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Spinal cord injury, Australia

2011–12

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Contents

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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.

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

Abbreviations

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

Symbols

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

Summary

This 13th 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 2011–12.

Some 220 new incident cases of traumatic SCI due to external causes were reported for 2011–12. This is the lowest recorded annual figure recorded for ASCIR.

The age-standardised rate for Australian residents aged 15 and older and discharged alive with a persisting traumatic SCI was estimated to be 10.9 new cases per million population. Caution is advised when interpreting this rate due to the lower than usual case numbers reported by one spinal unit (SU).

Incidence rates of persisting traumatic SCI were higher for males than females at all ages. The overall rate for Australian males aged 15 and older was 17.8 cases per million population, while for Australian females aged 15 and older, the rate was 4.3 cases per million population; a male to female ratio of 4.1:1.

Australian residents, aged 15 and older, discharged alive with a persisting traumatic SCI sustained in 2011–12, had a median length of stay of 132 days in a specialised SU.

Causes of spinal cord injury

Falls (45%) and *Land transport crashes* (38%) were the most common causes of traumatic SCI in 2011–12. This was a reverse pattern to previous reports in this series.

Falls led to 100 cases of traumatic SCI in 2011–12, with *High falls* being the single leading cause overall (29%). While the majority of *Falls* were *Unintentional*, 11% of *High falls* were recorded as *Intentional self-harm*. Generally, *Falls* contributed to a greater proportion of traumatic SCI among female cases than among males; 74% compared with 38%, even though the case numbers for males were higher.

Unprotected land transport users such as motorcyclists and pedal cyclists were the second most frequently injured group overall (23%) in 2011–12, and all of these cases were male. One-third of motorcyclists who sustained a traumatic SCI in this period were aged 15–24, followed by 30% aged 35–44, whereas 42% of the pedal cyclist cases were aged 45–54.

Other reported mechanisms of injury for traumatic SCI in 2011–12 include *Water-related* events such as diving into shallow water (6%), *Heavy falling objects* (2%), *Horse-related* events (1%) and *Football* (including rugby codes) (1%). Other cases were due to violence-related causes, other modes of transport and other sporting or physical activities.

Approximately 1 in 3 cases (36%) of traumatic SCI sustained during 2011–12 occurred *While engaged in sports or leisure*. Injuries sustained *While working for income* including travel to and from work accounted for 11% of traumatic SCI for this period.

1 Introduction

This report describes cases of traumatic spinal cord injury (SCI) sustained between 1 July 2011 and 30 June 2012 that required admission to a specialist spinal unit (SU) in Australia. It uses data from the Australian Spinal Cord Injury Register (ASCIR). Spinal cord injury 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 in increased mortality risk.

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 SUs specialising in acute management and rehabilitation of persons with an SCI. ASCIR built on a register established a decade earlier by Mr John Walsh AM.

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

Annual reports on the incidence of SCI have been produced from the ASCIR since its inception. Early reports, based on data from the period 1995–96 to 1998–99, were published in the *Australian injury prevention bulletin*. Subsequent reports have been published in the AIHW Injury research and statistics series *Spinal cord injury, Australia*, and this is the 15th report of that type.

Estimated incidence of traumatic spinal cord injury

The estimated incidence of persisting traumatic SCI for Australian residents aged 15 and older based on data reported to the ASCIR for the previous year, 2010–11, was 14.3 cases per million population (AIHW: Tovell & Harrison 2018). Population modelling using ASCIR data, supplementary data from the National Hospital Morbidity Database and data from Victoria's single paediatric trauma hospital, suggest that, as at 30 June 2011, the true estimate of traumatic SCI for all ages in Australia is between 21.0 and 32.3 cases per million population (New et al. 2015).

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

the estimates are based. (For example, few countries have national compulsory registers.) This caution also applies to the data reported for Australia, as the ASCIR does not have complete population coverage.

Mortality, life expectancy and estimated costs for traumatic SCI injury

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

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

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

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

Structure of this report

The primary focus of this report is traumatic SCI, resulting from injurious events that occurred during the period 1 July 2011 to 30 June 2012 (this period is abbreviated as '2011–12' in this report). It also includes information on trends in the period 1995–96 to 2011–12. The report is arranged as follows:

- **Chapter 2** presents an overview of all newly incident traumatic SCI cases that occurred in 2011–12 and had been registered by 31 December 2014.
- **Chapter 3** provides an analysis of newly incident cases of persisting traumatic SCI for Australian residents, including trends since 1995–96 and demographic, social and clinical characteristics of cases with onset in 2011–12. This chapter is restricted to Australian residents, including cases sustained while overseas (but were later treated in an Australian SU), as incidence rates are calculated using the estimated resident population (ERP) of Australia aged 15 or older as provided by the Australian Bureau of

Statistics (ABS) (see Appendix A: Population denominators). Direct age-standardisation was employed using the Australian population in 2001 as the reference (ABS 2003).

- **Chapter 4** provides information on external causes of injury and factors associated with the SCI event for all 2011–12 traumatic cases, irrespective of survival to discharge, persistence of deficit or place of usual residence.
- **Appendix A: Data issues** provides summary information on the ASCIR, estimates used to calculate population rates, analysis methods, and information on data quality.
- **Appendix B: Other SCI cases** provides summary information for non-traumatic SCI cases admitted to a participating SU during 2011–12 and complications of medical care SCI cases that occurred during 2011–12.
- **Appendix C: Median duration of initial care** presents trends in median duration of initial care (see Box 1.3) for persisting traumatic SCI incidents since 1995–96, irrespective of residency.
- **Appendix D: Additional tables** consists of data underpinning the figures presented in Chapter 3.

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

Box 1.1: Defining traumatic spinal cord injury

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

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

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

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

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

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

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

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

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

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

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

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

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

Neurological level of injury at time of discharge is the measure used to describe the clinical characteristics of persisting traumatic SCI in Chapter 3. Neurological injury at time of admission is the measure used when describing external causes of traumatic SCI in Chapter 4, and when calculating median duration of initial care in Appendix C.

Box 1.3: Other terminology used in this report

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

(continued)

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

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

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

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

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

Box 1.4: Classifying mechanism of injury for SCI cases

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

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

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

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

(continued)

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

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

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

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

2 Traumatic SCI case registrations in 2011–12

This chapter provides an overview of traumatic SCI incident cases where the injurious event occurred between 1 July 2011 and 30 June 2012, and the case had been registered by 31 December 2014.

For the period, 2011–12, a total of 220 incident cases were reported to ASCIR by participating SUs. This is the lowest recorded annual figure recorded for new traumatic SCI incident cases and appears to be influenced by an uncharacteristically low number of cases reported for one of the participating SUs in New South Wales. In 2011–12, cases from this SU accounted for 13% of new traumatic incidences, whereas the average proportion for the previous 16 years was 20%.

Table 2.1: Traumatic SCI cases with onset in 2011–12 and reported to ASCIR by 31 December 2014

	Australian residents		Non-residents		Total[a]	
	Number	%	Number	%	Number	%
At discharge from spinal unit:						
Persisting deficit	[b]201	92	2	100	203	92
No ongoing neurological deficit	8	4	0	0	8	4
Died on ward	9	4	0	0	9	4
Total	**218**	**100**	**2**	**100**	**220**	**100**

(a) Any persons over the age of 15 who sustained an SCI in 2011–12 due to trauma are the focus of Chapter 4.

(b) Australian residents over the age of 15 who sustained an SCI in 2011–12 due to trauma and had a persisting neurological deficit on discharge from a participating SU are the focus of Chapter 3.

The demographic, social and clinical characteristics of the 201 Australian residents discharged alive with a persisting traumatic SCI are the focus of Chapter 3. This includes 10 Australian residents transferred to an Australian SU after incurring spinal injury overseas.

External causes of injury and other factors related to the injury event are reported in Chapter 4 for all 220 traumatic SCI cases with onset in 2011–12, irrespective of survival to discharge, persistence of deficit or place of usual residence.

All 9 Australian residents who died on the ward were men older than 60 (mean age 77, *SD* = 11). Two-thirds of these cases involved a fall from a height greater than 1 metre. Five of the deaths on the ward occurred within 3 weeks of the injurious event, while the remainder were within 3 months (maximum 119 days).

3 Persisting traumatic SCI

This chapter examines the characteristics of the 201 Australian residents who sustained a persisting traumatic SCI due to community injury during 2011–12 In accordance with the annual *Spinal cord injury, Australia* reports, the injured person must meet the following criteria for inclusion in this chapter:

- an Australian resident at time of injury
- reported to have a spinal cord deficit at discharge
- discharged alive.

This chapter is restricted to Australian residents, including 10 cases sustained while overseas (but were later admitted to an Australian SU), as incidence rates are calculated using the ERP of Australia aged 15 or older as provided by the ABS) (see Appendix A, Population denominators). Direct age-standardisation was employed using the Australian population in 2001 as the reference (ABS 2003).

Persisting traumatic SCI in 2011–12 and earlier years

In 2011–12, the age-standardised incidence rate of persisting traumatic SCI at ages 15 and older was 10.9 cases per million population (95% *CI*: 9.4, 12.4).

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 D.1 in Appendix D). According to this, the incidence rate of persisting traumatic SCI at age 15 and older tended to decline since 1995–96 by an average of 2.1% per year (95% *CI*: –1.5%, –2.7%).

While this trend was significantly different from zero ($p = 0.000$), it must be interpreted cautiously due to the known under reporting of SCI cases to the ASCIR generally. Furthermore, the declines shown in the age-standardised rate in Figure 3.1 for 2009–10 and 2011–12 correspond to years where the proportion of under reporting is thought to be higher than normal.

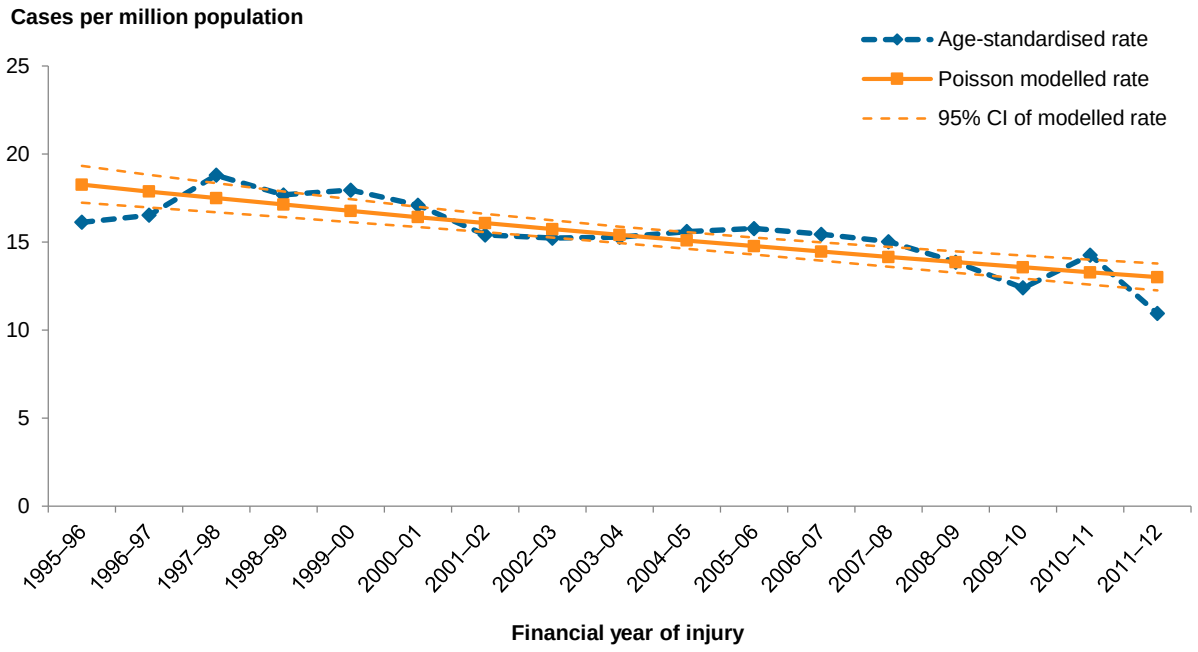


Figure 3.1: Trends in rates of persisting traumatic SCI cases aged 15 and older, by financial year of injury, Australian residents discharged alive, 1995–96 to 2011–12

Demographic and social characteristics of persisting traumatic SCI in 2011–12

Age and sex distribution

Eighty per cent of the 201 persisting traumatic SCI sustained in 2011–12 were male (161 cases). Figure 3.2 (and Table D.2) presents the age distribution of case counts and age-specific incidence rates for cases sustained in this period. In line with previous years, people aged 15–24 accounted for the greatest proportion of newly incidence cases aged 15 and older in Australia in 2011–12 (22%). Taking into account the population distribution of Australia however, the incidence rate was highest for those aged 65–74; 18.5 cases per million population for ages 65–74, compared with 14.3 cases per million population for ages 15–24.

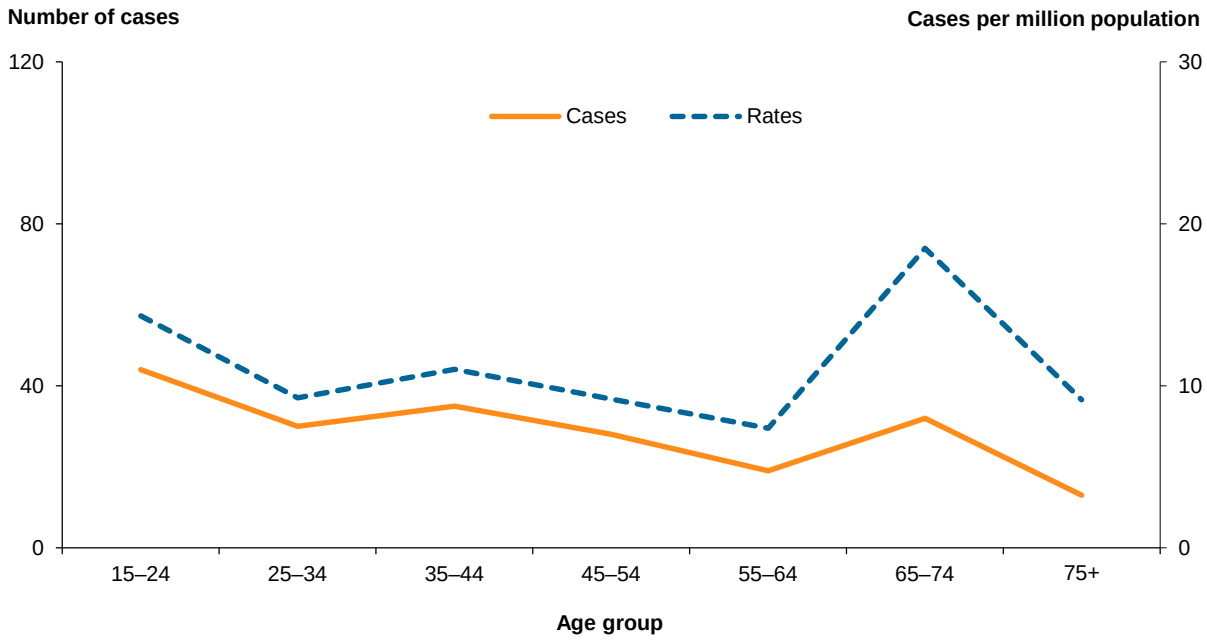


Figure 3.2: Counts and age-specific rates of persisting traumatic SCI, by age group, Australian residents discharged alive, 2011–12

Incidence rates of persisting traumatic SCI for males were higher across all age groups than those for females in 2011–12 (Figure 3.3 and Table D.3). Those aged 65–74 recorded the highest incidence rates for both sexes; 28.1 cases per million males and 9.1 cases per million females. The overall rate for males (17.8 cases per million population) was 4.1 times the rate for females (4.3 cases per million population). This is consistent with previously reported years.

Mean age at onset of persisting traumatic SCI was lower for males at 44 (*SD* = 19) compared with 48 (*SD* = 20) for females.

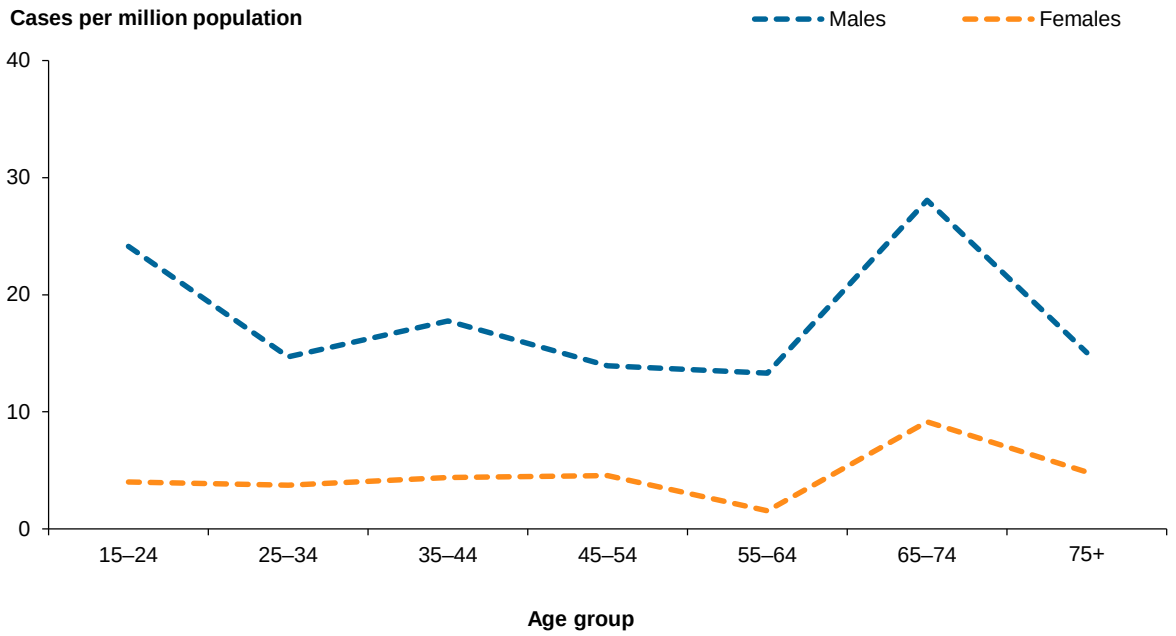


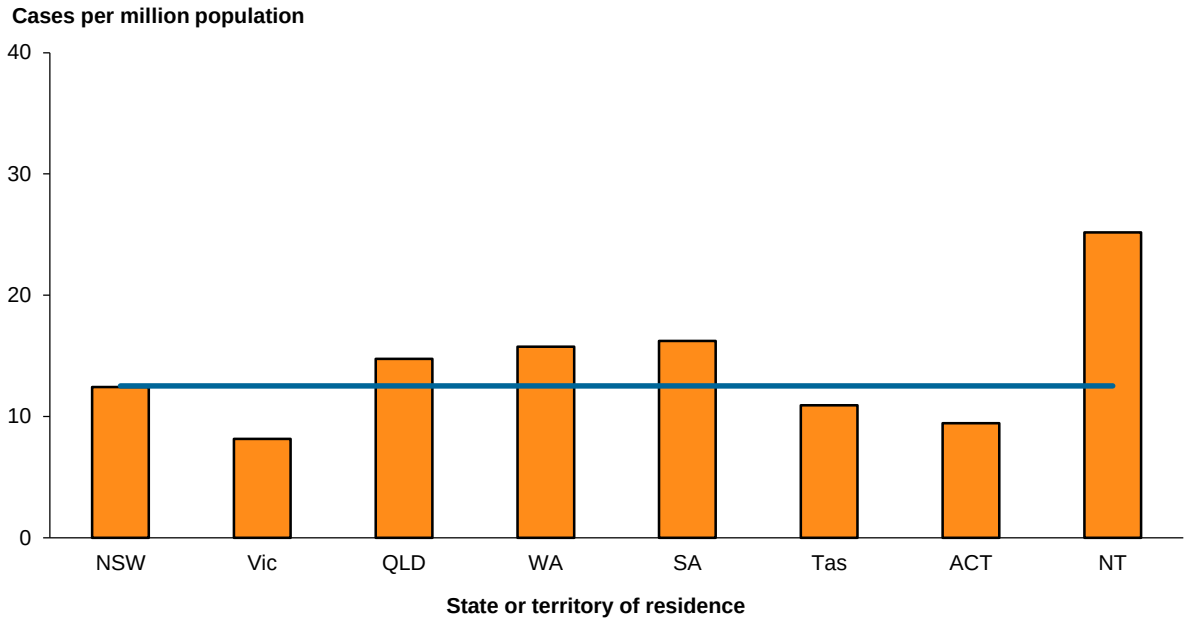
Figure 3.3: Age-specific rates of persisting traumatic SCI, by age group, by sex, Australian residents discharged alive, 2011–12

State and territory of usual residence

Figure 3.4 (and Table D.4) presents age-standardised incidence rates for persisting traumatic SCI by state or territory of usual residence. Due to the small number of cases in some jurisdictions, rates are based on aggregated state or territory case counts for the 3-year period 2009–10 to 2011–12.

Despite aggregation, rates are based on quite low numbers of cases, especially those for the smaller population jurisdictions (for example, less than 15 cases each in Tasmania, the Australian Capital Territory and the Northern Territory).

The 3-year rate for residents of Victoria (8.2 cases per million population) was lower than the 3-year national rate (12.5 cases per million population), while the 3-year rate for residents of the Northern Territory was the highest (25.2 cases per million population).



Note: Three-year Australia rate, aged 15 and older is shown as the solid horizontal line.

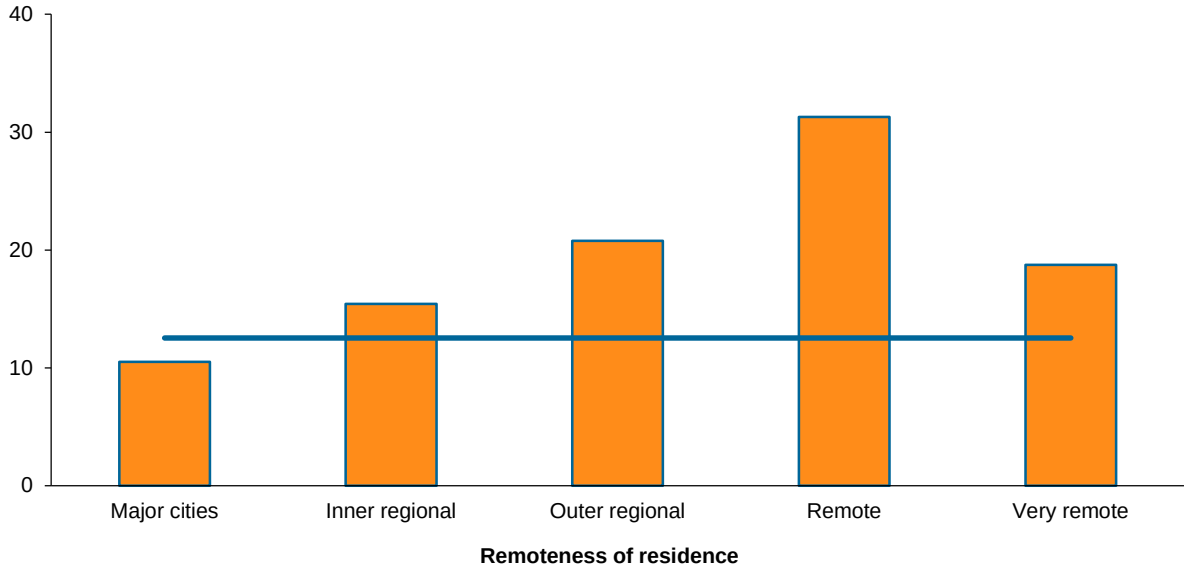
Figure 3.4: Age-standardised 3-year rates of persisting traumatic SCI cases, by state or territory of usual residence, Australian residents discharged alive, 2009–10 to 2011–12

Remoteness of residence and place of injury

As with state and territory of usual residence, rates for persisting traumatic SCI according to remoteness of residence are based on 3-year aggregated counts for each remoteness area and are presented in Figure 3.5 and Table D.5 (see Assignment to remoteness area in Appendix A).

The incidence rate for the 3-year period, 2009–10 to 2011–12, was highest for residents of *Remote Australia* (31.3 cases per million population) and lowest for residents of *Major cities* (10.5 cases per million population).

The 3-year rate for residents of *Major cities* was lower than the national 3-year rate, while the 3-year rates for *Inner* and *Outer regional* and *Remote* and *Very Remote Australia* were higher. Caution must be applied to interpreting rates for both *Remote* and *Very Remote Australia* however as they were calculated on fewer than 25 cases.



Note: Three-year Australia rate, aged 15 and older is shown as the solid horizontal line.

Figure 3.5: Age-standardised 3-year rates of persisting traumatic SCI, by remoteness of residence, Australian residents discharged alive, 2009–10 to 2011–12

Sixty-two per cent of new incident cases reported to ASCIR for 2011–12 involved residents of *Major cities* (Table 3.1). Approximately 5% lived in the two most remote areas. All except 1 of the 10 cases injured while overseas involved residents of *Major cities*.

More than a third (39%) of persisting traumatic SCI sustained in 2011–12 had insufficient information on the place of injury to allow for coding of remoteness of place of occurrence.

The remoteness of usual residence and place of injury were both known for 113 cases that occurred in Australia. Of these, the majority (80%) of injuries occurred in the same remoteness area as the person's usual place of residence, while 19% occurred in a more remote area. Only 2% occurred in a less remote area. (Note proportions equal more than 100 due to rounding.)

Table 3.1: Case counts of persisting traumatic SCI, by remoteness of usual residence, by area where injury occurred, Australian residents discharged alive, 2011–12

Area where injury occurred	Remoteness of usual residence					
	Major cities	Inner regional	Outer regional	Remote	Very remote	Total
	Case counts					
Major cities	57	1	0	0	0	58
Inner regional	7	20	1	0	0	28
Outer regional	5	1	8	0	0	14
Remote	6	0	1	3	0	10
Very remote	1	0	0	0	2	3
Australia, place not specified	39	16	17	6	0	78
Overseas	9	0	1	0	0	10
Total	**124**	**38**	**28**	**9**	**2**	**201**

Socioeconomic characteristics

Spinal cord injuries have enormous health, social and economic impacts on individuals, families, and communities. As well as the physical and psychological impact on those affected directly by SCI, there is also a heavy burden on those involved with the injured person. Socioeconomic factors that are known to be important in relation to injury and rehabilitation, such as marital status, employment status and level of educational at the time of onset of the SCI are recorded by the ASCIR and are described here. For example, Krause et al. (2010) found that being married was associated with lower mortality for people with SCI. A systematic review on the role of social support and social skills in people with SCI concluded that being married was an important source of social support only if the marriage was perceived positively (Müller et al. 2012).

In 2011–12, 48% of people who acquired a SCI were *Married* or in a de facto relationship at the time of injury, while 34% had never been married (Table 3.2).

Table 3.2: Marital status at onset of persisting traumatic SCI, by age group, Australian residents discharged alive, 2011–12

	15–24		25–64		65+		All ages	
Marital status	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Never married	36	82	29	26	3	7	68	34
Widowed	0	0	0	0	5	11	5	2
Divorced	0	0	10	9	5	11	15	7
Separated	1	2	7	6	0	0	8	4
Married (including de facto)	5	11	63	56	29	64	97	48
Not reported	2	5	3	3	3	7	8	4
Total[(a)]	**44**	**100**	**112**	**100**	**45**	**100**	**201**	**100**

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

A review of studies of return to work post-injury between 2000 and 2006 found that between 21% and 67% of people who were employed at onset of SCI returned to work after injury (Lidal et al. 2007). This review also noted that employment rates were found to be higher for cases who sustained their SCI during adolescence than later in adulthood. More recently, an Australian study also identified the contextual environment (such as social support, community integration and access to transport) as important factors in predicting a person's return to work at 2 years post-injury (Murphy et al. 2011).

In 2011–12, approximately three-quarters of SCI cases in their prime-working years (that is, aged between 25 and 64) were *Employed* at the time of injury (Table 3.3). Of those aged 15–24, 59% were *Employed* and 23% were *Not available for employment* either due to fulltime study (8 cases) or other commitments (2 cases).

Table 3.3: Employment status at onset of persisting traumatic SCI, by age group, Australian residents discharged alive, 2011–12

	15–24		25–64		65+		All ages	
Employment status	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Employed	26	59	83	74	10	22	119	59
Pensioner	1	2	10	9	27	60	38	19
Unemployed	3	7	13	12	2	4	18	9
Not available for employment	10	23	2	2	6	13	18	9
Not reported	4	9	4	4	0	0	8	4
Total[(a)]	**44**	**100**	**112**	**100**	**45**	**100**	**201**	**100**

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

The Lidal et al. study (2007) also found that a higher level of education at the time of SCI was associated with a higher likelihood of returning to work post-injury. Approximately one-third (32%) of people who sustained a persisting traumatic SCI in 2011–12 reported that they had a post-school qualification (Table 3.4). Forty per cent of these held *Tertiary/postgraduate* qualifications. Educational status was not reported for 32% of cases.

Table 3.4: Educational level attained at onset of persisting traumatic SCI, by age group, Australian residents discharged alive, 2011–12

	15–24		25–64		65+		All ages	
Education level	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Tertiary/postgraduate	6	14	17	15	3	7	26	13
Trade qualification/apprenticeship	7	16	11	10	2	4	20	10
Diploma or certificate	4	9	10	9	3	7	17	8
Other post school study	1	2	0	0	1	2	2	1
Highest available secondary school level	10	23	17	15	6	13	33	16
Left school aged 16 or over	1	2	8	7	6	13	15	7
Left school aged 15 or less	2	5	12	11	3	7	17	8
Never attended school	0	0	0	0	2	4	2	1
Still at school	3	7	1	1	0	0	4	2
Not reported	10	23	36	32	19	42	65	32
Total[(a)]	**44**	**100**	**112**	**100**	**45**	**100**	**201**	**100**

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

Clinical characteristics of persisting traumatic SCI in 2011–12

The monitoring of clinical information on SCI enables injury outcomes to be studied. It also indirectly provides an indication of the degree of support required by people with an SCI at discharge from hospital. Information on the neurological level of SCI, extent of injury to the cord, and the degree of impairment is routinely reported by SUs during the initial hospitalisation for the SCI, and at discharge from rehabilitation.

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 one financial year to not be discharged until the following financial year, sometimes later. Some cases had not been discharged at the time of preparing previous annual reports. Due to the time elapsed since the end of the reporting period for this report, all 201 cases had been discharged and extent level of injury was known for all cases (100% coverage).

Neurological level of injury at discharge

The distribution of neurological level of persisting traumatic SCI at discharge is presented in Figure 3.6 and Table D.6.

At discharge, just over half (53%) of the persisting traumatic SCI cases sustained during 2011–12 had an injury at one of the cervical spine segments, C1 to C8. The impairment resulting from this neurological level is referred to as tetraplegia.

More than a third of cases (39%) were discharged with a thoracic level injury. The remaining cases were discharged with a neurological injury located in the lumbar-sacral region, with all except one of these cases being in the lumbar region, L1 to L5. The impairment resulting from injury at the thoracic, lumbosacral neurological levels is referred to as paraplegia.

The most common neurological level of injury at discharge for 2011–12 cases was C4 (21%). Together, C4 and C5 accounted for 57% of cervical level injuries and 30% of cases at any level. Ten per cent of cases were discharged with neurological injury at the thoraco-lumbar junction, that is, injury at either T12 or L1.

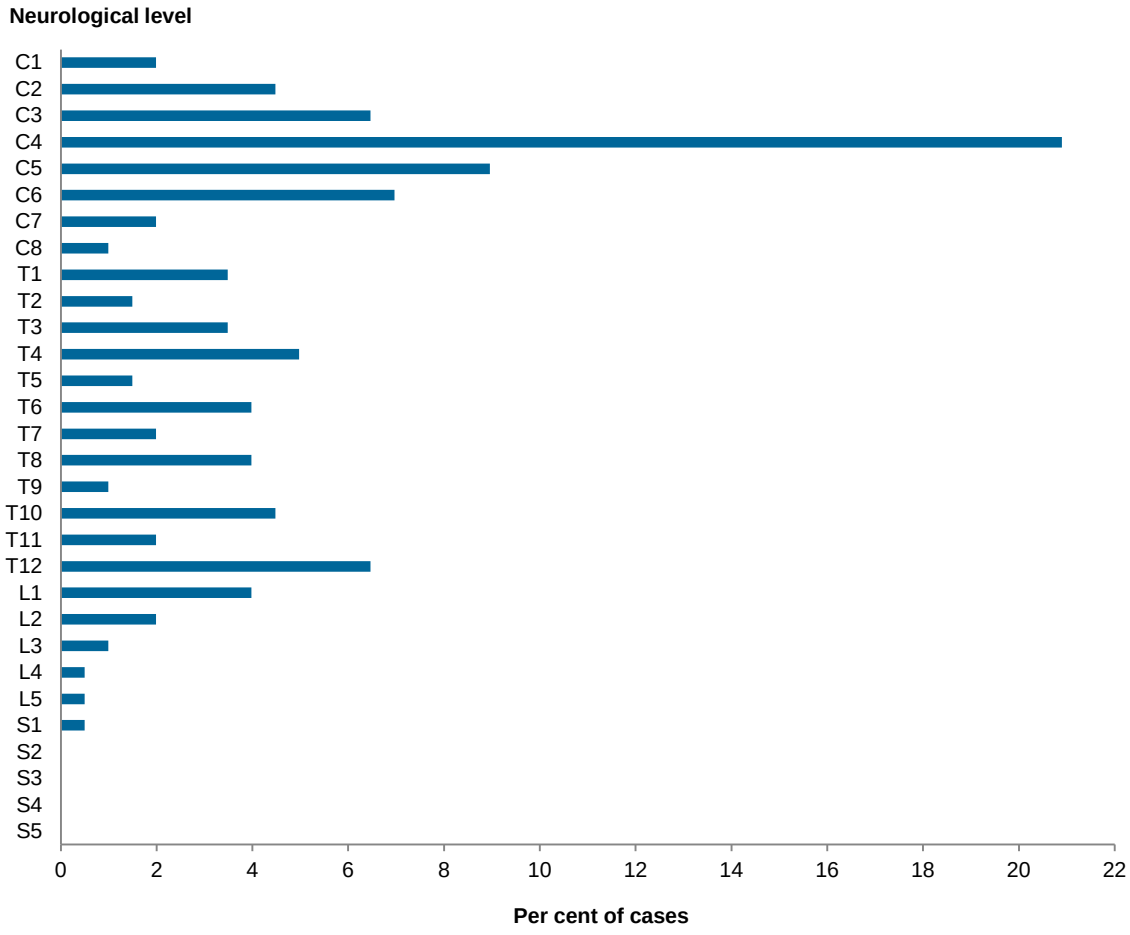


Figure 3.6: Neurological level of injury at discharge for persisting traumatic SCI cases, Australian residents discharged alive, 2011–12

Neurological impairment at discharge

Forty-two per cent of persisting traumatic SCI cases reported to the ASCIR in 2011–12 were categorised as incomplete tetraplegia on discharge (Table 3.5). Cases in this category had been assessed as having a cervical level injury, and an ASIA Impairment Scale grade of either B (some sensory but no motor function preserved), C or D (some motor function preserved).

The next most common (23%) impairment at discharge was complete paraplegia at the thoracic level. Cases of this type had been assessed as neurological level of injury between T1 and T12, with no sensory or motor function preserved in the sacral segments S4–S5, ASIA Impairment Scale A.

Cases involving the lumbosacral region were mostly discharged with incomplete paraplegia.

Table 3.5: Neurological impairment at discharge for persisting traumatic SCI, Australian residents discharged alive, 2011–12

Neurological impairment	Number of cases	%
Tetraplegia		
Cervical		
Complete tetraplegia	27	13
Incomplete tetraplegia	79	39
Paraplegia		
Thoracic		
Complete paraplegia	47	23
Incomplete paraplegia	31	15
Lumbosacral		
Complete paraplegia	2	1
Incomplete paraplegia	15	8
Total	**201**	**100**

Length of stay in spinal unit

Table 3.6 presents the median length of stay (LOS) in a SU for persisting traumatic SCI cases in 2012–13 by neurological impairment at discharge. The 5th and 95th percentiles are also provided to provide an indication of the patterns of variation in LOS between types of impairment. Longer LOS values are more likely for SUs that provide both acute and rehabilitation phases of care.

For SCI cases sustained during 2011–12, tetraplegia (cervical/neck level) cases had longer median stays in one of the participating SUs than did paraplegia (lower spine levels) cases. In particular, cases of complete tetraplegia recorded the highest median LOS at 195 days, or approximately 6.5 months (5th percentile 77 days, 95th percentile 440 days).

Table 3.6: Length of stay in spinal unit for persisting traumatic SCI, by neurological impairment at discharge, Australian residents discharged alive, 2011–12

Neurological impairment at discharge	Number of cases	Median LOS (days)	5th Percentile (days)	95th Percentile (days)
Tetraplegia				
Cervical				
Complete tetraplegia	27	195	77	440
Incomplete tetraplegia	79	140	23	321
Paraplegia				
Thoracic				
Complete paraplegia	47	129	35	342
Incomplete paraplegia	31	107	14	402
Lumbosacral				
Complete paraplegia	2	41	13	69
Incomplete paraplegia	15	90	23	286
Total	**201**	**132**	**23**	**342**

Information on trends in the median duration of initial care (DIC) for persisting traumatic SCI, as measured from the date of injury to date of discharge from a participating SU to a place of residence, is presented in Appendix C. This trends section is new to the *Spinal cord injury, Australia* series. The focus of LOS is the period of care in a SU, whereas DIC considers the entire period of injury to the end of admitted patient care.

4 External causes of SCI in 2011–12

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 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 220 cases of traumatic SCI with onset in 2011–12 that were treated in participating SUs and had been reported to ASCIR by 31 December 2014. This number includes the 201 cases of persisting traumatic SCI that are the subject of Chapter 3, as well as 8 cases in which a person admitted to a SU had no neurological deficit at discharge (that is, not persisting cases); 9 cases where a person with traumatic SCI died while an inpatient of a participating SU; and 2 non-residents of Australia who were admitted to a participating SU due to SCI sustained in 2011–12 (see Table 2.1).

Mechanism of injury

Falls (45%) were the leading mechanism of injury for cases of traumatic SCI sustained in 2011–12, followed by *Land transport crashes* (38%) (Table 4.1). This differs to previous reports in this series, where *Land transport crashes* have been more frequent than *Falls*. Characteristics of the cases due to each of the mechanisms shown in Table 4.1 are presented in following subsections. The method for grouping cases by mechanism is described in Appendix A.

Table 4.1: Mechanism of injury of all traumatic SCI, by sex, 2011–12

	Males		Females		Total	
Mechanism of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**
Land transport crash						
Motor vehicle occupant	27	15	6	13	33	15
Unprotected land transport user	50	29	0	0	50	23
Fall						
Low fall (same level or <1 metre)[(a)]	21	12	16	36	37	17
High fall (>1 metre)	46	26	17	38	63	29
Water-related	13	7	1	2	14	6
Heavy falling object	5	3	0	0	5	2
Horse-related	0	0	3	7	3	1
Football	3	2	0	0	3	1
Other and unspecified causes	10	6	2	4	12	5
Total[(b)]	**175**	**100**	**45**	**100**	**220**	**100**

(a) Includes falls from unspecified heights.

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

Land transport crashes involving *Unprotected land transport users* (29%) were the most common cause of traumatic SCI in 2011–12 for cases aged 15–24 (Table 4.2). *Land transport crashes* involving *Unprotected land transport users* and *High falls* were reported in equal numbers for cases aged 25–64; each mechanism involved 33 cases or 28%. *Low falls* accounted for 43% of traumatic SCI among cases aged 65 and older. Further data on the age-distribution of cases is presented in each relevant subsection.

Table 4.2: Mechanism of injury of all traumatic SCI, by age group, 2011–12

	15–24		25–64		65+		All ages	
Mechanism of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Land transport crash								
Motor vehicle occupant	9	18	17	14	7	13	33	15
Unprotected land transport user	14	29	33	28	3	6	50	23
Fall								
Low fall (same level or <1 metre)[(a)]	0	0	14	12	23	43	37	17
High fall (>1 metre)	11	22	33	28	19	36	63	29
Water-related	5	10	9	8	0	0	14	6
Heavy falling object	1	2	4	3	0	0	5	2
Horse-related	0	0	3	3	0	0	3	1
Football	2	4	1	1	0	0	3	1
Other and unspecified causes	7	14	4	3	1	2	12	5
Total[(b)]	**49**	**100**	**118**	**100**	**53**	**100**	**220**	**100**

(a) Includes falls from unspecified heights.

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

Approximately half (54%) of all traumatic SCI cases reported for 2011–12 sustained an injury to the cervical spine (Table 4.3). Of these cervical injury cases, one-quarter were due to a *High fall*, while 19% were due to a *low fall*. *Land transport crashes* involving *Motor vehicle occupants* contributed 18% of cervical injury cases and *Unprotected land transport users* accounted for 15%. All traumatic SCI cases sustained while playing *Football* or rugby in this period resulted in tetraplegia. Cases of *Water-related SCI* also generally resulted in tetraplegia (13 of 14 cases).

More than one-third of thoracic level injuries were sustained by *Unprotected land transport users* (37%) and a third (33%) were due to a *High fall*. One injury case that was in-scope for ASCIR was found to have no SCI.

Table 4.3: Mechanism of injury for all traumatic SCI, by neurological level of injury at admission, 2011–12

	Tetraplegia		Paraplegia					
	Cervical		Thoracic		Lumbosacral		Total	
	Number	%	Number	%	Number	%	Number	%
Land transport crash								
Motor vehicle occupant	22	19	8	10	3	15	33	15
Unprotected land transport user	18	15	29	37	3	15	50	23
Fall								
Low fall (same level or <1 metre)[(a)]	22	19	10	13	3	15	37	17
High fall (>1 metre)	30	25	26	33	7	35	63	29
Water-related	13	11	0	0	1	5	14	6
Heavy falling object	3	3	2	3	0	0	5	2
Horse-related	1	1	2	3	0	0	3	1
Football	3	3	0	0	0	0	3	1
Other and unspecified causes	6	5	2	3	3	15	12	5
Total[(b)(c)]	**118**	**100**	**79**	**100**	**20**	**100**	**220**	**100**

(a) Includes falls from unspecified heights.

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

(c) Total includes 3 cases where data on neurological level of injury was not available.

Land transport crashes

As noted previously in Table 4.1, more than a third (38%) of traumatic SCI cases reported to ASCIR for the 2011–12 reporting period were due to *Land transport crashes*, and after *Falls*, these were the second most common cause of traumatic SCI.

As shown in Table 4.4, the overwhelming majority of injured land transport users were males (93%), and of these 43% were motorcycle drivers. All female land transport users who sustained a SCI during 2011–12 were *Motor vehicle occupants*, with cases equally divided between drivers and passengers.

Table 4.4: Land transport user types for all traumatic SCI, 2011–12

	Males		Females		Total	
Land transport user type	**Number**	**%**	**Number**	**%**	**Number**	**%**
Motor vehicle driver	18	23	3	50	21	25
Motor vehicle passenger	9	12	3	50	12	15
Motorcycle driver[(a)]	33	43	0	0	33	40
Motorcycle passenger	0	0	0	0	0	0
Pedal cyclist or pedal cycle passenger	12	16	0	0	12	15
Pedestrian	5	7	0	0	5	6
Total[(b)]	**77**	**100**	**6**	**100**	**83**	**100**

(a) One quad-bike rider is included in the motorcycle driver user group for this reporting period.

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

The mean age for *Motor vehicle occupants* who sustained a traumatic SCI during 2011–12 was 42 (*SD* = 19), and 39 (*SD = 15*) for *Unprotected land transport users*.

Information of 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 registrations forms for ASCIR. Of the *Motor vehicle occupants* who sustained a spinal injury in 2011–12, 52% were reported to have worn a seatbelt at the time of the crash. A seatbelt was reported not to have been used by 15% and information on seatbelt use was not provided for the remaining 33%.

The most common type of event reported for *Motor vehicle occupants* in 2011–12 was a rollover event with 17 confirmed cases (52%). (Information on impact with a motor vehicle was not available in 27% of cases.) Forty-two per cent reported impacting with a roadside hazard such as a tree or utility supply poles, while 21% reported impact with another vehicle. In 5 cases (15%), the person was reported to have been ejected from the motor vehicle. These types of events are not mutually exclusive and more than one event may be reported for the same case. For instance, in this reporting period, 9% of *Motor vehicle occupants* reported both a rollover event and being ejected from the vehicle (3 cases).

Based on descriptive text provided to ASCIR, almost half of cases involving *Motor vehicle occupants* (49%) were reported to have been travelling at ‘high speed’ or at a speed of 80 km or more when the crash occurred. Other noted circumstances include rear impact collisions while own vehicle was stationary at an intersection or traffic lights, loss of control of vehicle in wet weather or on gravel roads, and intoxicated drivers.

Cervical spine injuries were most frequent (67%) for *Motor vehicle occupants* (Table 4.3). Twelve of these 22 cases reported incomplete injuries.

Approximately three-quarters (76%) of *Land transport crashes* involving *Motor vehicle occupants* occurred on public streets or highways. Other places where crashes occurred included on a racetrack and in a bush environment. Type of place were injury occurred was unspecified in 18% of cases.

Two-thirds (66%) of cases involving *Unprotected land transport users* in 2011–12 were motorcyclists, all of whom were drivers. Pedal cyclists accounted for 24% of cases in this land transport user group, and 10% were pedestrians. One quad-bike rider was included in the motorcycle group, while one skateboarder was included in the pedestrian group.

Nearly two-thirds of motorcyclists who sustained a traumatic SCI in 2011–12 were aged 15–24 (33%), or 35–44 (30%). The age distribution was different for pedal cyclists, with 42% recorded in the 45–54 category.

Events reported for cases involving *Unprotected land transport users* include impact with a motor vehicle, and impact with other hazards such as trees, kangaroos, roadside curbs and median strips.

Thoracic level injuries accounted for 29 of the 50 *unprotected land transport user* SCI cases sustained in 2011–12 (Table 4.3), with 22 of these being complete injuries. However, neurological impairment differed between the types of cyclists, with complete thoracic level injuries being most frequent (58%) for motorcyclists, while incomplete cervical level injuries were more common (67%) among pedal cyclists.

Fifty-four per cent of *Unprotected land transport users* cases occurred on public roads and highways, 10% occurred in a public park, oval or race-track, and 8% occurred in bushland or undeveloped areas. One case occurred on a farm, and place was unspecified for 13 cases (26%).

Falls

Fall from a height greater than 1 metre (hereafter referred to as a *High fall*) accounted for 29% of cases of traumatic SCI in 2011–12, and a fall on the same level or from a drop of less than 1 metre (hereafter referred to as a *Low fall*) accounted for 17% of cases (Table 4.1). In some instances, the height of the fall is not specified and these cases are traditionally coded as a *Low fall*. *Falls* contributed to a greater proportion of traumatic SCI among females, 73%, compared with 38% among males, although the number of cases was larger for males than females (67 cases compared with 33).

The mean age for *High falls* was 48 (*SD* = 21) compared with 65 (*SD* = 14) for *Low falls*.

While most *Falls* are *Unintentional* (that is, accidents), 11% of SCI cases due to a *High fall* were considered to be the result of *Intentional self-harm*.

Falling in a place of residence, including care homes for the elderly, frail or sick, was most common (62%) for *Low falls*, but less so for *High falls* (49%). Type of place where the injury occurred was not reported or was unspecified in 24% of *Low falls* and 29% of *High falls* cases.

Cervical level injuries were most frequent among both *Low* and *High fall* SCI cases in 2011–12 (Table 4.3), with 62% and 48%, respectively. Of these, 17 *Low* and 20 *High fall* cases were incomplete tetraplegia (that is, with sacral sparing).

Water-related

Six per cent of traumatic SCI cases reported to ASCIR for 2011–12 were due to *Water-related* events, and all except one of the 14 cases involved males (Table 4.1). The

majority of SCI in this category were due to diving into water (10 cases), while 3 cases were due to being dumped by a wave. The single remaining case involved surfing but specific information on how the injury came to be sustained was not available.

The mean age for *Water-related* SCI in 2011–12 was 30 (*SD* = 13).

Seaside beaches and oceans were the most common place where *Water-related* SCI occurred (10 cases). The remaining cases occurred in swimming pools and at an aquatic recreation and sport area.

All except 1 *Water-related* SCI case had a neurological impairment at the cervical spine (Table 4.3). Seven of these 13 cervical level cases were incomplete injuries.

Heavy falling objects

Heavy falling objects accounted for 5 (2%) traumatic SCI cases in 2011–12, and all cases were male (Table 4.1). Included in this category are cases where the person was injured by a falling tree branch (2 cases), machinery (2 cases) or a motor vehicle (1 case).

Cases involving *Heavy falling objects* ranged in age from 20 to 62 (mean age 47).

The types of places where these events occurred were either at home (2 cases) or on a farm (2 cases). One case was recorded as unspecified place.

Three cases in this category sustained a cervical level injury and 2 were thoracic (Table 4.3).

Horse-related

All 3 *Horse-related* cases were female, and these accounted for 1% of 2011–12 SCI cases overall. Cases ranged in age from 30 to 41.

Two cases occurred on racetracks while the person was working for income.

Two of the 3 *Horse-related* SCI cases sustained a neurological injury at the thoracic spine (Table 4.3), both of these were complete.

Football

A further 1% of traumatic SCI cases in 2011–12 were due to events that occurred while playing Australian Rules football (2 cases) or rugby (1 case). All cases were male, and ranged in age from 23 to 54.

All *Football* cases involved a cervical level injury, with 2 being incomplete injuries.

Other and unspecified causes

Twelve (5%) traumatic SCI cases for 2011–12 were due to causes other than those already described above. Included in this residual category were 5 cases due to assault with a firearm or knife, 3 cases involving wrestling, as well as 1 case each involving a light aircraft, a tractor, snowboarding, and while playing netball.

Eighty-three per cent of cases were male (Table 4.1), and the mean age was 28 (*SD* = 14).

Half of the cases in this residual category sustained an injury at the cervical spine (Table 4.3), 4 of which were incomplete.

One-third (33%) of *Other and unspecified cause* cases occurred at home, and one-quarter (25%) occurred in public spaces used for recreation or sporting activities.

Activity at time of injury

The classification used for reporting type of activity is based on the one in the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification* (ICD-10-AM) (NCCC 2013). It includes the following categories: *While engaged in sports or leisure, While working for income, While engaged in other types of work (unpaid*)*, While undertaking a personal activity* (such as resting, eating or showering) 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 in Table 4.5.

Thirty-six per cent of traumatic SCI cases sustained during 2011–12 occurred when the person was participating in *Sports or leisure* and the majority (81%) of these were males. Young people aged 15–24 made up the greatest proportion (30%) of *Sports or leisure* cases, with similar proportions observed for male cases (29%) and female cases (33%). The most frequently reported mechanism of injury for cases where activity was *Sports or leisure* were *Unprotected land transport users* (32%), followed by *High fall*s (28%) and *Water-related* activities (18%). Included in the *High falls* cases were one case each for snow-skiing, trampolining, rock-climbing and hiking. Overall, alcohol was noted as a contributing factor in 18% of *While engaged in sports or leisure* SCI cases.

The next most common type of activity when the spinal injury occurred was *While working for income* (11%). Three-quarters (75%) of these cases involved males. More than one-half (54%) of the cases injured *While working for income* were aged between 35 and 54. *High falls* accounted for more than one-third (38%) of cases sustained *While working for income*. Land transport users accounted for approximately another third (34%). Land transport users included 3 cases travelling to or from work at the time of injury. SCI cases *While working for income* occurred on public roads (29%), and in and around residential dwellings, aged care facilities, shops, racetracks and farms and other specified public places. Place of occurrence was not specified in 21% of the cases.

A further 10% of cases were sustained *While engaged in other types of work (unpaid)* activities, such as repairing a motor vehicle, gardening, fixing a roof or painting. The majority (71%) of these cases involved a *High fall*, including falling off a ladder (5 cases), rooftop (4 cases) and out of trees (2 cases). More than three-quarters (81%) of these cases occurred at home or on a farm. One case occurred in a public area and place of occurrence was unspecified for 3 cases. Fifty-seven per cent of cases injured *While engaged in other types of work (unpaid)* were aged 65 and older, and 18 of the 21 cases were males (86%).

Five per cent of cases in 2011–12 sustained a traumatic SCI *While undertaking a personal activity (*or while being cared for). All except one of these cases involved a *Low fall*. Circumstances described for these *Falls* included falling while in or on the way to the bathroom, getting out of bed, while in the kitchen, and tripping on carpet or low furniture. Three–quarters (75%) of these cases were males, and overall, 2 out of 3 cases were aged 55 or older (67%).

More than 50% of cases in the O*ther and unspecified activity* classification involved *Land transport crashes* (Table 4.5). In particular, one-third (33%) involved *Motor vehicle occupants*, and almost one-quarter (24%) were *Unprotected land transport users* including motorcyclists and pedestrians. This residual activity category also includes 6 *Intentional self-harm* due to *High fall* cases. As with other activity categories, more males sustained a traumatic SCI than females, 79% compared with 21%. The most common age group injured for males was 15–24 (27%), while females in this same age group only accounted for 11% of female cases.

Table 4.5: Traumatic SCI cases, by mechanism of injury, by type of activity, 2011–12

	Sports and leisure		Working for income[a]		Other type of work		Personal activity[b]		Other and unspecified activity		Total	
Mechanism of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Land transport crash												
Motor vehicle occupant	2	3	3	13	0	0	0	0	28	33	33	15
Unprotected land transport user	25	32	5	21	0	0	0	0	20	24	50	23
Fall		0										
Low fall (same level or <1 metre)[c]	6	8	2	8	2	10	11	92	16	19	37	17
High fall (>1 metre)	22	28	9	38	15	71	0	0	17	20	63	29
Water-related	14	18	0	0	0	0	0	0	0	0	14	6
Heavy falling object	0	0	1	4	3	14	0	0	1	1	5	2
Horse-related	1	1	2	8	0	0	0	0	0	0	3	1
Football	3	4	0	0	0	0	0	0	0	0	3	1
Other and unspecified causes	6	8	2	8	1	5	1	8	2	2	12	5
Total[d]	**79**	**100**	**24**	**100**	**21**	**100**	**12**	**100**	**84**	**100**	**220**	**100**

(a) Includes travel to and from work.

(b) Includes being nursed or cared for.

(c) Includes falls from unspecified heights.

(d) Percentage may not equal 100, due to rounding.

Appendix A: Data issues

Data quality statement

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

Summary of key data quality issues

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

Description

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

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

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

Institutional environment

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

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

The AIHW also plays a role in developing and maintaining national metadata standards. This work contributes to improving the quality and consistency of national health and welfare statistics. The AIHW works closely with governments and non-government organisations to achieve greater adherence to these standards in administrative data collections, to promote national consistency and comparability of data and reporting.

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

The *Australian Institute of Health and Welfare Act 1987*, in conjunction with compliance to the *Privacy Act 1988*, 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 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 *Australian Institute of Health and Welfare Act 1987*. The NISU is responsible for the security, proper operation, access to and use of ASCIR data. The Director, Professor Harrison, is responsible to the AIHW for ensuring that the operation of the ASCIR and the use of ASCIR data comply with AIHW policies and procedures.

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

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

Timeliness

The reference period for this report is 2011–12.

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 that period.

The date of closure for 2011–12 data was 31 December 2014. A snapshot file of the ASCIR was taken on 29 January 2016.

Data for 2008–09 to 2012–13 and a summary report for that period are planned to be released in 2018.

Accessibility

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

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

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

Interpretability

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

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

Relevance

The Australian Spinal Cord Injury Register contains records of newly incident cases of SCI which occur in Australia and overseas to Australian residents since 1995 and up to 2012–13. Cases for 2013–14 onwards are currently being registered.

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

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

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

Accuracy

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

Ideally, all cases would be added to the ASCIR during the initial period of hospitalisation following injury. However, in practice there has often been a substantial time lag between a patient's admission and the start of the case registration process. Each SU has a different

system for completing and compiling case registrations before submission to the NISU, and delays at different stages of the process occur from time to time.

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

Known contributing factors in underestimation include that the person a) did not consent to be included in the register, b) was released from hospital without the need for admitted patient rehabilitation, c) was admitted to another rehabilitation unit that does not provide data to the ASCIR or d) died before admission to a specialist SU occurred.

Coherence

The ASCIR includes data for each year from 1995–96 to 2012–13.

The data reported for 2011–12 are broadly consistent with data reported for the ASCIR for previous years.

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

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

Box A.1: Change in definition of traumatic spinal 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 (2–5 in most years), which would previously have been reported in the *Other and unspecified causes* category of the 'External causes' chapter in the annual *Spinal cord injury, Australia* series, are now included in an appendix with non-traumatic cases.

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

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

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

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

Population denominators

Population data were obtained from the ABS. Incidence rates have been calculated as cases per million of the estimated resident population (ERP) of Australia. The ERPs for jurisdiction, sex and 5-year age groups was sourced from *3101.0 Australian Demographic Statistics, June 2013*; released Tuesday 17 December 2013 (ABS 2013a). ERPs are calculated and published by the ABS to 30 June, and:

- for 2007–2011 have a status of Final
- for 1992–2006 have a status of Final (recast)
- before 1992 have a status of Final

  and
- are by State, Territory and Australia (including Other Territories).

ERPs for remoteness was sourced from *3235.0—Population by Age and Sex, Regions of Australia, 2012;* released Friday 30 August 2013 (ABS 2013c). The ABS advise the ERPs in this issue are final for 2001 to 2011 and preliminary for 2012.

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 2012b).

As with Australian Census data, place of residence at the time on injury for the ASCIR is self-reported and some visitors to Australia may have reported an address in Australia as their place of residence, rather than apply this technical distinction. This may have resulted in some non-residents being assigned *Australian resident* status in this report.

Use of confidence intervals

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

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

Assignment to reported mechanism of injury

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

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

The method for allocating cases into mechanism of injury categories shown in Table A.1 was a 3-step process as follows:

- Step 1: Draft allocation to the *Land transport crashes*, *Falls* and *Horse-related* SCI on the basis of the numeric code values in the ‘Main External Cause A’ data field.

- Step 2: Draft allocation to the next 3 categories on the basis of the presence of key words 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 A.1: Assignment to reported mechanism of injury

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

Assignment to remoteness area

The ABS Remoteness Structure is a common measurement used in Australian health data and provides a classification system which provides an indication of road distances people may have to travel to access their nearest service centres. The Remoteness Structure was developed by the Australian Government in 1997 and had a methodology update in 2011 (ABS 2013b). The classification of remoteness areas 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 categories for both place of residence and place of injury were calculated using 2 interactive map look-up tools.

The first step involved converting postcodes recorded in the ASCIR to remoteness areas using Table 3 in the Postcode 2011 to Remoteness Area 2006 Data Cube (ABS 2012a).

Where a postcode had more than 1 remoteness area assigned, the street address or location recorded in the ASCIR was used to search the Department of Health DoctorConnect website <http://www.doctorconnect.gov.au/internet/otd/Publishing.nsf/Content/locator>.

Appendix B: Other SCI cases

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

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

Non-traumatic SCI cases

In 2011–12, 41 males (54%) and 35 females with a non-traumatic SCI consented to being included in the ASCIR based on being admitted to one of the participating SUs between 1 July 2011 and 30 June 2012.

The mean age of non-traumatic SCI cases admitted in 2011–12 was 55 (*SD* = 17). The median duration of stay in a participating SU for non-traumatic SCI was 63 days (5th percentile 13 days, 95th percentile 307 days).

Non-traumatic SCI was most commonly secondary to osteomyelitis, myelopathy, tumours or an epidural abscess.

Complication of medical care SCI cases

Cases included here arose in the course of surgery or as a result of other medical care, commonly during repair of an abdominal aortic aneurysm, laminectomy or spinal decompression for pain reduction, removal of tumours, epidural haemorrhage due to anaesthesia or long-term anti-coagulant use, where the record states the onset of paralysis was post intervention.

Ten male (56%) and 8 female SCI cases with an injury date between 1 July 2011 and 30 June 2012 arose as a complication of medical care. The mean age of complication of medical care SCI cases in 2011–12 was 58 (*SD* = 16).

Appendix C: Median duration of initial care for persisting traumatic SCI

This appendix provides summary information on duration of initial care (DIC) for ASCIR cases with persisting SCI due to trauma that was sustained at ages 15 or older, commencing with 1995–96.

For the purposes of this report, **duration of initial care** (DIC) is conceptualised as:

- The period from the date of injury to the date of discharge from a participating SU to the person's previous home, or to a new home, nursing home or other accommodation. 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 often not all, is provided in a SU.

DIC is calculated as the difference, in days, between date of injury and date of discharge from SU, as recorded in the ASCIR, provided that the person did not die while in a SU, or the person was not discharged to another hospital or rehabilitation setting where care for their SCI was expected to continue.

The median DIC has been used as the summary measure because it is not greatly affected by outlier values. The data are presented by neurological level (cervical, thoracic, or lumbosacral), extent of lesion (complete or incomplete) and year of injury. Level and extent of lesion are as assessed on admission to a participating SU (SU). Cells in Table C.1 have been shaded if they are based on fewer than 10 cases, in which case the median DIC should be interpreted cautiously.

DIC (the subject of this appendix) may be longer than length of stay in a SU (the subject of Table 3.6) and the inclusion criteria for this appendix differ from those for Table 3.6. Hence, values in Appendix C and in Table 3.6 should not be expected to be the same.

Table C.1: Median duration of initial care for persisting traumatic SCI, by financial year of injury, by neurological impairment at admission

	Median duration of initial care (days)						
	Cervical		Thoracic		Lumbosacral		
Financial year of injury	Complete	Incomplete	Complete	Incomplete	Complete	Incomplete	Proportion included[(a)]
1995–96	261	76	144	134	83	49	*88%*
1996–97	220	104	148	102	97	67	*86%*
1997–98	204	68	143	92	125	69	*93%*
1998–99	245	89	157	84	111	61	*90%*
1999–00	232	80	149	70	106	79	*91%*
2000–01	254	95	136	121	145	67	*88%*
2001–02	224	98	155	106	104	54	*90%*
2002–03	201	95	142	103	112	54	*92%*
2003–04	238	62	138	104	131	61	*88%*
2004–05	227	103	145	111	179	52	*86%*
2005–06	252	139	143	111	104	97	*88%*
2006–07	220	124	161	128	123	74	*91%*
2007–08	228	113	146	104	108	88	*93%*
2008–09	247	143	151	132	106	88	*93%*
2009–10	261	174	164	127	133	54	*87%*
2010–11	227	128	165	115	88	60	*85%*
2011–12	235	123	134	146	117	117	*90%*

(a) Proportion is based on the total number of eligible persisting traumatic SCI cases. Cases omitted are mainly those that were discharged from the SU to another hospital, where initial care might have continued.

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

Appendix D: Additional tables

The data included in these additional tables underpin the figures presented in Chapter 3. As a reminder, the inclusion criteria for Chapter 3 was that the SCI must have occurred between 1 July 1995 and 30 June 2014, and the person must have been:

- an Australian resident at time of injury
- reported to have a spinal cord deficit at discharge
- discharged alive.

Table D.1: Trends in persisting traumatic SCI, by financial year of injury, Australian residents discharged alive, 1995–96 to 2011–12

Financial year of injury	Age-standardised rate per million population	Poisson modelled rate per million population	Upper 95% CI	Lower 95% CI
1995–96	16.1	18.3	19.3	17.2
1996–97	16.5	17.9	18.8	17.0
1997–98	18.8	17.5	18.3	16.7
1998–99	17.7	17.1	17.9	16.4
1999–00	17.9	16.8	17.4	16.1
2000–01	17.1	16.4	17.0	15.9
2001–02	15.4	16.1	16.6	15.6
2002–03	15.2	15.7	16.2	15.3
2003–04	15.3	15.4	15.9	14.9
2004–05	15.6	15.1	15.6	14.6
2005–06	15.8	14.8	15.3	14.3
2006–07	15.4	14.5	15.0	13.9
2007–08	15.0	14.2	14.7	13.6
2008–09	13.9	13.9	14.5	13.3
2009–10	12.4	13.6	14.2	12.9
2010–11	14.3	13.3	14.0	12.6
2011–12	10.9	13.0	13.8	12.3

Table D.2: Counts and age-specific rates of persisting traumatic SCI, by age group, Australian residents discharged alive, 2011–12

Age group	Cases	Rate per million population
15–24	44	14.3
25–34	30	9.3
35–44	35	11.0
45–54	28	9.2
55–64	19	7.4
65–74	32	18.5
75+	13	9.1

Table D.3: Age-specific rates of persisting traumatic SCI, by sex, by age group, Australian residents discharged alive, 2011–12

Age group	Cases	Rate per million population
Males		
15–24	38	24.1
25–34	24	14.7
35–44	28	17.8
45–54	21	13.9
55–64	17	13.3
65–74	24	28.1
75+	9	15.1
Females		
15–24	6	4.0
25–34	6	3.7
35–44	7	4.4
45–54	7	4.6
55–64	2	1.5
65–74	8	9.1
75+	4	4.8

Table D.4: Age-standardised 3-year rates of persisting traumatic SCI cases, by state or territory of usual residence, Australian residents discharged alive, 2009–10 to 2011–12

State or territory	Cases	3-year rate per million population
New South Wales	215	12.4
Victoria	108	8.2
Queensland	158	14.8
Western Australia	90	15.8
South Australia	68	16.2
Tasmania	14	10.9
Australian Capital Territory	9	9.5
Northern Territory	14	25.2
All Australian jurisdictions	**676**	**12.5**

Table D.5: Age-standardised 3-year rates of persisting traumatic SCI, by remoteness of residence, Australian residents discharged alive, 2009–10 to 2011–12

	Cases	3-year rate per million population
Major cities of Australia	402	10.5
Inner regional Australia	146	15.4
Outer regional Australia	97	20.8
Remote Australia	22	31.3
Very remote Australia	9	18.8
All remoteness areas	**676**	**12.5**

Table D.6: Neurological level of injury at discharge for persisting SCI cases, Australian residents discharged alive, 2011–12

Neurological level	Frequency	%
C1	4	2
C2	9	4
C3	13	6
C4	42	21
C5	18	9
C6	14	7
C7	4	2
C8	2	1
T1	7	3
T2	3	1
T3	7	3
T4	10	5
T5	3	1
T6	8	4
T7	4	2
T8	8	4
T9	2	1
T10	9	4
T11	4	2
T12	13	6
L1	8	4
L2	4	2
L3	2	1
L4	1	0
L5	1	0
S1	1	0
S2	0	0
S3	0	0
S4	0	0
S5	0	0
Total	**201**	**100**

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 three levels below the ipsilateral motor level on either side of the body. For a grade of C, less than half of the key muscle functions below the single neurological level of injury should have a muscle grade equal to or greater than 3, which is defined as having 'active movement, and full range of motion against gravity'.
>
> **D = Motor Incomplete.** Motor incomplete status as defined above, with at least half or more of key muscle functions below the single neurological level of injury having a muscle grade equal to or greater than 3.
>
> **E = Normal.** If sensation and motor function as tested with the ISNCSCI are graded as normal in all segments, and the patient had prior deficits, then the ASIA Impairment Scale grade is E (Kirshblum et al. 2011).

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

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

duration of initial care: The period from the date of injury to the date of discharge from a participating SU 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 SU.

extent of SCI: Refers to 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.

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

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

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

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

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

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

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Related publications

This report, *Spinal cord injury, Australia 2011–12*, is part of an annual series. Earlier editions and any published subsequently can be downloaded without cost from the AIHW website <www.aihw.gov.au>.

Some 220 cases of traumatic spinal cord injury (SCI) due to external causes were reported to the Australian Spinal Cord Injury Register (ASCIR) for 2011–12. Unlike previous years reports, Falls were the leading mechanism of injury for traumatic SCI cases sustained during 2011–12, at 45%. Land transport crashes accounted for 38% of traumatic SCI.

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