Australian Government
Australian Institute of Health and Welfare

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Spinal cord injury, Australia

2016–17

AIHW

Australian Government
Australian Institute of
Health and Welfare

Injury Research and Statistics Series
Number 129

Spinal cord injury, Australia

2016–17

Australian Institute of Health and Welfare
Canberra
Cat. no. INJCAT 209

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This publication is part of the Australian Institute of Health and Welfare's Injury research and statistics series. A complete list of the Institute's publications is available from the Institute's website www.aihw.gov.au.

ISSN 2205-510X (Online)
ISSN 1444-3791 (Print)
ISBN 978-1-76054-663-2 (Online)
ISBN 978-1-76054-664-9 (Print)

Suggested citation
AIHW: Tovell A 2020. Spinal cord injury, Australia, 2016–17. Injury research and statistics series no. 129. Cat. no. INJCAT 209. Canberra: AIHW.

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Published by the Australian Institute of Health and Welfare

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Contents

Summary

This 18th 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 (ASCIR) for 2016–17.

A total of 227 newly incident cases of traumatic SCI due to external causes were reported for 2016–17 among people aged 15 or over. Of these cases, 220 resulted in a persisting traumatic SCI; 3 died; 3 had no long-term neurological injury; and 1 was still to be discharged as at April 2019. All those who died were men aged over 50, and the time between the injury and death was 13 to 124 days. Neurological level of injury for all those who died was C4 or higher (the highest region being cervical spine segments C1–C8).

In 2016–17, the age-standardised incidence rate of persisting traumatic SCI was estimated to be 11.1 cases per million population aged 15 and over. The age-specific rate was highest for ages 75 or older (13.0 cases per million population), followed by 12.6 cases per million for ages 45–54.

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 2016–17 cases with *Complete tetraplegia* spent 250 days (approximately 36 weeks) or longer in hospital, from the time of injury to being discharged home from a specialist spinal unit.

Causes of spinal cord injury

A similar number of traumatic SCI cases sustained in 2016–17 were due to a *Land transport crash* (89 cases) or a *Fall* of some kind (88 cases), with each causal category contributing 39%.

Overall, *Unprotected land transport users* accounted for nearly 1 in 4 (24%) traumatic SCI cases for this reporting period. A *Low fall* or fall from an unspecified height (20%) was the second most frequently reported mechanism of injury, followed by a *High fall* (19%). *Motor vehicle occupants* contributed to 15% of traumatic SCI cases for 2016-17. Water-related events, such as diving into shallow water or being dumped by a wave, accounted for 7% of all traumatic SCI cases during this period.

The leading cause of traumatic SCI for males was a *Land transport crash* as an *Unprotected land transport user* (49 cases; 27%), while for females it was a *Low fall* (16 cases; 36%).

More than one-third (39%) of cases reported to the ASCIR for 2016–17 were sustained while the person was *Engaged in sports or leisure activities*, and 80% of these were males. Unlike in previous years, the second most frequent activity group reported was not *While working for income* (7%) but was *While engaged in other types of work* such as undertaking home maintenance (10%).

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 to understand 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 2016 and 30 June 2017 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 it does not include people who:

- did not consent to be included in the register
- were released from hospital without the need for inpatient rehabilitation
- were 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 scope, operation and management of the ASCIR.

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 18th 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 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. Some information about these cases is included at Appendix C of this report.

Estimated incidence of traumatic SCI

Based on data reported to the ASCIR for 2015–16, the estimated incidence of persisting traumatic SCI in Australia, for people aged 15 and over and who were discharged alive, was 12.1 cases per million population (AIHW: Tovell 2019). Population modelling using ASCIR data, supplementary data from the National Hospital Morbidity Database and data from Victoria's single paediatric trauma hospital, suggest that, at 30 June 2011, the estimated rate of traumatic SCI for all ages in Australia was between 21.0 and 32.3 cases per million population (New et al. 2015).

A study of the worldwide incidence of traumatic SCI 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 period, 2007–08, was 15.0 cases per million population aged 15 and over (AIHW: Norton 2010). The study by Lee and others (2014) noted that estimated rates varied 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 found country-specific rates that ranged from 13 cases per million for the Netherlands to 53 per million in Canada (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

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) American Spinal Injury Association (ASIA) Impairment Scale (hereafter referred to as the ASIA Impairment Scale), which is the classification measure used in the ASCIR and in this report (see Glossary). The international standards were most recently revised in 2011 (Kirshblum et al. 2011).

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

Spinal cord injuries are generally classified by the neurological level and extent of injury (Kirshblum et al. 2011).

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

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’. 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 no sensory and motor function in the lowest sacral segments (S4–S5). **Incomplete injury** is the term used when there is some sensory and/or motor function below the neurological level of injury that includes the lowest sacral segments S4–S5.

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 **persistent non-traumatic SCI**, based on a finding of an 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 and others (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 $1.3 billion, while those for paraplegia were close to $690 million (Access Economics 2009). Individual lifetime costs were estimated to be $9.5 million per case of tetraplegia and $5 million per case of paraplegia. With medical advances and the positive trend in survival beyond 12 months, lifetime costs will become more significant as people live longer with SCI.

Structure of this report

The primary focus of this report is traumatic SCI that occurred between 1 July 2016 and 30 June 2017 (abbreviated as '2016–17' in this report). It also includes information on trends in the period 1995–96 to 2016–17. The report is arranged as follows:

- **Chapter 2** presents an overview of all newly incident traumatic SCI cases that occurred in 2016–17.
- **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 2016–17. This chapter includes all cases aged 15 and over who were discharged alive.
- **Chapter 4** provides information on external causes of injury and factors associated with the SCI event for all 2016–17 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 2016–17, and complications of medical care SCI cases that occurred during 2016–17.
- **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 an index commonly 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 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 injury 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 to 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 motorcycles, 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.)

(continued)

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

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 spinal cord injury case registrations in 2016–17

This chapter provides an overview of traumatic SCI incident cases where the injury event occurred between 1 July 2016 and 30 June 2017, and the case was registered by 16 April 2019.

For the period 2016–17, a total of 227 incident cases were reported to the ASCIR by participating spinal units (Table 2.1).

Table 2.1: Traumatic SCI cases aged 15 and over with onset in 2016–17 and reported to the ASCIR by 16 April 2019, by residency status

	Australian residents		Non-residents		Total	
	Number	%	Number	%	Number	%
At discharge from spinal unit:						
Persisting deficit	218	96.9	2	100.0	220	96.9
No ongoing neurological deficit	3	1.3	0	0.0	3	1.3
Died on ward	3	1.3	0	0.0	3	1.3
Total[(a)(b)]	**225**	**100**	**2**	**100**	**227**	**100**

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

(b) One Australian resident injured in 2016–17 was still an inpatient in the spinal unit at the time data for this report was collated and has been included in these totals.

Source: AIHW Australian Spinal Cord Injury Register.

The demographic, social and clinical characteristics of the 218 Australian residents and 2 non-residents discharged alive with a persisting traumatic SCI are the focus of Chapter 3. The total includes 10 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 227 traumatic SCI cases with onset in 2016–17, irrespective of survival to discharge or persistence of deficit.

There were 3 deaths—all were men aged over 50. Two of these traumatic SCI cases were due to a *Water-related* event (67%), while the remaining case was the result of a *Low fall*. Time between the injury and death ranged between 13 and 124 days. Neurological level of injury for all cases who died was C4 or higher on admission.

3 Persisting traumatic spinal cord injury

This chapter examines the characteristics of the 220 cases of persisting traumatic SCI sustained during 2016–17. It also presents summary information on new cases reported each year from 1995–96 to 2016–17.

Records in the ASCIR that met all 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).

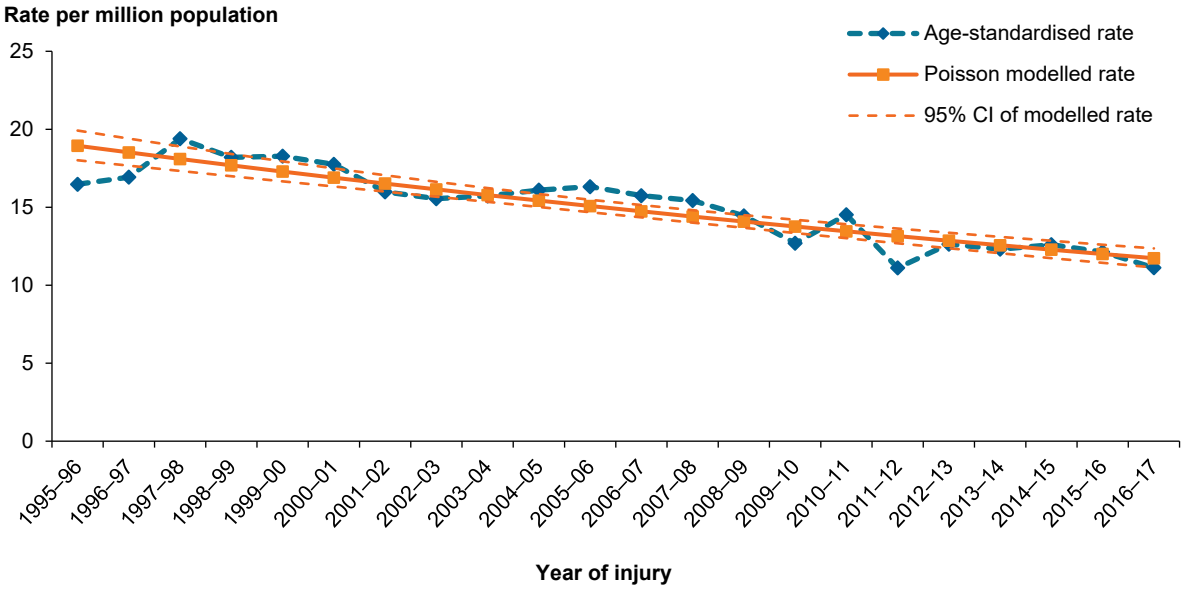
Trends of persisting traumatic SCI, 1995–96 to 2016–17

Incidence rates

In 2016–17, the age-standardised incidence rate of persisting traumatic SCI for cases aged 15 and over was 11.1 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 over has declined since 1995–96 by an average of 2.3% per year (95% CI –1.8% to –2.7%).

Figure 3.1: Trends in rates of persisting traumatic SCI cases aged 15 and over, by year of injury, 1995–96 to 2016–17

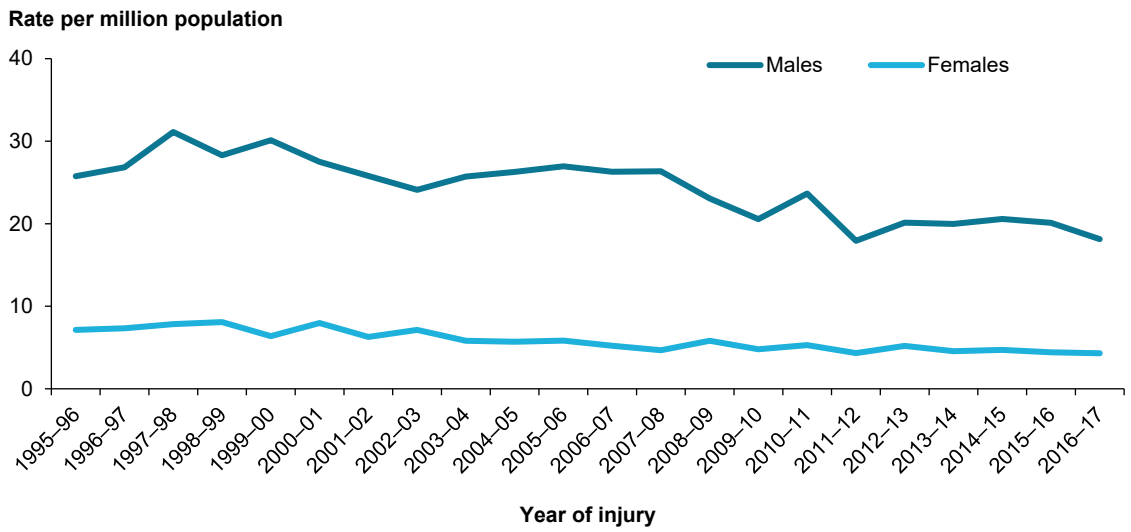


Source: AIHW Australian Spinal Cord Injury Register; Supplementary table D3.1.

The trend in incidence rates, by sex, is shown in Figure 3.2. Across the 22 years of the ASCIR data, the age-standardised rate of persisting traumatic SCI for males aged 15 and over has been consistently higher than for females aged 15 and over. The rate for females has shown little variation over this time, while there has been a decrease in the rate 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 22-year period was 31.1 cases per million males 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 over, by sex, by year of injury, 1995–96 to 2016–17



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 ranging between 197 and 261 days (or between 28 and 37 weeks). Cases with *Complete paraplegia* at the thoracic level had the next longest stay on average, ranging between 131 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 of less than 90 days (or 13 weeks) reported in most years. Fewer than 10 cases a year have been reported for *Complete paraplegia* at the lumbosacral level since 1999–00—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 over, by year of injury, by neurological impairment at admission, 1995–96 to 2016–17

Year of injury	Tetraplegia		Paraplegia				Proportion included[(a)]
	Cervical		Thoracic		Lumbosacral		
	Complete	Incomplete	Complete	Incomplete	Complete	Incomplete	
1995–96	261	88	144	134	83	49	89%
1996–97	220	104	148	102	97	67	86%
1997–98	204	68	143	92	125	69	94%
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	91%
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	87%
2005–06	252	139	143	111	104	97	89%
2006–07	220	124	161	128	123	74	91%
2007–08	228	113	146	104	108	88	93%
2008–09	247	143	151	132	106	88	93%
2009–10	261	174	164	127	133	54	87%
2010–11	227	128	165	115	88	60	85%
2011–12	235	123	134	146	117	117	90%
2012–13	197	110	135	111	80	99	86%
2013–14	239	111	168	114	89	56	88%
2014–15	216	140	179	119	70	101	90%
2015–16	212	106	131	143	70	67	90%
2016–17	250	146	149	116	67	65	88%

(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 2016–17

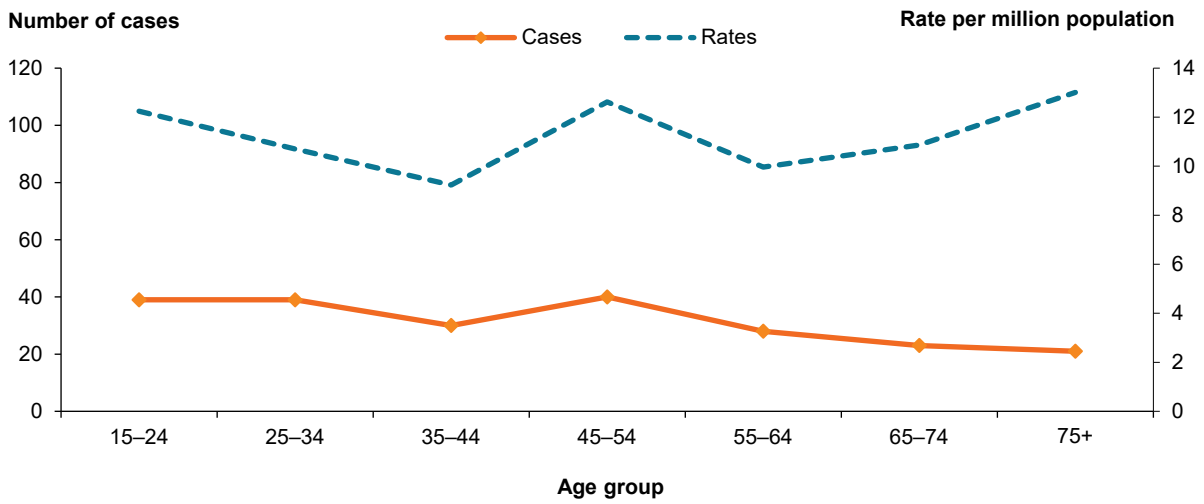
The remainder of this chapter focuses only on the newly incident cases of persisting traumatic SCI among people aged 15 and over with an injury date between 1 July 2016 and 30 June 2017.

Age and sex distribution

Consistent with most recorded years, the majority (80%) of cases of persisting traumatic SCI reported to the ASCIR for 2016–17 were male (176 cases). A total of 44 female cases were included in the register for the 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

highest number of new SCI cases was seen among those aged 45–54 (40 cases, or 18%). Cases aged 15–24 and 25–34 were the next most numerous, with 39 cases reported for each of these age-groups. The age-specific rate was highest for those aged 75 and over (13.0 cases per million population), followed by 12.6 cases per million for those aged 45–54.

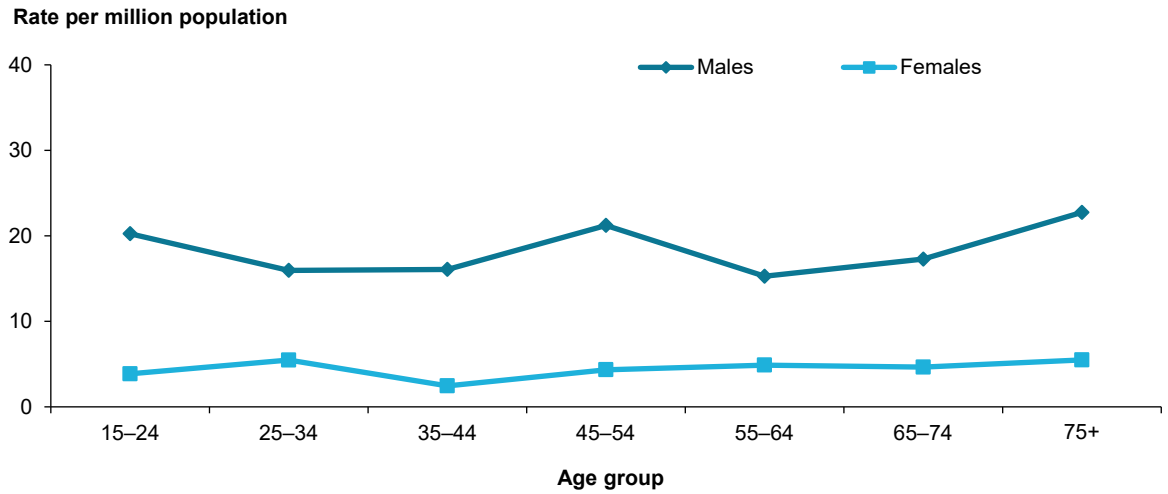
Figure 3.3: Counts and age-specific rates of persisting traumatic SCI cases aged 15 and over, by age group, 2016–17



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

The pattern of incidence rates for persisting traumatic SCI cases for people aged 15 and over remains consistent with previous years whereby the 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 75 and over. The highest rate observed for male cases was 22.8 per million for ages 75 and over, while for female cases it was 5.5 cases per million among 2 age groups, 25–34 and 75 and over. The overall rate for males was 18.1 cases per million compared with 4.4 for females—a male:female ratio of 4:1.

Figure 3.4: Age-specific rates of persisting traumatic SCI cases aged 15 and over, by age group, by sex, 2016–17



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 2014–15 to 2016–17.

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 Tasmania was the lowest (6.2 cases per million), while the rate for residents of Western Australia was the highest (17.8 cases per million). The 3-year rates of persisting traumatic SCI for Queensland, Western Australia, South Australia and the Northern Territory were higher than the national rate, which was 11.9 cases per million.

Figure 3.5: Age-standardised 3-year rates of persisting traumatic SCI cases aged 15 and over, by state or territory of usual residence, 2014–15 to 2016–17

Note: The 3-year national rate is shown as the solid horizontal line. The rate for Australia is calculated on 712 cases, including 9 non-residents.

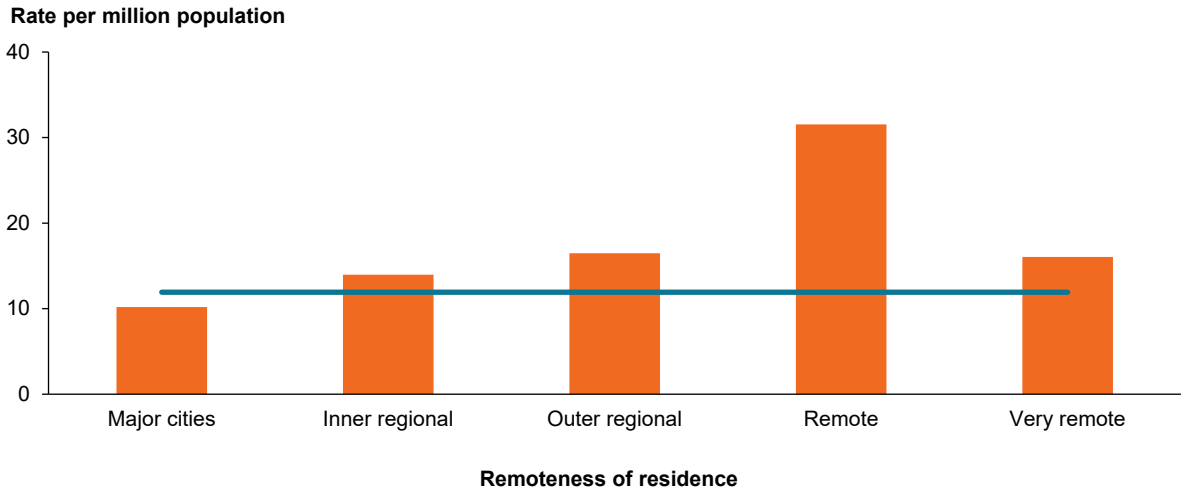
Source: AIHW Australian Spinal Cord Injury Register; Supplementary table D3.5.

Remoteness of residence

Three-year incidence rates were calculated for cases grouped according to remoteness of usual residence for the period 2014–15 to 2016–17 (Figure 3.6) (see 'Assignment to Remoteness Area' in Appendix B).

Consistent with previous reports, only residents of *Major cities* had a 3-year rate of persisting traumatic SCI lower than the 3-year national rate—10.2 cases per million population compared with 11.9 cases per million. The highest 3-year rate was 31.5 cases per million for residents of *Remote* Australia. However, caution should be used in interpreting the rates for residents of *Outer regional* 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 over, by remoteness of residence, 2014–15 to 2016–17



Note: The overall 3-year national rate is shown as the solid horizontal line. Included when calculating the rate for all of Australia, but not the specific remoteness areas, were 9 non-Australian residents injured in Australia and 4 residents with insufficient details to determine remoteness area.

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

Socioeconomic characteristics

Overall, roughly 2 in 5 people (43%) who sustained a persisting traumatic SCI in 2016–17 were married or in a de facto relationship at the time of injury (Table 3.2). None of these cases were aged 15–24. *Never married* (37%) was the next most commonly reported marital status for people injured during this period, with close to half (38 cases; 47%) of these being in the 15–24 age group.

Table 3.2: Marital status at onset of persisting traumatic SCI, by 3 age groups, 2016–17

	15–24 years		25–64 years		65+ years		All ages	
Marital status	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Never married	38	97.4	42	30.7	1	2.3	81	36.8
Widowed	0	0.0	2	1.5	6	13.6	8	3.6
Divorced	0	0.0	11	8.0	5	11.4	16	7.3
Separated	0	0.0	3	2.2	2	4.5	5	2.3
Married (including de facto)	0	0.0	66	48.2	28	63.6	94	42.7
Not reported	1	2.6	13	9.5	2	4.5	16	7.3
Total[(a)]	**39**	**100**	**137**	**100**	**44**	**100**	**220**	**100**

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

Source: AIHW Australian Spinal Cord Injury Register.

Two-thirds (66%) of those aged 25–64 who sustained a persisting traumatic SCI during 2016–17 were *Employed* at the time of injury, as were more than half (56%) of those aged 15–24 (Table 3.3). Overall, 54% of cases were *Employed* at the time of injury, and a further 16% of cases had an employment status of *Pensioner.* (Note: 'Pensioner' status in this context includes age and disability support pension recipients as well as self-funded retirees.) Of the 10 cases aged 15–24 who were reported as *Not available for employment*, half were at school or engaged in further studies.

About one-quarter (26%) of those aged 15–24 were *Not available for employment* due to study or other reasons not specified.

Table 3.3: Employment status at onset of persisting traumatic SCI, by 3 age groups, 2016–17

	15–24 years		25–64 years		65+ years		All ages	
Employment status	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Employed	22	56.4	90	65.7	6	13.6	118	53.6
Pensioner	0	0.0	9	6.6	27	61.4	36	16.4
Unemployed	7	17.9	18	13.1	2	4.5	27	12.3
Not available for employment	10	25.6	6	4.4	9	20.5	25	11.4
Not reported	0	0.0	14	10.2	0	0.0	14	6.4
Total[(a)]	**39**	**100**	**137**	**100**	**44**	**100**	**220**	**100**

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

Source: AIHW Australian Spinal Cord Injury Register.

The highest level of education completed at time of injury was poorly reported for 2016–17, with close to half (48%) of those cases with a persisting traumatic SCI registered with the ASCIR for this period being *Not reported* (Table 3.4). This applied to 70% of cases in the 65 and over age group, 45% of those aged 25–64, and one-third (33%) of those aged 15–24. Of the 114 cases who did have a highest education level reported, 47 people or 41% of these cases had a post-school qualification. This included 21 people who had completed tertiary or postgraduate education and 19 people who had completed a trade qualification or apprenticeship.

Table 3.4: Highest educational level attained at onset of persisting traumatic SCI, by 3 age groups, 2016–17

	15–24 years		25–64 years		65+ years		All ages	
Education level	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Tertiary/postgraduate	2	5.1	16	11.7	3	6.8	21	9.5
Trade qualification/apprenticeship	4	10.3	13	9.5	2	4.5	19	8.6
Diploma or certificate	2	5.1	1	0.7	3	6.8	6	2.7
Other post school study	0	0.0	1	0.7	0	0.0	1	0.5
Highest available secondary school level	5	12.8	24	17.5	2	4.5	31	14.1
Did not complete secondary school	11	28.2	20	14.6	3	6.8	34	15.5
Still at school/higher education	2	5.1	0	0.0	0	0.0	2	0.9
Not reported	13	33.3	62	45.3	31	70.5	106	48.2
Total[(a)]	**39**	**100**	**137**	**100**	**44**	**100**	**220**	**100**

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

Source: AIHW Australian Spinal Cord Injury Register.

Clinical characteristics of persisting traumatic SCI in 2016–17

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 not to 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.

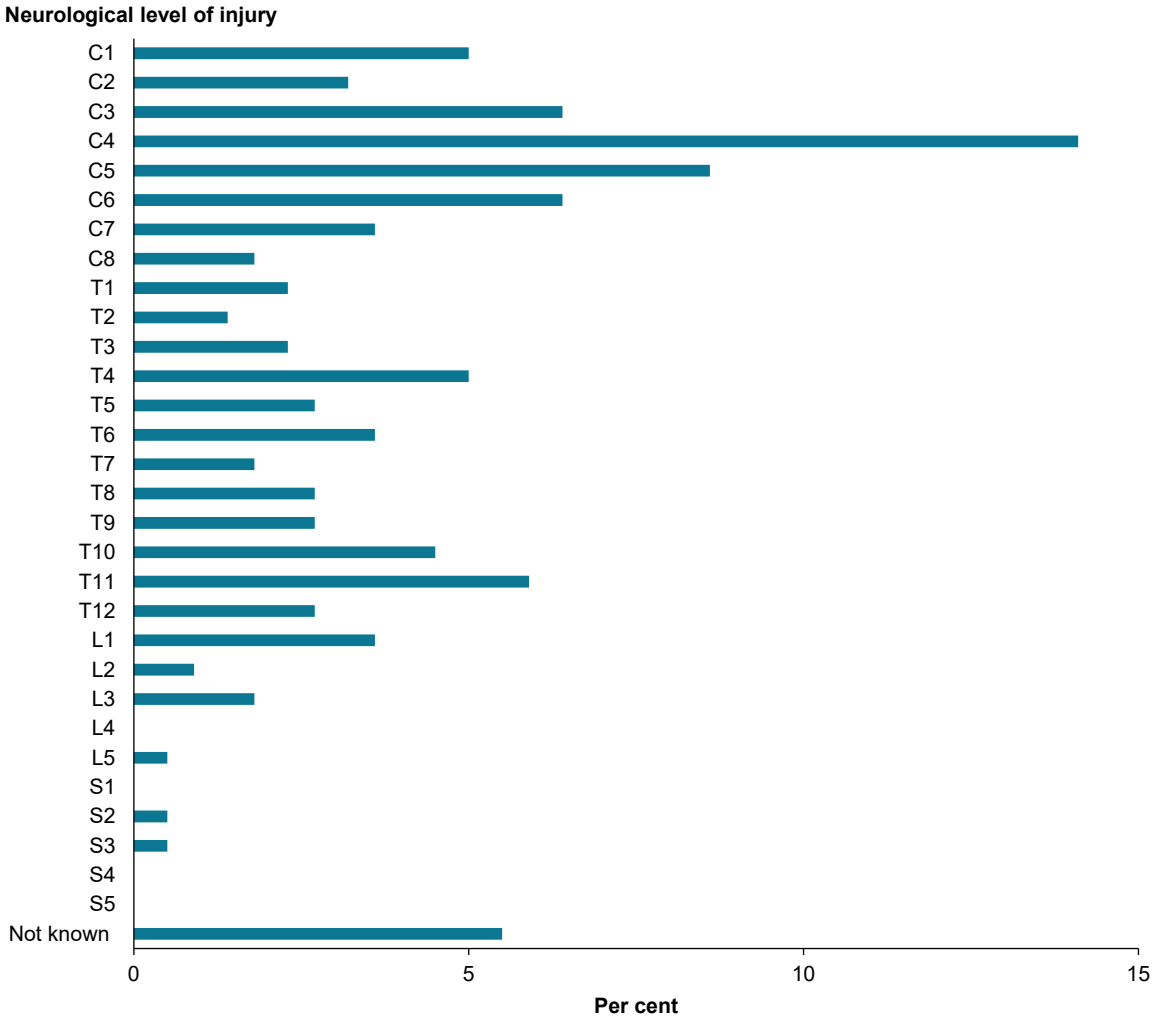
Neurological level of persisting traumatic SCI at discharge was not known for 12 cases (6%). Of the remaining 208 cases, just over half (52%) had a neurological injury at 1 of the cervical segments, C1–C8 (108 cases). The impairment resulting from this neurological level is referred to as *Tetraplegia*.

The most common neurological level of injury was C4, which accounted for 31 cases or 29% of cervical cases and 15% of the 208 cases with an identified level of injury. A further 19 cases had a neurological level of injury at C5 (18% of cervical cases and 9% of the total known cases).

Forty per cent of the 208 known cases had a neurological level of injury at a thoracic segment (T1–T12) (83 cases), and of these, an injury at T11 was most common (16% of thoracic cases and 6% of known cases).

Fewer than 10% of the 208 cases with an identified level of injury had an injury at a lumbar segment (L1–L5) (15 cases), or at a sacral segment (S1–S5) (2 cases). 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 over, 2016–17



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 2016–17, the most frequently reported neurological impairment at discharge was *Incomplete tetraplegia* at 40% (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 (21%). 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).

All except 1 of the 17 cases involving the lumbosacral region were discharged with *Incomplete paraplegia*.

Table 3.5: Neurological impairment at discharge for persisting traumatic SCI cases aged 15 and over, 2016–17

Neurological impairment	Number	Proportion of cases (%)
Tetraplegia		
Cervical	108	49.1
Complete tetraplegia	*20*	*9.1*
Incomplete tetraplegia	*88*	*40.0*
Paraplegia		
Thoracic	83	37.7
Complete paraplegia	*47*	*21.4*
Incomplete paraplegia	*36*	*16.4*
Lumbosacral	17	7.7
Complete paraplegia	*1*	*0.5*
Incomplete paraplegia	*16*	*7.3*
Unknown impairment	12	5.5
Total[(a)]	**220**	**100**

(a) 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 2016–17, 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 12 cases with a reported deficit at discharge but for whom the type of neurological impairment was unknown had a median LOS of 17 days or just over 2 weeks, with 5th and 95th percentiles of 1 and 339 days, respectively.

Cases with a *Complete injury* had a longer median LOS in a spinal unit than cases with an *Incomplete injury*, irrespective of spinal level impairment.

Overall, those with *Complete tetraplegia* had the longest median LOS at 184 days (roughly 26 weeks), while those with *Incomplete paraplegia* at the lumbosacral level had the shortest median LOS at 60 days (close to 9 weeks).

Table 3.6: Length of stay in a spinal unit for persisting traumatic SCI cases aged 15 and over, by neurological impairment at discharge, 2016–17

Neurological impairment at discharge	Number of cases	Median LOS (days)	5th percentile (days)	95th percentile (days)
Tetraplegia				
Cervical	108	152	27	409
Complete tetraplegia	*20*	*184*	*105*	*503*
Incomplete tetraplegia	*88*	*133*	*20*	*344*
Paraplegia				
Thoracic	83	130	42	444
Complete paraplegia	*47*	*151*	*73*	*508*
Incomplete paraplegia	*36*	*98*	*36*	*182*
Lumbosacral	17	62	5	133
Complete paraplegia	*1*	*77*	*77*	*77*
Incomplete paraplegia	*16*	*60*	*5*	*133*
Unknown impairment	12	17	1	339
Total	**220**	**129**	**19**	**407**

Source: AIHW Australian Spinal Cord Injury Register.

4 External causes of spinal cord injury in 2016–17

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 227 cases of traumatic SCI with onset in 2016–17 that were treated in participating spinal units and had been reported to the ASCIR by 16 April 2019. This includes the 220 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 3 cases who died while in a spinal unit; and the 1 case that had not yet been discharged at the time of data compilation (see Table 2.1). As has been the case for most reporting years for the ASCIR, males accounted for 80% of traumatic SCI cases for this 12-month period.

Mechanism of injury

A similar number of traumatic SCI cases sustained in 2016–17 were due to a *Land transport crash* (89 cases) or a *Fall* of some kind (88 cases), with each cause contributing 39% to mechanism of injury (Table 4.1). 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 over, by sex, 2016–17

	Males		Females		Total	
Mechanism of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**
Land transport crash						
Motor vehicle occupant	26	14.3	8	17.8	34	15.0
Unprotected land transport user	49	26.9	6	13.3	55	24.2
Fall						
Low fall (same level or <1 metre)[(a)]	29	15.9	16	35.6	45	19.8
High fall (≥1 metre)	38	20.9	5	11.1	43	18.9
Water-related	14	7.7	3	6.7	17	7.5
Heavy falling object	6	3.3	0	0.0	6	2.6
Horse-related	5	2.7	3	6.7	8	3.5
Football	5	2.7	3	6.7	8	3.5
Other and unspecified causes	10	5.5	1	2.2	11	4.8
Total[(b)]	**182**	**100**	**45**	**100**	**227**	**100**

(a) Includes falls from unspecified heights.

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

Source: AIHW Australian Spinal Cord Injury Register.

The leading cause of injury for males for this reporting period was a *Land transport crash* as an *Unprotected land transport user* (27%), while a *Low fall* (on the same level or from less than 1 metre, or from an unspecified height—hereafter referred to as a *Low fall*) was the most common cause for females (36%).

When age was accounted for, *Land transport crashes* as an *Unprotected land transport user* (for example, a motorcyclist or pedestrian) was the leading cause of traumatic SCI for cases aged 15–24 (23%) and 25–64 (28%) (Table 4.2). A *Low fall* or fall from an unspecified height (44%) was the leading cause of traumatic SCI among cases aged 65 and over.

Table 4.2: Mechanism of injury of all traumatic SCI cases aged 15 and over, by age group, 2016–17

	15–24 years		25–64 years		65+ years		All ages	
Mechanism of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Land transport crash								
Motor vehicle occupant	7	17.5	22	15.5	5	11.1	34	15.0
Unprotected land transport user	9	22.5	40	28.2	6	13.3	55	24.2
Fall								
Low fall (same level or <1 metre)[(a)]	5	12.5	20	14.0	20	44.4	45	19.8
High fall (≥1 metre)	8	20.0	26	18.3	9	20.0	43	18.9
Water-related	4	10.0	12	8.5	1	2.2	17	7.5
Heavy falling object	1	2.5	3	2.1	2	4.4	6	2.6
Horse-related	0	0.0	6	4.2	2	4.4	8	3.5
Football	6	15.0	2	1.4	0	0.0	8	3.5
Other and unspecified causes	0	0.0	11	7.7	0	0.0	11	4.8
Total[(b)]	**40**	**100**	**142**	**100**	**45**	**100**	**227**	**100**

(a) Includes falls from unspecified heights.

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

Source: AIHW Australian Spinal Cord Injury Register.

Just over half (55%) of traumatic SCI cases in 2016–17 had a neurological injury to the cervical spine, or *Tetraplegia*, when admitted to the spinal unit (Table 4.3). Nearly one-quarter (23%) of *Tetraplegia* cases were due to a *Low fall*, followed by 21% for crashes involving *Unprotected land transport users*. Crashes involving an *Unprotected land transport user* and cases due to a fall from a height greater than 1 metre (hereafter referred to as *High fall)* accounted for 29% and 28% respectively to neurological injuries sustained at the thoracic-level. Of the 19 lumbosacral-level cases, around one-third (32%) were the result of a *Low fall*.

Table 4.3: Mechanism of injury for all traumatic SCI cases aged 15 and over, by neurological level of injury at admission, 2016–17

	Tetraplegia		Paraplegia					
	Cervical		Thoracic		Lumbosacral		Total[a]	
Mechanism of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Land transport crash								
Motor vehicle occupant	23	18.5	10	12.0	0	0.0	34	15.0
Unprotected land transport user	26	20.9	24	28.9	5	26.3	55	24.2
Fall								
Low fall (same level or <1 metre)[b]	29	23.4	10	12.0	6	31.6	45	19.8
High fall (≥1 metre)	15	12.1	23	27.7	5	26.3	43	18.9
Water-related	15	12.1	2	2.4	0	0.0	17	7.5
Heavy falling object	3	2.4	3	3.6	0	0.0	6	2.6
Horse-related	2	1.6	6	7.2	0	0.0	8	3.5
Football	6	4.8	0	0.0	2	10.5	8	3.5
Other and unspecified causes	5	4.0	5	6.0	1	5.3	11	4.8
Total[c]	124	100	83	100	19	100	227	100

(a) Totals includes 1 motor vehicle occupant for whom neurological level of injury on admission was not available.

(b) Includes falls from unspecified heights.

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

Source: AIHW Australian Spinal Cord Injury Register.

Land transport crashes

As shown in Table 4.1, close to 2 in 5 traumatic SCI cases (39%) reported to the ASCIR for 2016–17 were due to a *Land transport crash*. Approximately one-third (34%) of these were male motorcycle drivers (30 cases) (Table 4.4). Five (36%) of the 14 female cases were motor vehicle passengers at the time of their injury. Four male and 1 female quad-bike riders were reported for 2016–17, accounting for 6% of *Land transport crash* cases and 2% of traumatic SCI cases overall.

Table 4.4: Land transport user types for all traumatic SCI cases aged 15 and over, by sex, 2016–17

	Males		Females		Total	
Land transport user type	**Number**	**%**	**Number**	**%**	**Number**	**%**
Motor vehicle driver	16	21.3	3	21.4	19	21.3
Motor vehicle passenger[(a)]	10	13.3	5	35.7	15	16.9
Motorcycle driver	30	40.0	2	14.3	32	36.0
Pedal cyclist or pedal cycle passenger	10	13.3	1	7.1	11	12.4
Pedestrian	5	6.7	1	7.1	6	6.7
Three- or four-wheeled motor vehicle user[(b)]	4	5.3	2	14.3	6	6.7
Total[(c)]	**75**	**100**	**14**	**100**	**89**	**100**

(a) Includes 1 case where seat occupancy in vehicle was not specified.

(b) Includes 1 tricycle motorbike and 5 quad-bike users.

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

Source: AIHW Australian Spinal Cord Injury Register.

The mean age at onset for traumatic SCI due to a *Land transport crash* in 2016–17 was similar for both *Motor vehicle occupants* and *Unprotected land transport users* at 41 and 40 respectively. The age range for injured *Motor vehicle occupants* was 16 to 85, while for injured *Unprotected land transport users* it was 17 to 76.

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 34 *Motor vehicle occupants* who sustained a traumatic SCI in 2016–17, 35% stated they were wearing a seatbelt at the time of the crash (12 cases), while 24% stated they weren't (8 cases). Information on the use of seatbelts was not available in 41% of cases (14 cases).

The most common type of crash event for *Motor vehicle occupants* was a vehicle rollover and/or impact with a roadside hazard, with 13 identified cases in each event category. Nine people reported they had been ejected from the vehicle they had been travelling in. Relatively few (4 cases; 12%) injured *Motor vehicle occupants* stated the injury event included impact with another motor vehicle, while half (17 cases) stated there was no other motor vehicle involved. These types of events are not mutually exclusive and more than 1 event might have been reported for the same person. For instance, in this reporting period, 4 of the 9 people who were ejected from their motor vehicles had also stated there had been impact with a roadside hazard.

Roughly two-thirds (68%) of *Motor vehicle occupants* sustained a neurological injury at the cervical-level (Table 4.3). Fourteen (61%) of these 23 cases were discharged with *Incomplete tetraplegia*. A further 10 cases sustained a thoracic-level injury, and of these, *Incomplete paraplegia* was the most common impairment at discharge (5 cases). Neurological level of injury on admission was not available for 1 *Motor vehicle occupant*.

Forty-nine (89%) of the 55 *Unprotected land transport user* SCI cases were male (Table 4.1). Thirty-two motorcycle drivers (36%), including 2 females, accounted for more than one-third of *Land transport crash* cases in 2016–17 (Table 4.4). The motorcyclists are 58% of the *Unprotected land transport users* who sustained a traumatic SCI in 2016–17. Eleven pedal cyclists accounted for a further 20%. The remaining cases were equally distributed between pedestrians (6 cases) and users of three- or four-wheeled bikes; specifically 1 tricycle motorbike and 5 quad-bike users.

Types of crash events that resulted in a traumatic SCI for *Unprotected land transport users* differed by user group. For instance, the most common confirmed crash event for motorcyclists was impact with a roadside hazard (10 cases; 31% of motorcyclists), followed by impact with a motor vehicle (6 cases). Equal numbers of pedal cyclist cases were due to impact either with a motor vehicle or with a roadside hazard (4 cases or 36% for each). Of the 6 pedestrian cases who sustained a traumatic SCI in 2016–17, 5 (83%) involved being hit by a motor vehicle and 1 case was due to a collision with a roadside hazard while using a pedestrian conveyance (an electric scooter). In contrast, injured quad-bike riders were likely to have experienced a rollover, as described in the registration record of 4 of the 5 quad-bike cases. Half of the 32 motorcyclist cases were reported to have occurred at 'high speed', or at a speed of at least 60 kilometres per hour.

A traumatic SCI at the cervical-level was most frequent for pedal cyclists (7 of 11 cases) and pedestrians (4 of 6 cases), while thoracic-level injuries were most numerous for motorcyclists (15 of 32 cases) and three- or four-wheeled bike riders (4 of 6 cases).

While 29 of 34 (85%) *Motor vehicle occupants* were injured on a public road, the types of places where *Unprotected land transport users* were injured were more varied and included public recreation areas, racetracks, farms and bushland; 31 (56%) of these occurred on public roads.

Falls

About 2 in 5 traumatic SCI cases (39%) in 2016–17 were attributed to a fall of some kind (Table 4.1). Similar numbers of cases were reported for traumatic SCI due to a *Low fall* (45 cases) or a *High fall* (43 cases). Ten *High fall* cases involved falling off a ladder (23%), and a further 20% involved either falling off a roof (6 cases) or through a roof or skylight (3 cases).

When gender was accounted for, female cases contributed to a greater proportion of *Low fall* cases than to *High fall* cases: 36% of *Low falls* compared with 11% of *High falls*.

The mean age at onset for traumatic SCI due to a *Low fall* was 60, and cases ranged in age from 16 to 94. Traumatic SCI cases involving a *High fall* tended to be younger with a mean age at onset of 46, and an age range of 15 to 80. This difference is reflected in Table 4.2—20 of the 45 *Low falls* cases (44%) were aged 65 or older compared with 9 of 43 (21%) of the *High fall* cases. In contrast, while another 44% of *Low fall* cases were at ages 25 to 64, this age-range included 60% of the *High fall* cases.

Close to two-thirds (64%) of *Low fall* SCI cases were admitted to a spinal unit with a cervical-level injury, compared with around one-third (35%) of *High fall* cases (Table 4.3).

The places where injuries occurred were diverse, but about half of each fall type cases occurred in or around the home—24 (53%) of the *Low fall* cases and 21 (49%) of the *High fall* cases. The place where the injury was sustained was unspecified for 27% of *Low falls* and 16% of *High falls*.

While most traumatic SCI cases due to a fall appear to have been unintentional, 3 *High fall* cases were attributed to an act of *Intentional self-harm* and intent was unclear for a further 1 *High fall* case.

Water-related

Of the 17 (7%) of traumatic SCI cases reported for 2016–17 that were due to a *Water-related* event, 82% were males (14 cases) (Table 4.1).

Nine (53%) of the *Water-related* SCI cases involved the person diving or jumping into water including into pools, in shallow surf or off a jetty. Three cases (18%) occurred when the person was surfing. Other *Water-related* events for this period involved being dumped by a wave (2 cases), or being hit by, or falling from a boat or jet-ski (3 cases).

The mean age at onset for *Water-related* SCI in 2016–17 was 37, and the age range was 20 to 72.

All except 2 of the 17 *Water-related* SCI cases were admitted to a spinal unit with a neurological injury to the cervical-level spine, or *Tetraplegia* (Table 4.3). Ten of these 15 cases were discharged with *Incomplete tetraplegia*, and no ASIA Impairment Scale on discharge was available for 3 cases.

Heavy falling objects

Heavy falling objects accounted for 3% of traumatic SCI cases in 2016–17, with all 6 cases being male (Table 4.1).

Four of the 6 cases involved being struck by a tree branch or log.

Heavy falling object SCI cases ranged in age from 19 to 79, with a mean age at onset of 55.

Equal numbers of *Heavy falling object* SCI cases had a neurological injury at the cervical or at the thoracic spine on admission (Table 4.3).

Horse-related

Five males and 3 females sustained a *Horse-related* SCI in 2016–17 (Table 4.1). These cases accounted for 4% of traumatic SCI overall.

All 8 cases involved falling from a horse. In several instances the descriptive text indicated that the person fell from the horse after the horse bucked, while 2 others fell when the horse appeared to trip or fall.

The mean age at onset for a *Horse-related* SCI in 2016–17 was 54, and the age range was 33 to 72.

Three-quarters (75%) of *Horse-related* SCI cases were admitted with a thoracic-level injury (Table 4.3).

Football

Football also accounted for 8 cases in 2016–17, 4% of traumatic SCI overall (Table 4.1). Five of these cases were male and 3 were female. For the 21-year period before 2016–17, the ASCIR includes records of 158 cases in which a person sustained traumatic SCI while playing football, only one of whom was female.

Rugby (4 cases) was the most frequently mentioned football code, followed by Australian Rules football (3 cases).

Football SCI cases ranged in age from 16 to 28 and had the lowest mean age at onset (22) of any mechanism of injury specified in this report.

Most *Football* SCI cases were admitted with cervical-level injuries (6 cases), while the remaining 2 cases were admitted with lumbosacral-level injuries (Table 4.3).

Other and unspecified causes

Ten male and 1 female traumatic SCI cases reported to ASCIR for 2016–17 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. Causes of traumatic SCI in this category included air-transport crashes (3 cases), tractor crashes (2 cases), and assault with a weapon (2 cases).

The mean age at onset for *Other and unspecified causes* of SCI in 2016–17 was 50, and cases in this residual category ranged in age from 32 to 61.

Five of the 11 cases in this residual category were admitted with an injury to the cervical spine, and a further 5 had a thoracic-level injury (Table 4.3).

Activity at time of injury

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

Close to 2 in 5 (39%) of the 227 traumatic SCI cases reported to ASCIR for 2016–17 occurred while the person was *Engaged in sports or leisure activities*, and of these, 70 (80%) were males. *Unprotected land transport users* accounted for the largest proportion (30%) of cases injured during a sport or leisure activity, including 13 motorcyclists, 8 pedal cyclists, 3 pedestrians and 2 quad-bike riders. *Water-related* SCI cases were next most common (19%), followed by *Low falls* (15%). All of the 8 *Football* cases and 6 of the 8 *Horse-related* SCI cases are included in this activity category. Other sporting activities during which SCI occurred included trampolining (3 cases), snow-skiing (2 cases), snowboarding, sky-diving, base jumping and rock climbing. Young men aged 15–24 (24 cases) accounted for more than one-quarter (27%) of cases in this activity group. In contrast, young women (4 cases) in the same age group accounted for only 5% of cases. Intoxication due to alcohol or drugs was noted as a contributing factor in 13 cases (11%).

In previous reports, *While working for income* was the next most numerous specified activity being undertaken when a traumatic SCI occurred. In 2016–17, the second most common specified activity was *While engaged in other types of work* (22 cases; 10%). All but 1 of the 22 people who sustained a traumatic SCI while engaged in unpaid work were male (95%). Only 2 (9%) of the 22 cases were under the age of 45. A *High fall* from a height of 1 metre or more accounted for 64% of cases and included 7 cases of falling off a ladder and 6 cases of falling off or through a roof (Table 4.5). A further 4 (18%) of cases were due to a *Heavy falling object*—3 of the objects being a tree or part of a tree that the person had cut or was cutting.

Of the 17 cases who were injured *While working for income* (7%), 15 were males. Six of the 15 males were aged 45–54. A fall of some kind accounted for 41% of work-related cases, including 5 *High falls* all from a height estimated to be 3 metres or more. *Land transport crashes* (5 cases; 29%) contributed the second highest proportion of cases injured *While working for income*, and included a person travelling to work, a truck driver and 2 quad-bike riders. Two of the 8 *Horse-related* SCI cases were also included in this activity group. The

places where these work-related SCI cases occurred included 2 construction sites, 2 public roads, 2 public recreation areas, a factory, a warehouse, and a farm.

Six males and 5 females made up the 5% of 2016–17 traumatic SCI cases that occurred *While engaged in a personal activity* (such as eating, sleeping or self-care). All except 1 of these cases were due to a *Low fall.* Included in these *Low fall* cases were 3 cases where the person was reaching for or using a wheeled mobility aid which rolled away, or the person tripped; 2 cases who fell during a 'transfer' from a chair; and 2 cases in which the person was found next to their bed. The *High fall* case involved falling down a set of stairs. The majority (6 cases; 73%) of traumatic SCI cases in this activity group occurred in the home, 2 cases occurred in a hospital and 1 case had no specified type of place.

Twenty-eight (32%) of the remaining 89 cases had no specified activity recorded at the time of injury. *Land transport crashes* accounted for close to 3 in 5 cases (58%) in this residual *Other and unspecified activity* group, including 26 *Motor vehicle occupants* and 27 *Unprotected land transport users* (Table 4.5). A further 33% were due to a fall, including 18 *Low fall* and 11 *High fall* cases. The great majority (90%) of traumatic SCI cases in this activity group were due to unintentional events, while 3 cases were due to *Intentional self-harm* (3%), 2 were due to *Assault* (2%), and 1 was due to *Legal intervention* (1%). Intent was unknown for the remaining 3 cases. Males (70 cases) accounted for 79% of cases in this activity group, and cases were distributed throughout all age groups for both genders. Type of place was not recorded for 20% of cases, while 53% occurred on a public road (47 cases), and 18% occurred in and around the home (16 cases).

Table 4.5: Traumatic SCI cases aged 15 and over, by mechanism of injury, by type of activity, 2016–17

	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	5	5.7	3	17.7	0	0.0	0	0.0	26	29.2	34	15.0
Unprotected land transport user	26	29.5	2	11.8	0	0.0	0	0.0	27	30.3	55	24.2
Fall												
Low fall (same level or <1 metre)[b]	13	14.8	2	11.8	2	9.1	10	90.9	18	20.2	45	19.8
High fall (≥1 metre)	12	13.6	5	29.4	14	63.6	1	9.1	11	12.4	43	18.9
Water-related	17	19.3	0	0.0	0	0.0	0	0.0	0	0.0	17	7.5
Heavy falling object	0	0.0	1	5.9	4	18.2	0	0.0	1	1.1	6	2.6
Horse-related	6	6.8	2	11.8	0	0.0	0	0.0	0	0.0	8	3.5
Football	8	9.1	0	0.0	0	0.0	0	0.0	0	0.0	8	3.5
Other and unspecified causes	1	1.1	2	11.8	2	9.1	0	0.0	6	6.7	11	4.8
Total[c]	**88**	**100**	**17**	**100**	**22**	**100**	**11**	**100**	**89**	**100**	**227**	**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

Almost half (49%) of traumatic SCI cases that occurred during 2016–17 had insufficient detail recorded for place of injury to enable assignment to an Australian remoteness area (Table 4.6). Four per cent (10 cases) of traumatic SCI cases were sustained by an Australian resident while visiting another country, and no details were available for the 2 overseas residents injured while visiting Australia.

Consistent with previous reports, of the 116 cases where remoteness area for the place of injury could be assigned, the majority (43%) occurred in *Major cities* and the number of cases decreased with increasing remoteness.

Table 4.6: Remoteness area for place where traumatic SCI occurred, 2016–17

Remoteness area	Number	Proportion of cases (%)
Major cities of Australia	50	22.0
Inner regional Australia	29	12.8
Outer regional Australia	20	8.8
Remote Australia	5	2.2
Very remote Australia	2	0.9
Australia, place not specified	111	48.9
Overseas	10	4.4
Total	**227**	**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, 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 with the *Privacy Act 1988* (Cwlth), 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 2016–17.

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 2016–17 data was 16 April 2019. Data corrections from spinal units up to 29 July 2019 are included in this report. A snapshot file of the ASCIR was taken on 30 July 2019.

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 2016–17. Cases for 2017–18 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 the 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 2016–17.

The data reported for 2016–17 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 one 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 usual. 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

Australia, states and territory population data were obtained from the Australian Bureau of Statistics (ABS) in March 2019 (ABS 2018). Australian Statistical Geography Standard (ASGS) population-based data for calculating remoteness rates were supplied by the AIHW (2018, pers. comm., 21 November).

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 might have reported an address in Australia as their place of residence, rather than applied this technical distinction. This might 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 has 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	
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	267	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	229	12.3	234	12.6
2013–14	230	12.0	235	12.3
2014–15	245	12.3	250	12.6
2015–16	238	11.9	242	12.1
2016–17	218	11.0	220	11.1

(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.

Source: AIHW Australian Spinal Cord Injury Register.

Use of confidence intervals

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

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

Assignment to reported mechanism of injury

Cases were assigned to one 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 to mechanism of injury categories shown in Table B2 was a 3-step process:

- Step 1: Draft allocation to *Land transport crashes*, *Falls* or *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, jet-ski
Heavy falling object	Records searched for mention of heavy object falling onto or striking the person. Types of objects include logs, trees and parts of trees, machinery, parts of buildings and hay (stacks or bales).
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 measurement commonly used in Australian health data and provides a classification system which gives an indication of road distances people may have to travel to their nearest service centres. The Remoteness Structure was developed by the Australian Government in 1997 and its methodology was updated in 2011 (ABS 2013b). The classification of Remoteness Areas (RA) remains the same, however, and includes:

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

Where a postcode had more than one RA assigned, and 95% or more of the postcode area was in one RA, then cases were assigned to that RA. Otherwise, the street address or location recorded in the ASCIR was used to search the Department of Health DoctorConnect website https://beta.health.gov.au/resources/apps-and-tools/health-workforce-locator/health-workforce-locator#hwc-map 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 ('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 cases

A total of 147 non-traumatic SCI cases were admitted to a participating spinal unit between 1 July 2016 and 30 June 2017 and consented to being included in the ASCIR. Males accounted for 55% of these—81 cases, compared with 66 for females.

The mean age at admission for non-traumatic SCI cases was 56, and admitted patients ranged in age from 16 to 89.

One person was still an inpatient at the time of data collation (April 2019), and all other persons were discharged alive. The median LOS for these 146 discharged patients was 77 days (5th percentile 14 days; 95th percentile 280 days).

Close to three-quarters (107 cases; 73%) of non-traumatic SCI cases had a mode of separation to a private home (previous, new or unknown home). Eighteen people were transferred to *Another acute hospital*, while 8 were discharged to a *Nursing home* and 7 to *Another type of health care accommodation*. For the remaining 6 cases the mode of separation was recorded as *Statistical discharge from leave* or *Left against medical advice*.

Complication of medical care cases

Cases included here arose in the course of surgery (most commonly decompressive) or as a result of other medical care (for example, an adverse medication effect), where the record states that the onset of paralysis was post-intervention.

Seven male (39%) and 11 female cases with a date of SCI onset between 1 July 2016 and 30 June 2017 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 62 (with an age range of 16 to 83).

Length of stay in a spinal unit for these cases ranged from 37 to 824 days, with the median LOS being 106 days.

Thirteen cases were discharged to a private home, 3 cases were discharged to a *Nursing home* and 2 were transferred to *Another acute hospital*.

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 were that the SCI must have occurred between 1 July 1995 and 30 June 2017, 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 over, by year of injury, 1995–96 to 2016–17

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	18.9	19.9	18.0	245
1996–97	16.9	18.5	19.4	17.7	249
1997–98	19.4	18.1	18.9	17.3	289
1998–99	18.2	17.7	18.4	17.0	272
1999–00	18.3	17.3	17.9	16.7	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	16.1	16.6	15.7	243
2003–04	15.7	15.8	16.2	15.3	249
2004–05	16.1	15.4	15.8	15.0	258
2005–06	16.3	15.1	15.5	14.7	265
2006–07	15.7	14.7	15.1	14.3	260
2007–08	15.4	14.4	14.8	14.0	262
2008–09	14.4	14.1	14.5	13.7	248
2009–10	12.7	13.8	14.2	13.3	224
2010–11	14.5	13.5	13.9	13.0	260
2011–12	11.1	13.1	13.6	12.7	204
2012–13	12.6	12.9	13.4	12.4	234
2013–14	12.3	12.6	13.1	12.0	235
2014–15	12.6	12.3	12.8	11.7	250
2015–16	12.1	12.0	12.6	11.4	242
2016–17	11.1	11.7	12.4	11.1	220

(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 age-standardised rates of persisting traumatic SCI cases aged 15 and over, by year of injury, by sex, 1995–96 to 2016–17

	Males		Females	
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	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	185	20.1	49	5.2
2013–14	189	20.0	46	4.6
2014–15	201	20.6	49	4.7
2015–16	195	20.1	47	4.4
2016–17	176	18.1	44	4.3

(a) Age at onset of persisting traumatic SCI was missing for 2 cases.

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

Source: AIHW Australian Spinal Cord Injury Register.

Table D3.3: Counts and age-specific rates of persisting traumatic SCI cases aged 15 and over, by age group, 2016–17

Age group	Cases	Rate per million population
15–24	39	12.2
25–34	39	10.7
35–44	30	9.2
45–54	40	12.6
55–64	28	10.0
65–74	23	10.9
75+	21	13.0

Source: AIHW Australian Spinal Cord Injury Register.

Table D3.4: Age-specific rates of persisting traumatic SCI cases aged 15 and over, by age group, by sex, 2016–17

Age group	Cases	Rate per million population
Males		
15–24	33	20.3
25–34	29	16.0
35–44	26	16.1
45–54	33	21.2
55–64	21	15.3
65–74	18	17.3
75+	16	22.8
Total males	*176*	*18.1*
Females		
15–24	6	3.9
25–34	10	5.5
35–44	4	2.5
45–54	7	4.3
55–64	7	4.9
65–74	5	4.6
75+	5	5.5
Total females	*44*	*4.4*

Source: AIHW Australian Spinal Cord Injury Register.

Table D3.5: Age-standardised 3-year rates of persisting traumatic SCI cases aged 15 and over, by state or territory of usual residence, 2014–15 to 2016–17

State or territory	Cases	3-year rate per million population
New South Wales	199	10.4
Victoria	146	9.7
Queensland	154	13.1
Western Australia	112	17.8
South Australia	70	15.0
Tasmania	7	6.2
Australian Capital Territory	7	7.1
Northern Territory	8	14.0
National [(a)]	**712**	**11.9**

(a) The 3-year national rate includes 9 non-Australian residents injured in Australia.

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 over, by remoteness of residence, 2014–15 to 2016–17

Remoteness of residence	Cases	3-year rate per million population
Major cities	432	10.2
Inner regional	151	14.0
Outer regional	85	16.5
Remote	23	31.5
Very remote	8	16.1
National [(a)]	**712**	**11.9**

(a) The 3-year national rate includes 9 non-Australian residents injured in Australia and 4 Australian residents with insufficient details to determine remoteness area.

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 over, 2016–17

Neurological level	Frequency	Proportion of cases (%)
C1	11	5.0
C2	7	3.2
C3	14	6.4
C4	31	14.1
C5	19	8.6
C6	14	6.4
C7	8	3.6
C8	4	1.8
T1	5	2.3
T2	3	1.4
T3	5	2.3
T4	11	5.0
T5	6	2.7
T6	8	3.6
T7	4	1.8
T8	6	2.7
T9	6	2.7
T10	10	4.5
T11	13	5.9
T12	6	2.7
L1	8	3.6
L2	2	0.9
L3	4	1.8
L4	0	0.0
L5	1	0.5
S1	0	0.0
S2	1	0.5
S3	1	0.5
S4	0	0.0
S5	0	0.0
Not known	12	5.5
Total[(a)]	**220**	**100**

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

Source: AIHW Australian Spinal Cord Injury Register.

Acknowledgments

The Australian Spinal Cord Injury Register (ASCIR) is operated by the Australian Institute of Health and Welfare's (AIHW) National Injury Surveillance Unit (NISU) in collaboration with the directors of participating spinal units.

The AIHW acknowledges the financial and project support for this publication provided by the Department of Health.

The people who sustained a spinal cord injury and provided consent for their details to be included in the ASCIR are gratefully acknowledged, as are the spinal unit staff who collect and provide the data for inclusion.

The author would also like to thank AIHW staff from the Health Systems Group for peer reviewing the manuscript.

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
CI	confidence interval
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
pers. comm.	personal communication
RA	Remoteness Area
SCI	spinal cord injury
SMR	standard mortality ratio

Symbols

≥	equal to or greater than
<	less than

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. Prior to 1992, 'quadriplegia' was the term commonly used to describe a spinal cord injury at the cervical level (ASIA 1992).

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.

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Related publications

This report, *Spinal cord injury, Australia 2016–17*, 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.

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.

A total of 227 newly incident cases of traumatic spinal cord injury (SCI) due to external causes were reported to the Australian Spinal Cord Injury Register for 2016–17. The majority (80%) of these were males. Land transport crashes (39%) and falls (39%) were most often reported as the cause of traumatic SCI.

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