–16, the most frequently reported neurological impairment at discharge was *Incomplete tetraplegia* at 46% (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 (18%). Cases of this type had been assessed as having a neurological level of injury between T1 and T12, with an ASIA Impairment Scale grade of A (no sensory or motor function at S4–S5—that is, no sacral sparing).

Twenty-four of the 30 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, 2015–16

Neurological impairment	Number of cases	Proportion of cases (%)
Tetraplegia		
Cervical	129	54
Complete tetraplegia	*19*	*8*
Incomplete tetraplegia	*110*	*46*
Paraplegia		
Thoracic	75	31
Complete paraplegia	*43*	*18*
Incomplete paraplegia	*32*	*13*
Lumbosacral	30	12
Complete paraplegia	*6*	*3*
Incomplete paraplegia	*24*	*10*
Total[(a)(b)]	**241**	**100**

(a) Neurological level and completeness of SCI were not available for 7 cases.

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

Source: AIHW Australian Spinal Cord Injury Register.

Length of stay in spinal unit

Table 3.6 presents the median length of stay (LOS) in a spinal unit for persisting traumatic SCI cases in 2015–16, 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 7 cases with a reported deficit at discharge but for whom the type of neurological impairment was unknown had a median LOS of approximately 6 weeks (41 days) with 5th and 95th percentiles of 12 and 118 days, respectively.

The median LOS in a spinal unit was approximately 17 weeks for cases with neurological impairment at either the cervical or thoracic level (median LOS of 113 days and 111 days, respectively). Median LOS was approximately 13 weeks (92 days) for cases with neurological impairment at the lumbosacral level.

The median LOS in a spinal unit was shorter for cases with an incomplete SCI than those with complete SCI, irrespective of level of neurological impairment.

Overall, complete cases at the cervical level *(Complete tetraplegia)* had the longest median LOS in a spinal unit, at 193 days (almost 28 weeks), with 5th and 95th percentiles of 8 and 394 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, 2015–16

Neurological impairment at discharge	Number of cases	Median LOS (days)	5th percentile (days)	95th percentile (days)
Tetraplegia				
Cervical	129	113	23	299
Complete tetraplegia	*19*	*193*	*8*	*394*
Incomplete tetraplegia	*110*	*101*	*23*	*284*
Paraplegia				
Thoracic	75	111	24	261
Complete paraplegia	*43*	*121*	*55*	*212*
Incomplete paraplegia	*32*	*102*	*21*	*342*
Lumbosacral	30	60	14	137
Complete paraplegia	*6*	*67*	*8*	*128*
Incomplete paraplegia	*24*	*48*	*14*	*137*
Unknown impairment	7	41	12	118
Total	**241**	**100**	**17**	**269**

Source: AIHW Australian Spinal Cord Injury Register.

4 External causes of SCI in 2015–16

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 253 cases of traumatic SCI with onset in 2015–16 that were treated in participating spinal units and had been reported to the ASCIR by 31 January 2018. This includes the 241 cases of persisting traumatic SCI that are the subject of Chapter 3; the 3 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); the 8 cases where the person died while an admitted patient of a participating spinal unit; and the 1 case injured in 2015–16 who was still an inpatient at the time this report was prepared (see Table 2.1).

Mechanism of injury

Almost 1 in 2 (48%) of traumatic SCI cases sustained in 2015–16 were due to a *Fall* of some kind (Table 4.1). A further 39% were due to a *Land transport crash*. Overall, males accounted for 80% of traumatic SCI cases for this period. The leading cause of injury for males for this reporting period was a *Land transport crash* as an *Unprotected land transport user* (29%), while for females, nearly 1 in every 2 traumatic SCI was due to a *Low fall* (on the same level or from less than 1 metre, or from an unspecified height) (49%).

Characteristics of the cases due to each of the mechanisms shown in Table 4.1 are presented in the following subsections. The method for grouping cases by mechanism is described in Appendix B.

Table 4.1: Mechanism of injury of all traumatic SCI cases aged 15 and older, by sex, 2015–16

	Males		Females		Total	
Mechanism of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**
Land transport crash						
Motor vehicle occupant	23	11	15	29	38	15
Unprotected land transport user	58	29	2	4	60	24
Fall						
Low fall (same level or <1 metre)[(a)]	45	22	25	49	70	28
High fall (≥1 metre)	42	21	8	16	50	20
Water-related	13	6	0	0	13	5
Heavy falling object	4	2	0	0	4	2
Horse-related	1	0	1	2	2	1
Football	4	2	0	0	4	2
Other and unspecified causes	12	6	0	0	12	5
Total[(b)]	**202**	**100**	**51**	**100**	**253**	**100**

(a) Includes falls from unspecified heights.

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

Source: AIHW Australian Spinal Cord Injury Register.

For cases aged 15–24, approximately half (48%) sustained their injury as an *Unprotected land transport user*, such as a motor or pedal cyclist (Table 4.2). *Land transport crashes* involving *Unprotected land transport users* (28%) was also the most common mechanism of injury for traumatic SCI cases aged 25–64, while a *Low fall* accounted for approximately 3 in 5 (58%) of traumatic SCI cases among people 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 cases aged 15 and older, by age group, 2015–16

	15–24 years		25–64 years		65+ years		All ages	
Mechanism of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Land transport crash								
Motor vehicle occupant	5	16	26	18	7	9	38	15
Unprotected land transport user	15	48	41	28	4	5	60	24
Fall								
Low fall (same level or <1 metre)[(a)]	3	10	24	16	43	58	70	28
High fall (≥1 metre)	6	19	28	19	16	22	50	20
Water-related	1	3	11	7	1	1	13	5
Heavy falling object	0	0	4	3	0	0	4	2
Horse-related	0	0	1	1	1	1	2	1
Football	0	0	4	3	0	0	4	2
Other and unspecified causes	1	3	9	6	2	3	12	5
Total[(b)]	**31**	**100**	**148**	**100**	**74**	**100**	**253**	**100**

(a) Includes falls from unspecified heights.

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

Source: AIHW Australian Spinal Cord Injury Register.

The neurological level of injury at admission was unable to be assessed for 2 *Low fall* cases and 1 *Other and unspecified causes* case (Table 4.3). A neurological injury to the cervical spine, or *Tetraplegia*, on admission accounted for more than half (58%) of traumatic SCI cases reported to the ASCIR for 2015–16. Approximately one-third (48 cases, or 32%) of these *Tetraplegia* injuries were the result of a *Low fall* (or a fall from an unspecified height). The next most numerous *Tetraplegia* injuries on admission occurred among *Unprotected land transport users* (29 cases, or 20%). A cervical-level injury at admission was reported for all cases due to *Football* (4 cases).

An injury to the thoracic spine was the next most frequent type of neurological injury at admission, with 79 cases, or 31% overall. *Unprotected land transport users* (26 cases) contributed the greatest portion of injuries at this level, at 33%, followed by 28% due to a *High fall* (equal to or greater than 1 metre) (22 cases). Mechanism of injury for cases with lumbosacral-level injuries were distributed equally between *Motor vehicle occupants*, *Unprotected land transport users*, and *High falls*, with each mechanism contributing 5 cases, or 22%. A further 3 lumbosacral cases were due to a *Low fall*, while the remaining 5 cases were in the residual *Other and unspecified causes* category.

Table 4.3: Mechanism of injury for all traumatic SCI cases aged 15 and older, by neurological level of injury at admission, 2015–16

	Tetraplegia		Paraplegia					
	Cervical		Thoracic		Lumbosacral		Total	
Mechanism of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Land transport crash								
Motor vehicle occupant	24	16	9	11	5	22	38	15
Unprotected land transport user	29	20	26	33	5	22	60	24
Fall								
Low fall (same level or <1 metre)[(a)]	48	32	17	22	3	13	70	28
High fall (≥1 metre)	23	16	22	28	5	22	50	20
Water-related	11	7	2	3	0	0	13	5
Heavy falling object	2	1	2	3	0	0	4	2
Horse-related	2	1	0	0	0	0	2	1
Football	4	3	0	0	0	0	4	2
Other and unspecified causes	5	3	1	1	5	22	12	5
Total[(b)(c)]	**148**	**100**	**79**	**100**	**23**	**100**	**253**	**100**

(a) Includes falls from unspecified heights.

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

(c) Total includes 3 cases for whom neurological level of injury on admission was unable to be assessed. All 3 cases had a reported fracture at 1 of the cervical spine segments.

Source: AIHW Australian Spinal Cord Injury Register.

Land transport crashes

As shown in Table 4.1, more than 1 in 3 (39%) of cases of traumatic SCI sustained during 2015–16 were due to a *Land transport crash*. More than one-third (39%) of these cases involved a motorcyclist, with all except 1 case being the motorcycle driver (Table 4.4). Motor vehicle drivers (26%) were the next most frequently injured land transport user type in 2015–16. Pedal cyclists (17 cases, or 17%) rounded out the top 3 type of land transport users who sustained a traumatic SCI during 2015–16.

The majority (83%) of injured land transport users were male. The type of land transport user who sustained a traumatic SCI also differed for males and females. For males, the leading type of user were motorcyclists (44%), followed by pedal cyclists (21%). In contrast, the leading type of user for female traumatic SCI cases were motor vehicle drivers (59%), followed by motor vehicle passengers (29%).

The mean age at onset for traumatic SCI for *Motor vehicle occupants* was 47 (an age range of 18 to 82), while the mean age at onset for *Unprotected land transport users* was 40 (an age range of 15 to 79).

Table 4.4: Land transport user types for all traumatic SCI cases aged 15 and older, 2015–16

	Males		Females		Total	
Land transport user type	**Number**	**%**	**Number**	**%**	**Number**	**%**
Motor vehicle driver	15	19	10	59	25	26
Motor vehicle passenger	8	10	5	29	13	13
Motorcycle driver or passenger	36	44	2	12	38	39
Pedal cyclist or pedal cycle passenger	17	21	0	0	17	17
Pedestrian	3	4	0	0	3	3
Quad-bike rider	2	2	0	0	2	2
Total[(a)]	**81**	**100**	**17**	**100**	**98**	**100**

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

Source: AIHW Australian Spinal Cord Injury Register.

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 traumatic SCI in 2015–16, 53% stated they were wearing a seatbelt at the time of the crash (20 cases). Information on the use of seatbelts was not available in 26% of cases (10 cases).

The most common type of crash event reported for *Motor vehicle occupants* was a vehicle rollover, with 18 identified cases (47%). Impact with roadside hazards, such as trees and roadside barriers, was reported for 15 cases (40%). Eleven (29%) of *Motor vehicle occupant* cases also reported impact with another motor vehicle. Being ejected from a motor vehicle was reported for 6 traumatic SCI cases in 2015–16. 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, 5 of the 6 people who were ejected from their motor vehicles had experienced a vehicle rollover.

Twenty-four (63%) of the 38 *Motor vehicle occupant* cases were admitted to the spinal unit with a neurological injury at the cervical level (Table 4.3). Neurological injury at the cervical level was also most frequent for *Unprotected land transport users*, but to a lesser extent (29 of 60 cases, or 48%).

Only 2 (3%) of the 60 *Unprotected land transport user* SCI cases reported to the ASCIR for 2015–16 were female, and both female cases involved a motorcycle (Table 4.4). Combined with the 36 male cases, motorcycle drivers and passengers accounted for 63% of traumatic SCI cases among *Unprotected land transport users.* Other *Unprotected land transport users* for this period included 17 pedal cyclists, 3 pedestrians and 2 quad-bike riders—all of whom were male. The number of traumatic SCI due to quad-bikes was lower for this year compared with recent years: 6 cases in 2012–13 (AIHW: Tovell 2018a), 7 cases in 2013–14 (AIHW: Tovell 2018b) and 6 cases in 2014–15 (AIHW: Tovell 2018c).

Impact with a roadside or track hazard such as guttering, a tree or jump was the most common type of crash event involving *Unprotected land transport user* SCI cases in 2015–16 (26 cases, or 43% of such cases reported). Close to 1 in 5 (18%) of *Unprotected land transport user* SCI cases reported an impact with a motor vehicle (11 cases).

The most common neurological level of injury differed between motor and pedal cyclists, with a greater portion of motorcycle SCI cases than pedal cycle SCI cases admitted with a thoracic injury (19 cases or 50%, compared with 5 cases or 29%, respectively) (data not shown).

In contrast, cervical-level injuries accounted for 71% of pedal cycle SCI, at 12 cases, compared with 37% or 14 of the motorcycle SCI cases.

The type of place where the *Land transport crash* occurred was unspecified for 16% of *Motor vehicle occupant* SCI cases (6 of 38 cases) and 12% of *Unprotected land transport user* SCI cases (7 of 60 cases) (data not shown). The remainder of the *Motor vehicle occupants* were injured on a public road, while the types of places where *Unprotected land transport users* were injured were more varied and included public roads (37 cases), race tracks (4 cases), farms (3 cases) and public/amusement parks (3 cases).

Falls

Combined, *Falls* (48%) were the leading mechanism of injury for traumatic SCI in 2015–16, with a *Low fall* (28%) being the greatest single contributor to SCI overall, and a *High fall* (20%) being the third largest contributor (Table 4.1). The number of *Low fall* cases has risen in recent years, from an average of about 40 cases per year since 2008–09 to 53 in 2014–15 (AIHW: Tovell 2018c) and 70 in 2015–16.

Falling from a ladder (11 cases) was the most frequent type of *High fall* reported in 2015–16, followed by falling off or through a roof (6 cases) and a fall during an extreme sport such as ski jumping, abseiling or sky diving (6 cases). Other types of *High fall* cases reported for this period included falling from scaffolding or platforms, bridges, buildings, vehicles and trees as well as down cliffs and steps/stairs. Falling while under the influence of alcohol or drugs was mentioned in the short-text narrative of 14 *Low fall* and 5 *High fall* cases.

Low falls were the second leading cause of traumatic SCI for male cases during 2015–16 (45 cases, or 22%) and were the single leading cause for female cases (25 cases, or 49%). *High falls* were the third leading cause of traumatic SCI for both male and female cases, at 21% and 16%, respectively.

The age range for traumatic SCI cases due to a *Low fall* was 19 to 92, and the mean age at onset was 66. Traumatic SCI cases involving a *High fall* were generally younger, with an age range between 16 and 80, and a mean age at onset of 51.

A small number of *High fall* SCI cases sustained in 2015–16 were attributable to an act of *Intentional self-harm* (3 cases, or 6% of *High fall* cases).

Forty-eight of the 70 *Low fall* SCI cases had a neurological injury at the cervical level (*Tetraplegia*) on admission (Table 4.3). This amounted to more than two-thirds (69%) of *Low fall* SCI cases. A similar number of *High fall* SCI cases were admitted with a neurological injury of the cervical (23 cases) and the thoracic spine (22 cases). These amounted to 46% and 44%, respectively, of *High fall* SCI cases.

Water-related

Water-related SCI accounted for 5% of traumatic SCI cases reported to the ASCIR for 2015–16, with all 13 cases being male (Table 4.1). After *Falls* and *Land transport crashes*, *Water-related* events were the third most frequent cause of traumatic SCI in Australia.

A search through the narrative text for *Water-related* SCI found an equal number of cases due to being dumped by a wave (5 cases) or diving/jumping into shallow water either at the beach or in a pool (5 cases). The remaining 3 cases all occurred in the ocean and involved either free-diving or were an unwitnessed event, with the person being rescued unconscious by lifeguards.

The majority (85%) of *Water-related* SCI cases occurred in the middle age group, 25–64 (Table 4.2). The mean age at onset for this mechanism of injury in 2015–16 was 44.

Eleven of the 13 *Water-related* SCI cases had a neurological injury at the cervical level on admission (Table 4.3), which equates to 85% for this mechanism of injury.

Heavy falling objects

Fewer than 5 cases of traumatic SCI sustained during 2015–16 were due to *Heavy falling objects,* such as a tree branch or scaffolding. All 4 cases involved males (Table 4.1).

Neurological level of injury at admission for these cases was equally distributed between the cervical and the thoracic spine segments (Table 4.3).

Horse-related

Two cases reported to the ASCIR for 2015–16 were attributable to a *Horse-related* event; 1 male and 1 female (Table 4.1). In the previous 7 years, the average number of *Horse-related* SCI cases was 5. Both cases involved a cervical-level injury at admission (Table 4.3).

Football

In 2015–16, a total of 4 cases of traumatic SCI due to *Football* were reported to the ASCIR, accounting for 2% of cases overall (Table 4.1). Three of the 4 cases were sustained during a game of rugby. All cases were male.

All 4 traumatic SCI cases due to *Football* in 2015–16 were admitted to a spinal unit with a cervical-level injury (*Tetraplegia*) (Table 4.3).

Other and unspecified causes

A further 12 cases reported to the ASCIR for 2015–16, all males, had a mechanism of injury other than those described above. This residual category, *Other and unspecified causes*, accounted for 5% of traumatic SCI cases overall (Table 4.1).

Causes of traumatic SCI cases in this period included lifting heavy objects, other types of transport/machinery, assault and being struck unintentionally by another person or object.

The mean age at onset for traumatic SCI due to *Other and unspecified causes* was 45, and the age range for cases in this residual category was 21 to 72.

Of these 12 cases, 5 had a cervical injury when admitted and 5 had an injury at the lumbosacral-level (Table 4.3).

Activity at time of injury

The classification system for reporting type of activity when injury occurred is based on the one used in the ICD-10-AM (NCCC 2013). It includes the following categories: *While 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.

Just over one-quarter (26%) of traumatic SCI cases reported to the ASCIR for 2015–16 occurred while the person was *Engaged in sports or leisure* activities, and the overwhelming majority (89%) of these were male (58 of 65 cases). *Unprotected land transport users*

contributed more than one-third (37%) of sport and leisure traumatic SCI cases. A further 20% were due to a *Water-related* event, while a similar proportion of sports and leisure cases were due to either a *Low* (15%) or *High fall* (14%). Overall, pedal cyclists contributed the greatest portion to sport and leisure SCI cases (14 cases, or 22%), while 10 motorcyclists contributed a further 15%. All 4 *Football-related* SCI cases are included in this activity group. Other types of sport and leisure activities reported for 2015–15 included walking/skiing/snow-boarding on snow or ice (4 cases), abseiling, base-jumping and horse-riding. Cases injured *While engaged in sports or leisure* activities ranged in age from 15 to 84 and had a mean age of 44.

The next most common type of specified activity during which traumatic SCI occurred was *While working for income*, at 12% (31 cases). Cases injured while working included 27 males (87%) and 4 females. Close to 1 in every 2 people (45%) who sustained a traumatic SCI in 2015–16 *While working for income* had experienced a *High fall* (14 cases). *Land transport crashes* accounted for a further 25% of cases in this activity group, with 6 (75%) of these 8 cases being *Motor vehicle occupants*. Cases injured *While working for income* ranged in age from 21 to 71 and had a mean age of 45. A construction site (4 cases) was the most commonly reported type of workplace where a work-related SCI occurred, followed by farms and farmhouses (3 cases).

A further 7% of cases occurred while the person was engaged in *Other types of work* (not for payment) (Table 4.5). Overall, a *Fall* of some kind accounted for the majority (83%) of these cases. More specifically, 11 cases were due to a *High fall*, including 6 falls involving a ladder. Descriptions of what the person was doing at the time of the *High fall* often included while cleaning out gutters or while trimming trees. Cases injured *While engaged in other types of work* ranged in age from 35 to 89 and had a mean age of 67. All 3 female cases of traumatic SCI sustained *While engaged in other types of work* were aged 65 or older; all were due to *Falls*.

Just over 1 in 10 (11%) of traumatic SCI cases reported to the ASCIR for 2015–16 were sustained while the person was *Engaged in a personal activity* (such as eating, sleeping or self-care). The vast majority (89%) of these were due to a *Low fall* (24 cases). Cases in this activity group included falls while in the bathroom or bedroom, a fall due to tripping or dizziness, as well as falling down stairs. Just over three-quarter (78%) of traumatic SCI cases in this activity group were male (21 cases). The mean age of cases injured *While engaged in a personal activity* was 66, with ages ranging from 22 to 86.

Twenty-nine of the remaining 112 cases had no activity recorded at the time of injury. This amounted to 28% of cases in the residual category *While engaged in other or unspecified activity*. *Land transport* cases accounted for 57% of this activity category, including 30 *Motor vehicle occupants* and 34 *Unprotected land transport users.* A further 38% were attributable to a *Fall*, including 29 *Low fall* and 14 *High fall* cases. While the majority (96%) of traumatic SCI cases in this activity group were due to unintentional events, 4 cases were due to *Intentional self-harm* (3%). Seven out of 10 people (72%) who sustained a traumatic SCI *While engaged in other or unspecified activity* during 2015–16 were male. The age range for male and female cases in this residual activity group was 16 to 92 and the mean age was 50.

Table 4.5: Traumatic SCI cases aged 15 and older, by mechanism of injury, by type of activity, 2015–16

	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	2	3	6	19	0	0	0	0	30	27	38	15
Unprotected land transport user	24	37	2	6	0	0	0	0	34	30	60	24
Fall												
Low fall (same level or <1metre)[b]	10	15	3	10	4	22	24	89	29	26	70	28
High fall (≥1 metre)	9	14	14	45	11	61	2	7	14	13	50	20
Water-related	13	20	0	0	0	0	0	0	0	0	13	5
Heavy falling object	0	0	2	6	1	6	0	0	1	1	4	2
Horse-related	1	2	1	3	0	0	0	0	0	0	2	1
Football	4	6	0	0	0	0	0	0	0	0	4	2
Other and unspecified causes	2	3	3	10	2	11	1	4	4	4	12	5
Total[c]	**65**	**100**	**31**	**100**	**18**	**100**	**27**	**100**	**112**	**100**	**253**	**100**

(a) Includes travel to and from work.

(b) Includes falls from unspecified heights.

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

Source: AIHW Australian Spinal Cord Injury Register.

Remoteness of place of injury

In 100 cases (40%), the injury event appeared to occur while the person was in Australia but insufficient information was provided to allow classification of the remoteness of the place where the injury occurred (Table 4.6). Fifteen cases (6%) were sustained by an Australian resident while visiting another country.

Of the remaining 153 cases (including the 4 non-residents of Australia), 52% of traumatic SCI cases occurred in *Major cities of Australia.* The number of traumatic SCI cases decreased with increasing remoteness.

Table 4.6: Remoteness zone for place where traumatic SCI occurred, 2015–16

Remoteness zone	Number	Proportion of cases (%)
Major cities	79	31
Inner regional	28	11
Outer regional	21	8
Remote or very remote	10	4
Australia, place not specified	100	40
Overseas	15	6
Total	**253**	**100**

Source: AIHW Australian Spinal Cord Injury Register.

Appendix A: 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 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 a spinal unit in Australia. The ASCIR has operated as a cooperative venture of the directors of the participating spinal units in Australia and the AIHW through the AIHW NISU, since 1995. The ASCIR is part of the NISU work program, which is managed and operated by the Research Centre for Injury Studies 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 spinal units; the Director of NISU; and invited specialists in epidemiology, paediatric rehabilitation and other fields of relevance.

The registration process begins in the spinal unit after patient stabilisation. The director at each participating spinal unit is responsible for data collection and patient consent arrangements in their own units. The registration process and reporting to the NISU differs between spinal units: some spinal units 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 data sets based on data from each jurisdiction; to analyse these data sets; 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 spinal units, 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 Rehab (Sydney)
- Queensland Spinal Cord Injuries Service, Princess Alexandra Hospital (Brisbane)
- South Australian Spinal Cord Injury Service, Hampstead Rehabilitation Unit (Adelaide)
- Victorian Spinal Cord Service, Austin Health (Melbourne)
- Western Australian State Rehabilitation Service, Fiona Stanley Hospital (Perth).

Timeliness

The reference period for this report is 2015–16.

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 2015–16 data was 31 January 2018. Data corrections from spinal units up to 6 June 2018 are included in this report. A snapshot file of the ASCIR was taken on 18 September 2018.

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 the AIHW.

Aggregated jurisdictional data may be released with the permission of the AIHW Data Custodian and the relevant spinal unit 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 SCI which occur, in Australia and overseas, to Australian residents (who received treatment in an Australian spinal unit) between 1995–96 and 2015–16. Cases for 2016–17 onwards are currently being registered.

The scope of the ASCIR includes patients who are admitted to 1 of the 7 specialised spinal units 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 a spinal unit, and does not obtain follow-up data after discharge from a spinal unit.

Accuracy

The participating spinal units 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 spinal unit, 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 spinal unit 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 for 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 spinal unit occurred.

Coherence

The ASCIR includes data for each year from 1995–96 to 2015–16.

The data reported for 2015–16 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 spinal unit.

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, 10th 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 an appendix. 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 A1). 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 A1: 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.

Beginning with the data year 2011–12, this practice has been applied to the reporting of 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 spinal units but were later found to have no ongoing neurological injury (that is, an 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 spinal units experienced difficulties in retrospectively achieving full case registration.

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

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

Appendix B: Technical notes

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.

Since 2014–15, the rate of persisting traumatic SCI in the *Spinal cord injury, Australia* series have been calculated using both resident and non-resident SCI cases. This change has made little difference to the annual rates as shown in Table B1 below.

Table B1: 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	237	16.0	245	16.5
1996–97	242	16.5	249	16.9
1997–98	279	18.7	289	19.4
1998–99	263	17.6	272	18.2
1999–00	268	17.7	276	18.3
2000–01	257	16.9	270	17.8
2001–02	229	14.9	247	16.0
2002–03	235	15.0	243	15.5
2003–04	237	15.0	249	15.7
2004–05	242	15.1	258	16.1
2005–06	254	15.6	265	16.3
2006–07	254	15.4	260	15.7
2007–08	252	14.8	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	202	11.0	204	11.1
2012–13	230	12.4	235	12.7
2013–14	231	12.1	236	12.4
2014–15	250	12.6	255	12.9
2015–16	238	11.9	241	12.1

(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) are 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 the *Mechanism of injury categories* shown in Table B2 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 B2: 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 provides 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) remains the same however and include:

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

In this report, remoteness 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 *Postcode 2015 to Remoteness Area 2011 Data Cube* (ABS 2016, pers. com., 22 June) for cases with an injury date on or after 1 January 2015.

Where a postcode had more than 1 RA assigned, and 95% or more of the postcode area was in 1 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 http://www.doctorconnect.gov.au/internet/otd/Publishing.nsf/Content/locator and the case was assigned to an RA on that basis.

Appendix C: 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.

Non-traumatic SCI cases often have a gradual onset. Accordingly, these non-traumatic SCI cases are reported according to year of admission. 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

A total of 145 people with a non-traumatic SCI were admitted to a participating spinal unit between 1 July 2015 and 30 June 2016, and consented to being included in the ASCIR. This included 80 males (55%) and 65 females.

The age range of non-traumatic SCI cases admitted in this period was 17 to 92, with a mean age of 58. The median LOS in a spinal unit was 84 days (5th percentile 18 days; 95th percentile 292 days).

None of these non-traumatic SCI cases died before discharge. Close to 4 out of 5 (79%) of people admitted to a spinal unit for a non-traumatic SCI during 2015–16 were discharged to a new (8 cases) or previous home (106 cases). Twelve people with a non-traumatic SCI were discharged to a *Nursing home* (8%), while 10 were discharged to *Another acute hospital* (7%). The remaining 9 cases had a mode of separation recorded as to *Another type of health care accommodation*, *Statistical discharge-type change* or *Left against medical advice*.

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 or a laminectomy), where the record states that the onset of paralysis was post-intervention.

Six male (46%) and 7 female cases with a date of SCI onset between 1 July 2015 and 30 June 2016 were reported to the ASCIR as meeting the criteria for a complication of medical care case. The mean age at onset for these cases was 56 (with an age range of 32 to 78).

Length of stay in a spinal unit for these cases ranged from 15 to 207 days, with the median LOS being 141 days.

All complication of medical care SCI cases for this period were discharged to a private home.

Appendix D: Supplementary 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 2016, and the person must have been:

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

Table D3.1: Trends in rates of persisting traumatic SCI cases aged 15 and older, by year of injury, 1995–96 to 2015–16

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	17.6	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	17.1	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	15.1	258
2005–06	16.3	15.1	15.5	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	14.3	13.4	224
2010–11	14.5	13.6	14.1	13.1	260
2011–12	11.1	13.3	13.8	12.8	204
2012–13	12.7	13.0	13.5	12.5	235
2013–14	12.4	12.7	13.3	12.1	236
2014–15	12.9	12.4	13.1	11.8	255
2015–16	12.1	12.2	12.8	11.5	241

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

Source: AIHW Australian Spinal Cord Injury Register.

Table D3.2: Trends in in age-standardised rates of persisting traumatic SCI cases aged 15 and older, by year of injury, by sex, 1995–96 to 2015–16

	Males		Females	
Financial year of injury	Number of cases[(a)]	Age-standardised rate per million population	Number of cases[(a)]	Age-standardised rate per million population
1995–96	192	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	227	30.1	49	6.4
2000–01	208	27.5	62	8.0
2001–02	197	25.8	50	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	164	17.9	40	4.3
2012–13	186	20.2	49	5.2
2013–14	189	19.9	47	4.6
2014–15	203	20.8	52	5.0
2015–16	194	20.0	47	4.4

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

Source: AIHW Australian Spinal Cord Injury Register.

Table D3.3: Counts and age-specific rates of persisting traumatic SCI cases aged 15 and older, by age group, 2015–16

Age group	Cases	Rate per million population
15–24	29	9.2
25–34	30	8.4
35–44	34	10.5
45–54	46	14.6
55–64	36	13.1
65–74	41	20.0
75+	25	15.9

Source: AIHW Australian Spinal Cord Injury Register.

Table D3.4: Age-specific rates of persisting traumatic SCI cases aged 15 and older, by age group, by sex, 2015–16

Age group	Cases	Rate per million population
Males		
15–24	24	14.8
25–34	25	14.0
35–44	29	18.0
45–54	41	26.6
55–64	29	21.5
65–74	27	26.8
75+	19	28.0
Total males	*194*	*20.2*
Females		
15–24	5	3.2
25–34	5	2.8
35–44	5	3.1
45–54	5	3.1
55–64	7	5.0
65–74	14	13.5
75+	6	6.7
Total females	*47*	*4.7*

Source: AIHW Australian Spinal Cord Injury Register.

Table D3.5: Age-standardised 3-year rates of persisting traumatic SCI cases aged 15 and older, by state or territory of usual residence, 2013–14 to 2015–16

State or territory	Cases	3-year rate per million population
New South Wales	218	11.6
Victoria	146	9.7
Queensland	155	13.5
Western Australia	109	17.5
South Australia	70	15.3
Tasmania	9	7.9
Australian Capital Territory	6	6.4
Northern Territory	7	12.0
Australia[(a)]	732	12.4

(a) The 3-year Australia rate includes 12 non-resident of Australia cases.

Note: Rates were calculated using an aggregated 3-year period due to small case counts for the less populous states and territories.

Source: AIHW Australian Spinal Cord Injury Register.

Table D3.6: Age-standardised 3-year rates of persisting traumatic SCI cases aged 15 and older, by remoteness of residence, 2013–14 to 2015–16

Remoteness of residence	Cases	3-year rate per million population
Major cities of Australia	454	10.9
Inner regional Australia	150	13.9
Outer regional Australia	83	16.8
Remote Australia	25	33.2
Very remote Australia	7	13.3
Australia[(a)]	732	12.4

(a) The 3-year Australia rate includes 12 non-residents injured in Australia and 1 resident with insufficient details to determine remoteness zone.

Note: Rates were calculated using an aggregated 3-year period due to small case counts for some remoteness areas.

Source: AIHW Australian Spinal Cord Injury Register.

Table D3.7: Neurological level of injury at discharge for persisting SCI cases aged 15 and older, 2015–16

Neurological level	Frequency	Proportion of cases (%)
C1	16	7
C2	15	6
C3	17	7
C4	43	18
C5	20	8
C6	12	5
C7	3	1
C8	3	1
T1	1	0
T2	5	2
T3	7	3
T4	6	3
T5	3	1
T6	8	3
T7	6	3
T8	6	3
T9	3	1
T10	11	5
T11	11	5
T12	8	3
L1	9	4
L2	7	3
L3	8	3
L4	0	0
L5	3	1
S1	1	0
S2	1	0
S3	1	0
S4	0	0
S5	0	0
Not known	7	3
Total[(a)]	**241**	**100**

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

Source: AIHW Australian Spinal Cord Injury Register.

Acknowledgments

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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, 10th 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
WHO	World Health Organization

Symbols

CI	confidence interval
p	statistical significance *p* value
SMR	standard mortality ratio

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* (ASIA 2016).

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

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**).

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**. 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 spinal unit.

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 United States.

unprotected land transport user: A pedestrian, pedal cyclist, 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 quarter 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): Kreisfeld R, Harrison JE & Tovell A 2017. Hospital care for Australian sports injury, 2012–13. Injury research and statistics series no. 105. Cat. no. INJCAT 181. Canberra: AIHW.

AIHW: Norton L 2010. Spinal cord injury, Australia, 2007–08. Injury research and statistics series no. 52. Cat. no. INJCAT 128. 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.

AIHW: Tovell A 2018c. Spinal cord injury, Australia, 2014–15. Injury research and statistics series no. 113. Cat. no. INJCAT 193. Canberra: AIHW.

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

ASIA 2016. International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) worksheet. Last updated November 2015. Chicago: ASIA. Viewed 30 August 2017, http://asia-spinalinjury.org/wp-content/uploads/2016/02/International_Stds_Diagram_Worksheet.pdf.

Bickenbach J, Officer A, Shakespeare T, von Groote P, World Health Organization & 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, 10th 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 2015–16*, is part of an annual series. Earlier editions and any published subsequently can be downloaded without cost from the AIHW website http://www.aihw.gov.au/publications/.

Readers interested in sport-related injuries are referred to the following AIHW publication for the most recent analysis of hospitalised admissions due to a sports-related spinal injury:

- AIHW: Kreisfeld R, Harrison JE & Tovell A 2017. Hospital care for Australian sports injury, 2012–13. Injury research and statistics series no. 105. Cat. no. INJCAT 181. Canberra: AIHW.

In 2015–16, 253 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 80% of traumatic SCI cases. Almost half (48%) of the traumatic SCI cases sustained in 2015–16 were due to a fall. A further 39% were due to a land transport crash.

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