Spinal cord injury, Australia, 2006–07

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INJURY RESEARCH AND STATISTICS SERIES
Number 48

Spinal cord injury, Australia, 2006–07

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January 2009

Australian Institute of Health and Welfare
Canberra

Cat. no. INJCAT 119

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ISSN 1444-3791

ISBN 978 1 74024 818 1

Suggested citation

Cripps RA 2008. Spinal cord injury, Australia, 2006–07. Injury research and statistics series number 48. Cat. no. INJCAT 119. Adelaide: AIHW.

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Published by Australian Institute of Health and Welfare

Printed by Snap Printing

Proofreading and layout by Stacey Avefua

Contents

Acknowledgments

We gratefully acknowledge the support of the Directors and staff of the spinal units in the operation of the ASCIR and we would like to thank the patients in those units for agreeing to be included in the Australian Spinal Cord Injury Register (ASCIR).

The administrative support of Jill Carlson is also greatly appreciated and has contributed much to the successful operation of the ASCIR.

Executive summary

The report *Spinal cord injury, Australia, 2006–07*, presents national statistics on spinal cord injury using data from the 2006–07 reporting period.

The number and rate of new cases of persisting Spinal Cord Injury (SCI) due to traumatic causes in the Australian population have changed very little since the previous annual report. Overall, a total of 348 newly incident cases of SCI were reported in 2006–07. Two hundred and seventy-two cases were due to trauma and another 76 new cases of SCI were due to disease, not trauma. One case involved a person under the age of 15 and was excluded from some further analysis. The age-adjusted rate of persisting SCI from traumatic causes was estimated to be 14.9 new cases per million population aged 15 years and older, slightly lower, but not significantly different from 2005–06 reporting period (15.7 cases per million population).

State and territory age-adjusted three-year annual average incident rates remained similar to rates in the 2005–06 report.

The highest case count and age-specific rate occurred in the age group 15–24 years. Male rates of persisting SCI from traumatic causes were higher than female rates at all ages. The distribution by age differed from the previous report with the rise in male cases seen after the 45–54 year age group in 2005-06 replaced with an overall decline until 65 years and older.

Transport-related injuries (52%) and falls (29%) accounted for over three-quarters of the 271 cases of traumatic spinal cord injury (SCI) during 2006–07.

In the transport-related group, 78% of the SCI cases were caused by traffic accidents (110 cases). Sixty five of the transport related cases were vehicle occupants and 49 were unprotected road users, predominately motorcyclists (76%).

The number of motorcyclist cases (traffic) in 2006–07 (37) was greater in number than in the previous year (26). Motorcyclists in the 15–44 year age group (n = 27) represented 73%of all motorcycle cases at all ages.

Falls led to 78 cases of persisting spinal cord injury in 2006–07, lower than the number in the previous year (95). Approximately one half of these were falls from a height of 1 metre or higher (n = 38). Falls on the same level or from less than 1 metre led to spinal cord injury in 40 cases, 58% of these involving people aged 65 years or older.

1 Introduction

Spinal cord injury (SCI) is sudden and unexpected, and it can be devastating and costly in human and social terms. Medical advances, especially in initial resuscitation and long-term care, have improved survival rates and increased longevity (Tyroch et al. 1997).

From the 1940s through to the 1960s, the level of acute care and rehabilitation of persons with SCI was poor, with few tetraplegic cases or high level paraplegics surviving (Stover 1995). Changes in acute care and rehabilitation, particularly in the development of a team approach to patient case management in the 1970s, brought about a significant reduction in premature mortality, especially from respiratory and renal diseases (Geisler et al. 1983); (Nakajima 1989); (DeVivo et al. 1993).

Each year in Australia, about 300–400* new cases of SCI from traumatic and non-traumatic causes are added to an estimated prevalent SCI population of about 9,000. Based on 2005 cost estimates (Walsh et al. 2005), the ongoing costs associated with the long-term care of the prevalent population of about 9,000 are estimated to be nearly A$500 million per year. These cost estimates allow for attendant care and equipment only and do not include medical or ancillary treatment. It should also be noted that this estimate of A$500 million may change quite markedly from year to year depending on the number of ventilator-dependent or high-level tetraplegia (C1–C3) cases that occur. Estimated attendant care and equipment costs for each ventilator-dependent and each non-ventilator dependent tetraplegic patient are about A$284,000 and A$197,000 per year, respectively (Walsh et al. 2005).

To facilitate national and international comparisons, the US Centers for Disease Control (CDC) case definition of SCI was adopted in Australia for registration of cases of SCI. The CDC's case definition of SCI is as follows:

> … a case of spinal cord injury is defined as the occurrence of 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).

This report presents:

(a) statistical information on new cases of SCI in Australia to Australian residents who were injured and admitted to any of the six spinal units and reported to the National Injury Surveillance Unit (NISU) during the period 1 July 2006 to 30 June 2007 (this period is abbreviated as '2006–07' in this report),

(b) clinical information on patients injured and admitted during 2006–07 who were Australian residents and acquired a persisting neurological deficit from injury to their spinal cord during 2006–07, and

(c) information on external causes of SCI to Australian residents and overseas visitors who were injured and admitted during 2006–07.

* This number underestimates the total number of incident cases of SCI as it only represents those people admitted to spinal units. Cases not admitted to these units include cases in which death occurs soon after injury, and cases in which the presence of other conditions necessitate treatment elsewhere.

The following section (Section 2) of the report is an overview of case registration and reporting by spinal units, with a particular focus on the characteristics of the patients admitted during 2006–07. Section 3 reports on the incidence of persisting SCI from traumatic causes in Australian residents, including trends, the incidence of SCI by state and territory of usual residence, and a description of socio-demographic characteristics of the injured Australian residents. Section 4 provides a clinical description of SCI cases of Australian residents injured and treated in 2006–07 who had a persisting neurological deficit 90 days after injury or at discharge from rehabilitation, and the last section provides information on external causes of injury and factors associated with the SCI event for all traumatic cases (Australian residents and overseas visitors).

This report is the 12th statistical report based on case registration data holdings of the Australian Spinal Cord Injury Register (ASCIR). Early reports, based on data from the period 1995–96 to 1998–99, were published in the *Australian Injury Prevention Bulletin*, and more recent publications, based on ASCIR data from the period 1999–2000 to 2004–05, have been reported in the AIHW's *Injury Research and Statistics Series*. The previous report in this series was based on ASCIR data from the 2005–06 period (Cripps, 2007). Terms used in the report are defined in the Glossary (p. 28).

The ASCIR, a cooperative arrangement of the six Australian spinal units and the AIHW National Injury Surveillance Unit in the Flinders University Research Centre for Injury Studies (RCIS), has enhanced its collaborative relationship with spinal units by the establishment of an ASCIR Operation and Management Board in late 2003.

In 2006–07, the ASCIR was in its 13th year of operation. Almost 11,900 cases of persisting SCI have been registered.

2 Overview of SCI case registrations in 2006–07

Six spinal units (SUs), located in five states and specialising in acute management and rehabilitation of SCI patients nationally, reported 348 newly incident cases of SCI during 2006–07. Patients from states and territories which have no spinal units (Tasmania, the Northern Territory and the Australian Capital Territory) are normally sent to the nearest available spinal unit in another state for treatment.

Treatment of newly incident SCI cases comprises only part of the workload of SUs. These SUs also provide outpatient and outreach care as well as inpatient care for those readmitted for various reasons, sometimes long after the date of injury.

Complete enumeration of newly incident cases was confirmed by the Director or nominated staff at each SU and a quality assurance audit of ASCIR data was completed before data analysis.

Data used in this report is a *snapshot* of data extracted from the ASCIR on the 21 February 2008 and includes discharged and non-discharged cases. Operation and management of ASCIR and data issues are summarised in Appendix 1.

The focus of this report is persisting SCI resulting from trauma. In the year 2006–07, 272 of the 348 new SCI cases (78%) reported by the SUs incurred their SCI from traumatic causes (Table 2.1).

Section 3 of the report deals with newly incident cases of persisting SCI from trauma in the Australian population (n = 248) and excludes patients under the age of 15 years (1 paediatric case). Section 4 deals with the clinical characteristics of these newly incident cases of persisting SCI from trauma. Section 5 deals with the external causes of all traumatic cases of SCI during 2006–07 which were notified to the ASCIR (n = 272).

Twenty-two per cent of the cases of SCI registered in 2006–07 were from non-traumatic causes. In these cases, SCI was secondary to medical conditions such as ischaemia (14%), cancer (15%), spinal abscesses (19%) and spinal canal stenosis (12%). Other causes of non-traumatic SCI were related to disc disease, myelopathy, pain, and medical interventions. The average age of the patients in these non-traumatic cases was 52 years (S.D.=16), compared with 42 years (S.D.=19) for traumatic cases.

Other cases included those where patients were admitted with suspected SCI or transient cord concussion but who had no lasting neurological deficit (6 cases), patients who were reported to have died on ward, 8 of which were due to trauma and 2 due to non-trauma, and others who were non-residents of Australia who had their SCI in Australia (10 cases). This non-resident group is omitted from Australia incidence rate calculations, since the denominator is the population of usual residents of Australia. Australian residents who acquire SCI while elsewhere are within the scope of the register. Such cases are normally registered only if they are admitted to a spinal unit in Australia.

Table 2.1: Case registrations reported to ASCIR by spinal units; Australia 2006–07

Newly incident SCI case characteristics	Counts	Per cent
Traumatic causes:		
Australian residents		
Survived 90 days or to discharge, neurological deficit*	249	72
Survived 90 days or to discharge, no neurological deficit	6	2
Died on ward**	8	2
Non residents		
Survived to discharge, neurological deficit	9	3
Total traumatic causes* **	**272**	**78**
Non-traumatic causes:		
Australian residents		
Survived 90 days or to discharge, neurological deficit	73	21
Survived 90 days or to discharge, no neurological deficit	0	0
Died on ward**	2	1
Non resident		
Survived to discharge, neurological deficit	1	0
Total non-traumatic causes	**76**	**22**
Total newly incident SCI cases	**348**	**100**

* These cases are the focus of Sections 3 and 4. Includes 18 non-discharged cases who met the definition of persisting SCI. *Note:* One paediatric case included in this case total will not be included in Sections 3, 4 and 5.

** Of the 10 patients who died, 8 had an SCI from traumatic causes and 3 of these trauma cases were aged 65 years and above (mean age of 78 years).

*** These cases are the focus of Section 5.

3 Incidence of persisting SCI in 2006–07

This section of the report describes the incidence of persisting SCI from traumatic causes in Australian residents during 2006–07, and trends in rates for the period commencing 1995–96. The incidence of persisting SCI, as in previous reports, is based on *snapshots* of ASCIR data taken at various times after the end of reporting periods.

The ASCIR is continuously updated as information on patients arrives at NISU. Often this information comes after the closure of a reporting period (closure occurs following an audit/review period extending for one year after the reporting period ends) and is added to a case file. As a result, analysis of data from the register over longer periods of time (designated as *cumulative* data for the purposes of this report) will reflect these changes and additions and will not necessarily match the results of analyses on individual reporting periods (designated as *snapshot* data for the purposes of this report).

The section also includes the incidence of SCI by state and territory of usual residence and socio-demographic characteristics of these persisting SCI cases.

Given the rarity, at present, of complete neurological recovery from SCI after 3 months, those patients discharged during financial year 2006–07 with a neurological deficit or having a deficit for at least 90 days after injury (248 cases aged 15 years or older) can be regarded as *persisting* cases of SCI. At the time of writing this report, 18 of the 248 cases had not been discharged from rehabilitation and remained on ward. All had persisting neurological deficits and are included in this section.

Clinical features of these cases are discussed in Section 4 of this report. These cases are an important group to monitor because they contribute to the prevalent SCI population whose health and welfare require ongoing care and (commonly) financial support. The size of the persisting SCI group reflects the combined effects of the rate of incidence of SCI, patients' response to retrieval and treatment, and the rate of survival to discharge. Two hundred and forty-eight Australian residents who sustained SCI from traumatic causes during 2006–07 satisfy the case definition of persisting SCI.

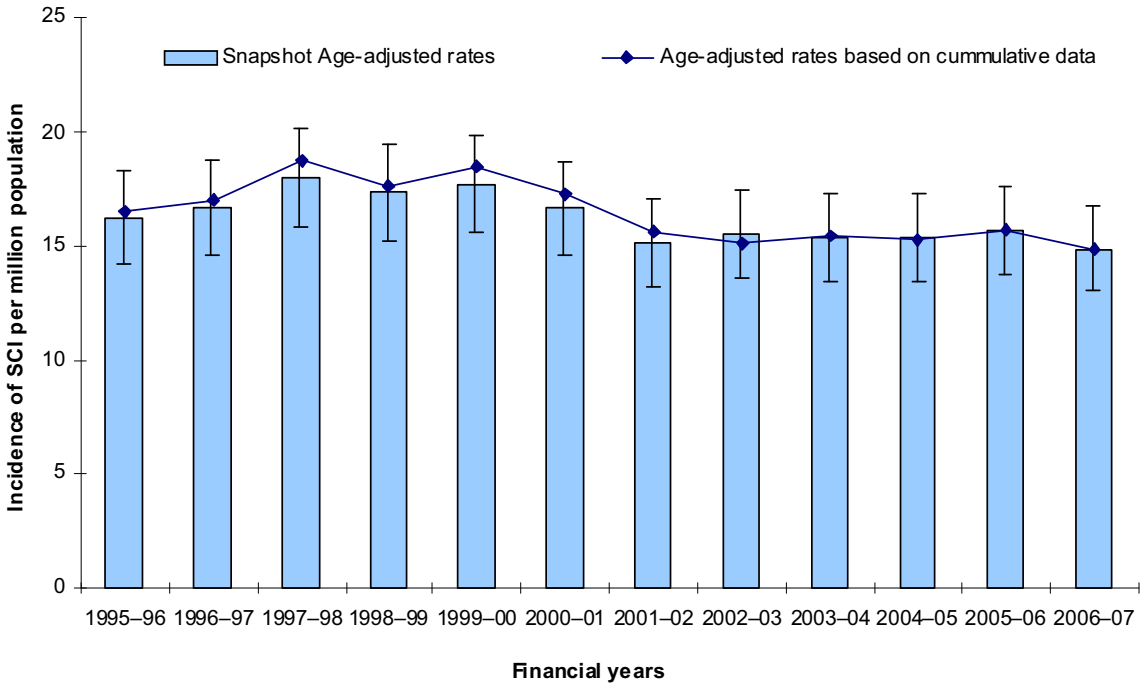
3.1 Persisting SCI in 2006–07 and earlier years

The age-adjusted incidence rates of persisting SCI from traumatic causes in 2006–07 in the Australian population aged 15 years and older using *snapshot* and *cumulative* data is presented in Figure 3.1. The values shown are rates for persons aged 15 years and older and standardised by the direct method to the Australian population in 2001.

The age-adjusted incidence rates of persisting SCI from traumatic causes in 2006–07 in the Australian population aged 15 years and older was estimated to be 14.9 new cases per million population (Figure 3.1). The rate was lower than the rate in 2005–06 (15.7 new cases per million population), but not significantly different (95% CI=13.0–16.7).

As illustrated in Figure 3.1, point estimates of *snapshot*-based rates when compared with rates based on *cumulative* data were lower, but not significantly so, during the reporting periods 1997–98 through 2001–02 and higher in 2002–03. These differences reflect adjustments in case numbers due to routine auditing and periodic review of case registration data.

As in previous reports, paediatric cases (patients under the age of 15 years) were excluded from the incidence rate calculations because of the poor coverage of this group in the Register. Children with SCI are usually treated in paediatric hospitals rather than SUs.



Note: Error bars indicate 95% confidence intervals for snapshot rates.
Rates are based on *snapshot* data of persisting cases of SCI for Australian residents who had their SCI in Australia (248 cases aged 15 years and older in 2006–07). Direct age standardisation was employed, taking the Australian population in 2001 as the standard.
Rates for reporting periods 1995–96 to 2005–06, based on cumulative data, used direct age standardisation taking the Australian population in 2001 as the standard.

Figure 3.1: Incidence of persisting SCI from traumatic causes by year; Australia (age 15 years and over)

3.2 State or territory of usual residence

The age-adjusted rate of incidence of persisting SCI from traumatic causes by state and territory of usual residence is presented in Figure 3.2. Because of the small number of cases in some jurisdictions, incidence rates for jurisdictions are annual average rates based on cases in the three years 2004–05 to 2006–07. (This differs from calculations in reports before 2003–04.)

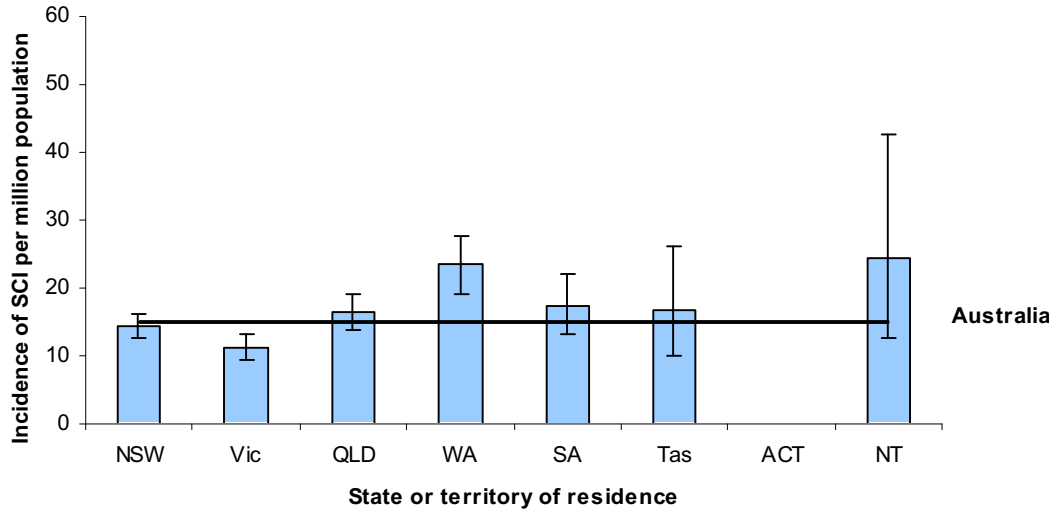
Three-year case counts for Tasmania (19 cases) and the Northern Territory (12 cases) were low, which is reflected in the wide confidence intervals for these two jurisdictions. No cases were reported from the Australian Capital Territory.

The incidence rates range from a high of 24.4 persisting SCI cases per million of population in Northern Territory to a low of 11.3 SCI cases per million of population in Victoria.

Residents of Western Australia had a three-year annual average incidence rate of persisting SCI that was significantly higher than the national incidence rate (23.5 cases per million population versus 15.1 cases per million population). Only residents of Victoria

had three-year annual average incidence rates of persisting SCI significantly lower than the national incident rate (11.3 cases per million population versus 15.1 cases per million population). Western Australian and Victoria rates when compared to the national rate were similar to rates reported in the previous year.

While the rate for Northern Territory did not differ significantly from the national rate, it is noteworthy that the point estimate for the period shown here is high, as it has been in previous periods.



Note: Error bars indicate 95% confidence intervals for rates, based on Poisson distribution. Direct age standardisation was employed, taking the Australian population in 2001 as the standard.

Figure 3.2: Incidence of persisting SCI from traumatic causes by state or territory of usual residence; Australia 2004–05 to 2006–07 (three-year annual average rates, age 15 years and over)

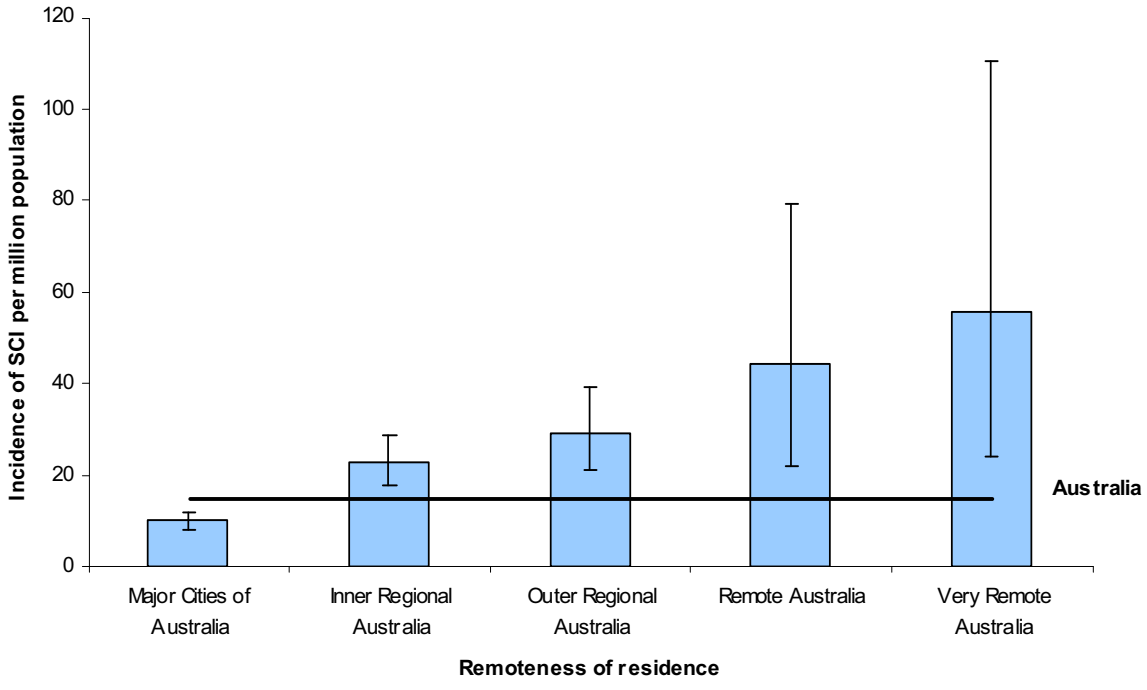
3.3 Remoteness of residence

Remoteness of residence was obtained by converting postcodes present in the ASCIR to Australian Standard Geographical Classification zones (see Data Issues). The age-adjusted rate of incidence of persisting SCI from traumatic causes by remoteness zone of a person's usual residence is presented in Figure 3.3. Rates for all remoteness zones were significantly different from the national rate (14.9 persisting SCI per million population). The rates for remoteness zones outside of *Major cities* increased with remoteness, with *Very remote* rates 5 times the *Major cities* rate of 10.1 persisting SCI per million population although this result and the result for *Remote* (about 4 times) must be interpreted with caution due to low case numbers.

Of cases where both place of residence and place of occurrence could be determined, just over three-quarters (76%) occurred in the remoteness zone of usual residence. The zone of occurrence was more remote than the zone of residence in 29 (17%) cases and less remote in 12 (7%) cases.

Table 3.1: Incidence of persisting SCI from traumatic causes by remoteness of residence and where injury occurred, Australia 2006–07 (case counts and row percentages)

Remoteness area of patient residence	Remoteness area where injury occurred										All remoteness areas	
	Major Cities of Australia		Inner Regional Australia		Outer Regional Australia		Remote Australia		Very Remote Australia			
	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent
Major Cities of Australia	59	74	*	*	*	*	*	*	*	*	80	100
Inner Regional Australia	11	23	31	66	*	*	*	*	*	*	47	100
Outer Regional Australia	0	0	*	*	24	30	*	*	*	*	27	100
Remote Australia	0	0	0	0	0	0	*	*	*	*	9	100
Very Remote Australia	0	0	0	0	0	0	0	0	5	6	5	100
All remoteness areas	**70**	**42**	**44**	**26**	**30**	**38**	**13**	**16**	**11**	**14**	**168**	**100**



Note: Error bars indicate 95% confidence intervals for rates, based on Poisson distribution. Direct age standardisation was employed, taking the Australian population in 2001 as the standard.

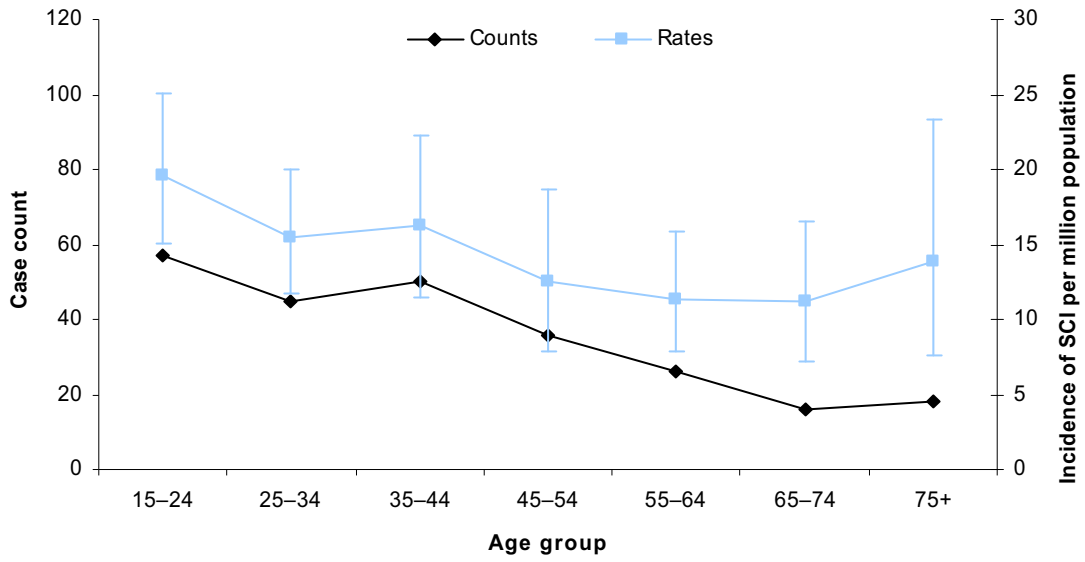
Figure 3.3: Incidence of persisting SCI from traumatic causes by remoteness of residence; Australia 2006–07 (aged 15 years and over)

3.4 Age and sex distribution

The age distribution of cases and rates of persisting SCI from traumatic causes is presented in Figure 3.4. The highest case count and age-specific rate occurred in the age group 15–24 years. The 15–24 year age group accounted for 23% (n = 57) of the cases of persisting SCI from traumatic causes. The 95% confidence intervals on the rates, based on the Poisson distribution, indicated that in 2006–07, age-specific rates were not significantly different in any age group, as was the case in 2004–05. Point estimates of the age specific rates tended to decline with increasing age.

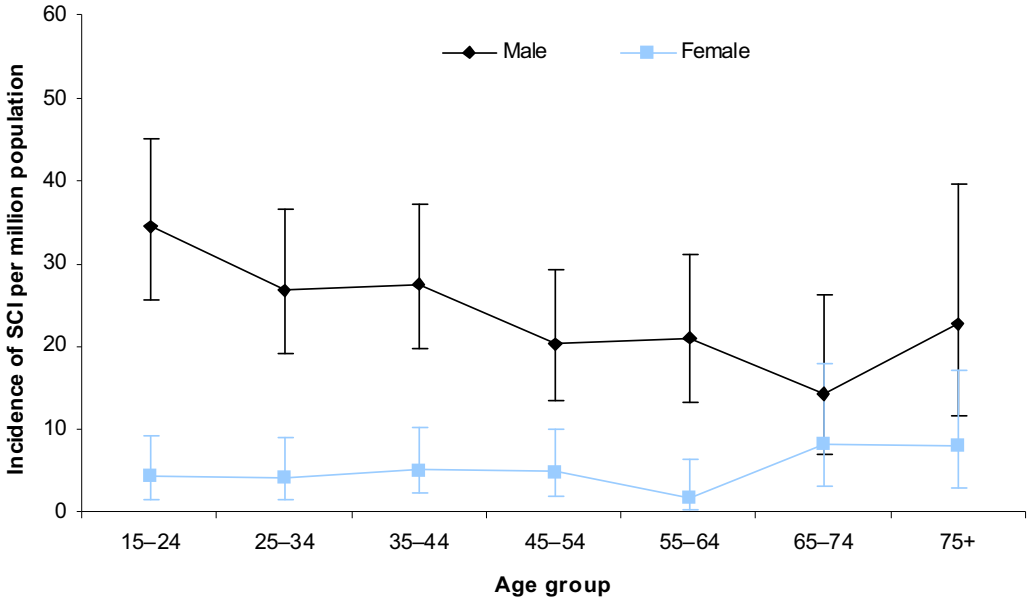
Of the cases of persisting SCI from traumatic causes, 83% were male and 17% were female. All-ages male and female rates were respectively 25.0 and 4.8 persisting SCI cases per million population, with a M:F ratio of 5.2.

Rates for males were higher than rates for females at all ages though 95% confidence intervals overlap for age groups 65–74 and 75 years and above (Figure 3.5). The difference was greatest for young adults and least in middle age. The male to female rate ratio ranged from a low of 2.9:1 in the age group 75 years and above, to a high of 12.0:1 in the age group 55–64 years. Case counts for people aged 75 years and above were low, and accounted for about 7% of the new cases of persisting SCI from traumatic causes. A frequency count of persisting SCI cases during the whole period of operation of the ASCIR by age at onset shows that the highest number of persisting SCI cases occurred at age 21 years, followed by a decline in number of cases with increasing age.



Note: Error bars indicate 95% confidence intervals for rates.

Figure 3.4: Incidence of persisting SCI from traumatic causes by age group, Australia 2006–07 (counts and age-specific rates)



Note: Error bars indicate 95% confidence intervals for rates.

Figure 3.5: Incidence of persisting SCI from traumatic causes by age group and sex, Australia 2006–07 (age-specific rates)

3.5 Socioeconomic characteristics

Living successfully with SCI after rehabilitation is dependent on a number of factors. Psycho-social factors such as internal locus of control, family support, education, employment, and developed social skills all contribute to personal role performance and environmental integration in spite of disablement (Stiens et al. 1997; Warren et al. 1996; Athanasou et al. 1996).

Marital status, employment status and educational level attained (education status) at the time of onset of persisting SCI are three socioeconomic factors recorded in the ASCIR which may affect the outcome after rehabilitation and are presented as age-specific populations in Tables 3.2–3.4.

Thirty eight per cent of the patients were married or in a de-facto relationship, proportionally similar to the marital status reported in 2004–05 (40%) for this group, but less than the proportion reported (45%) for the Australian population in 2005 (ABS 2005) (Table 3.1). Close to one-half (49.5%) of the 'never married' group were young adults aged 15–24 years. In terms of post-rehabilitation care, a patient's spouse may be the main provider of care, which over the long term may affect the health and well-being of the spouse or the relationship (Weitzenkamp et al. 1997). For unmarried patients, care may be provided by the patient's parents or other relatives. For the 17% of patients who were widowed, divorced or separated, care may be provided also by family or friends (depending on age or level of care needed) or in health care facilities and nursing homes.

Sixty-two per cent of those who acquired persisting SCI were employed when their SCI occurred (Table 3.3), similar to the employed crude proportion (62%) of Australians aged

15 years and older (ABS 2007). In addition, age-specific proportions of SCI cases who were employed at time of injury were similar to employed proportions of Australians at ages 15–24 years (72% versus 66%) and at ages 25–64 years (70% versus 74%). At ages 65 years and above, the employed proportion of people acquiring SCI was slightly lower than the employed proportion for the entire population of Australians at ages 65 and older (6% versus 8%).

Overall, 10% had a tertiary or post-graduate education and a similar proportion (12%) attained the highest available secondary school level (Table 3.4). Twenty-one percent of the total sample had a trade qualification. The vocational potential of people with persisting SCI in Australia is quite good, with about 40% of people with SCI returning to work (Athanasou et al. 1996). Returning to paid work is not only determined by physical abilities and rehabilitation, but also by economic circumstances and the willingness of employers to hire workers with disabilities (Post et al. 1998).

Table 3.2: Marital status at onset of persisting SCI by age group: patients reported to ASCIR by spinal units; Australia 2006–07 (counts and column percentages)

	Age of the person with SCI at the time of admission							
	15–24		25–64		65 and older		All ages	
Marital status	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent
Never married	54	95	53	34	*	*	109	44
Widowed	*	*	*	*	10	29	12	5
Divorced	0	0	13	8	4	12	17	7
Separated	*	*	9	6	*	*	12	5
Married (including de facto)	*	5	77	49	13	38	93	38
Not stated/inadequately described	*	*	*	*	*	*	*	*
Not reported	*	*	*	*	*	*	*	*
Group Total**	**57**	**100**	**157**	**100**	**34**	**100**	**248**	**100**

* Cell counts of 3 or fewer, and related percentages, are not shown in tabulation.
**Totals include 4 cases where marital status was not stated, not reported or inadequately described.

Table 3.3: Employment status at onset of persisting SCI by age group: patients reported to ASCIR by spinal units; Australia 2006–07 (counts and column percentages)

	Age of the person with SCI at the time of admission							
	15–24		25–64		65 and older		All ages*	
Employment status	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent
Employed	41	72	110	70	*	*	153	62
Pensioner	0	0	10	6	27	79	37	15
Unemployed/not avail for employment/Not reported	16	28	37	24	*	*	58	23
Group Total	**57**	**100**	**157**	**100**	**34**	**100**	**248**	**100**

* Employment status for 7 cases was not reported.
** Cell counts of 3 or fewer, and related percentages, are not shown in tabulation.

Table 3.4: Educational level attained at onset of persisting SCI by age group: patients reported to ASCIR by spinal units; Australia 2006–07 (counts and column percentages)

	Age of the person with SCI at the time of admission							
	15–24		25–64		65 and older		All ages	
Education status	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent
Tertiary/post graduate	*	*	18	11	*	*	25	10
Trade qualification/apprentice	11	19	39	25	*	*	51	21
Diploma or certificate	*	*	4	3	*	*	*	*
Other post school study	*	*	*	*	*	*	6	2
Highest available secondary school level	11	19	16	10	*	*	29	12
Left school aged 16 or over	9	16	19	12	5	15	33	13
Left school aged 15 or less	4	7	10	6	6	18	20	8
Never attended school	*	*	*	*	*	*	*	*
Still at school	7	12	0	0	0	0	7	3
Not reported	7	12	47	30	16	47	70	28
Group Total	**57**	**100**	**157**	**100**	**34**	**100**	**248**	**100**

* Cell counts of 3 or fewer, and related percentages, are not shown in tabulation.

4 Clinical characteristics of persisting SCI cases

The monitoring of clinical information on SCI enables the patients' outcomes in response to treatment to be studied, and indirectly provides an indication of the degree of support required by this population 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.

In this report, discussion of clinical features of SCI is based on *persisting* SCI cases, i.e. people who are Australian residents who sustained their incident SCI injury in 2006–07 from traumatic causes, had an ASIA Impairment Scale score† of A to D either 90 days post injury or at discharge from rehabilitation (end of episode of inpatient care), and incurred the injury in Australia or overseas. During 2006–07, 248 SCI cases admitted to SUs met this definition. Of these 248 cases, 18 cases were still on ward at the time of writing this report and 19 cases were discharged to another hospital from the spinal unit where the incident admission occurred. All 37 cases had been on ward or discharged from the spinal units at least 90 days after their injury date and are by definition *persisting* SCI cases.

The 248 cases for whom information on neurological level and extent of injury are known to meet the register's definition of 'persisting SCI' will be the focus of the first two parts of this section of the report. This year, as requested by SU Directors, the duration of initial care (DIC) values presented in Section 4.3 are based on persisting SCI cases discharged during 2006–07 who had their injury prior to or during the 2006–07 reporting period.

4.1 Neurological level of injury

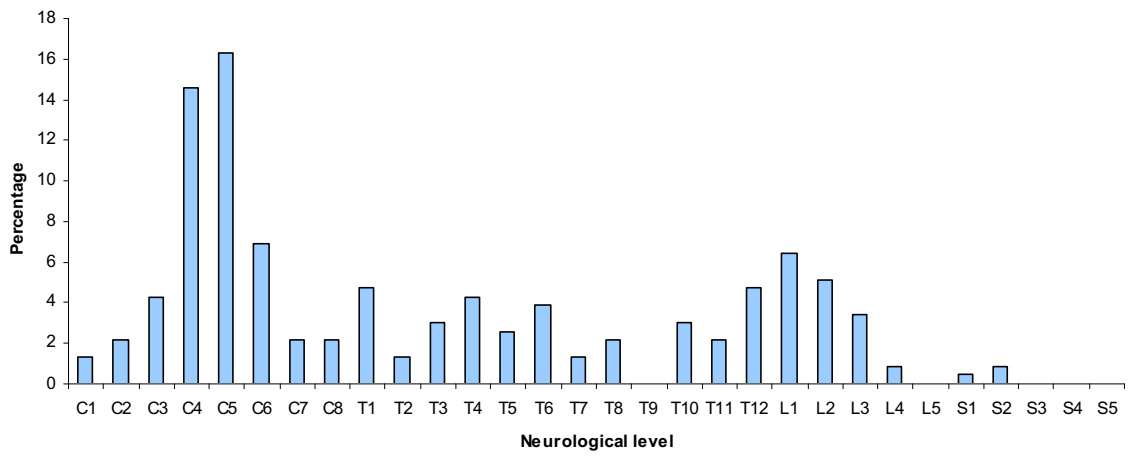
The neurological level of persisting SCI at discharge is presented in Figure 4.1.

Half of the cases that had neurological levels reported or were available from spinal units (n = 233) involved the cervical segments (49.8%, n = 116). Injury to the cord at the cervical level results in 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*.

Thirty-eight cases were reported as being at the C5 neurological level. This means that the motor and sensory functions served by the C5 segment of the spinal cord were the lowest (i.e. furthest from the head) that were found to be normal. Another 34 cases were at the C4 neurological level and 16 at the C6 level. Together, C4, C5 and C6 cases made up 75.9% of cases of persisting cervical SCI that occurred in 2006–07 and 54.1% of cases for all neurological levels reported.

† A measure of function after spinal cord injury, used by physicians where A means 'Complete: No sensory or motor function is preserved in sacral segments S4–S5' and E means 'Normal: Sensory and motor functions are normal'.

The remaining 117 cases (50.2%) had an injury at the thoracic, lumbar or sacral levels, most commonly involving the spinal segments at the thoraco-lumbar junction (T12 and L1, *n* = 36, 11.2% of cases at all levels reported). The impairment resulting from injury at these levels is referred to as *paraplegia*. With paraplegia, upper limb function is spared but, depending on the level of injury, the trunk, pelvic organs and lower limbs may be functionally impaired.



N = 233 cases

Figure 4.1: Incidence of persisting SCI from traumatic causes by neurological level at discharge; Australia 2006–07 (percentages)

4.2 Neurological category

The overall severity of SCI is usually measured by a combination of the neurological level and extent of injury and is divided into 5 neurological categories (complete tetraplegia, incomplete tetraplegia, complete paraplegia, incomplete paraplegia, and complete recovery). Table 4.1 presents the counts and table percentages for the 4 neurological categories relevant to a discussion of persisting cases of SCI, as well as a finer breakdown of the paraplegia category.

Based on all cases with neurological levels and extent of injury reported (233 cases), the most common neurological category was incomplete tetraplegia (68%, *n* = 79), followed by incomplete paraplegia (50%, *n* = 59), complete paraplegia (50%, *n* = 58) and complete tetraplegia (32%, *n* = 37). Complete injury was most common in the thoracic spinal segments, due to the small diameter of the spinal canal in this region in relation to the size of the cord (White & Panjabi 1990).

In 2005–06, the number of patients that suffered injury to the thoracic and lumbar spinal segments was quite similar to the number reported in 2006–07. Three sacral spinal segment injuries were reported in 2006–07, compared with no cases in 2005–06.

Table 4.1: Incidence of persisting SCI from traumatic causes by neurological level (major grouping) and extent of injury; Australia 2006–07 (counts and table percentages)

Extent of injury	Tetraplegia		Paraplegia								Total	
	Cervical		Thoracic		Lumbar		Sacral		All paraplegia			
	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent
Complete	37	32	51	66	7	19	0	0	58	50	95	41
Incomplete	79	68	26	34	30	81	*	*	59	50	138	59
Total	**116**	**100**	**77**	**100**	**37**	**100**	*	**100**	**117**	**100**	**233**	**100**

4.3 Duration of initial care

When this report was prepared (April 2008), 230 of the 248 cases of persisting SCI incidents in 2006–07 had been discharged from SUs after completing rehabilitation (18 cases were still on ward).

For this report, the method of calculating *duration of initial care* (DIC) has been changed on recommendation of the spinal unit Directors. It now includes persisting SCI cases that occurred and were discharged from spinal units during the 2006–07 reporting period (138 cases) and 109 cases who had their SCI prior to the 2006–07 reporting period but were discharged in this reporting period, a total of 247 cases.

The DIC is the period of time from the date of injury to the date of discharge from the SU to another hospital, to their previous home or a new home, nursing home or other accommodation. This also differs from previous DIC calculations, which excluded patients discharged from spinal units to other hospitals. Patients who died on ward are not included in the DIC calculation. This period of care includes retrieval of the patient from the scene of the accident, stabilisation in a hospital or intensive care unit, acute care in an SU and other wards, and rehabilitation. Information on the duration of initial care in hospital from the date of injury to the date of discharge from the SU, by neurological category, is presented in Table 4.2. In this tabulation, the average duration of initial care (ADIC) has been replaced by the *median* duration of initial care (MDIC) to reduce the effect of outliers.

Table 4.2: Neurological status of injury to the spinal cord of cases of persisting SCI from traumatic causes for age groups discharged during 2006–07 in Australia (counts and median duration of initial care (MDIC))

Extent of injury	Tetraplegia		Paraplegia								Total	
	Cervical		Thoracic		Lumbar		Sacral		All paraplegia			
	Count	MDIC (days)	Count	MDIC (days)	Count	MDIC (days)	Count	MDIC (days)	Count	MDIC (days)	Count	MDIC (days)
Complete	40	252	43	147	4	128	0	0	47	131	87	189
Incomplete	98	155	27	128	33	77	*	*	62	107	160	122
Total	**138**	**189**	**70**	**133**	**37**	**88**	*	*	**109**	**120**	**247**	**154**

The median duration of initial care (MDIC) for all persisting cases of SCI discharged during 2006–07 (247 cases) was 154 days, ranging from a high of 252 days for cases of complete tetraplegia to 61 days for cases of incomplete paraplegia involving injury to sacral spinal segments (Table 4.2).

Overall, patients with tetraplegia had a MDIC 58% greater than those with paraplegia (189 days versus 120 days). For patients with paraplegia, the longest MDIC was reported for those with complete injury to the thoracic spinal segments (147 days). The MDIC for those with complete injury to the lumbar spinal segments was also high, but cases were fewer in number than cases with complete injury at the thoracic level (43 cases versus 4 cases).

Duration of initial care can vary according to the extent and neurological level of injury to the cord as well as other factors such as patient co-morbidities, other injuries sustained at the time of the accident and the health and age of the patient. In addition, the discharge process after completion of rehabilitation may be prolonged due to the lack of suitable accommodation or trained carer availability for some patients, further increasing the duration of care. The distribution of durations is illustrated in Table 4.3.

For tetraplegic patients, the 5th and 95th percentiles of length of stay were 24 and 562 days compared to 22 and 290 days for paraplegic cases (Table 4.3). The longest MDIC occurred while treating patients with complete tetraplegia (252 days). The 5th and 95th percentiles for duration of initial inpatient treatment for this group were 164 days and 878 days, illustrating the effect of patient case mix, small numbers at spinal units, as well as other factors mentioned above, on MDIC. Utilisation of national MDIC data for benchmarking purposes at the state level should be made with caution.

Table 4.3: Neurological category of injury to the spinal cord of cases of persisting SCI from traumatic causes for age groups discharged during 2006–07 in Australia (median duration of initial care (MDIC) and percentiles [5th and 95th])

	Tetraplegia				Paraplegia			
Extent of injury at discharge	Count	Median	5th Percentile	95th Percentile	Count	Median	5th Percentile	95th Percentile
Complete	40	252	164	878	47	145	83	529
Incomplete	98	155	24	456	62	104	13	243
Group Total	**138**	**189**	**24**	**562**	**109**	**120**	**22**	**290**

5 Factors associated with the SCI event

In addition to collecting information on the incidence of SCI, including socio-demographic features of the patients involved, the ASCIR also collects information about the event which resulted in the injury, such as the mechanism of the injury, the role of human intent, the type of place where the injury occurred, and the type of activity involved at the time of injury. Such factors are often referred to as *External Causes of Injury*. This information, obtained from case registration forms of all incident SCI cases from traumatic causes aged 15 years and older (n = 271) and coded according to the NISU's National Data Standards for Injury Surveillance (NDS-IS), helps to improve understanding of the underlying events that led to the injury. Although 6 of these cases resulted in no persisting neurological loss, the aetiology was related to transport, falls and leisure-related accidents—common causes of SCI. Information on underlying events is intended to assist in setting priorities for prevention and in the development and implementation of injury prevention interventions to reduce the incidence of SCI in Australia.

In this report, mechanisms of injury are described in Section 5.1 and activities being undertaken at the time of injury in Section 5.2. The latter section includes a cross-tabulation of mechanism by activity. Aggregation of cases coded to the NDS-IS into mechanism of injury categories used in Sections 5.1 and 5.2 is described in Appendix 1, Data issues, Table A1.1.

5.1 Mechanism of injury

The mechanisms of injury for incident cases of SCI from traumatic causes are shown in Table 5.1. These cases, originally coded to NDS-IS, have been allocated to categories which reflect major mechanisms of injury that resulted in SCI. Mechanism of injury by age group is presented in Figures 5.1–5.3. Cases are described by mechanism of injury and neurological level of injury in Table 5.2 and mechanism of injury and activity at the time of injury in Table 5.3. The mechanisms of injury shown in Table 5.1 are described in the following sections.

Table 5.1: Incidence of SCI from traumatic causes by mechanism of injury; Australia 2006–07 (counts and column percentages)

Mechanism	Counts	Per cent
Traffic—Land transport: Motor vehicle occupants	61	22.5
Traffic—Land transport: Unprotected road users	49	18.1
Non-traffic—Land transport: Motor vehicle occupants	4	1.5
Non-traffic—Land transport: Unprotected road users	28	10.3
Low falls	40	14.8
High falls	38	14.0
Struck by or collision with a person or object	22	8.1
Water-related	21	7.7
Other	8	3.0
Total	**271**	**100**

5.1.1 Traffic—Land transport: Motor vehicle occupants

A comparison of the incidence of SCI from traffic and non-traffic land transport accidents by age group is shown in Figure 5.1. The age distribution of SCI cases, except for the group aged 65 years and above, did not differ greatly between the land transport groups, nor between these groups and all traumatic SCI.

The most common type of event resulting in motor vehicle occupant SCI was vehicle rollover, accounting for 59% (n = 36) of the cases (n = 32 in 2005–06). High speed and loss of control appear to be major contributing factors in more than one-half of the accidents involving rollover. Ejection of occupant occurred in 22% (n = 8) of the rollover cases resulting from lack of use or failure of seat belts, four times as many as the cases of this type reported in 2005–06 (n = 2). Impact with a roadside hazard occurred before rollover in 28% (n = 10) and a driver being intoxicated was also reported in 14% (n = 5) of the rollover cases.

For non-rollover motor vehicle occupant cases (n = 22), impact with another vehicle was reported in 36% (n = 8) of the accidents, 59% (n = 13) involved an impact with roadside hazards such as poles, trees or ditches, and ejection of occupants occurred in 9% (n = 2) of the cases.

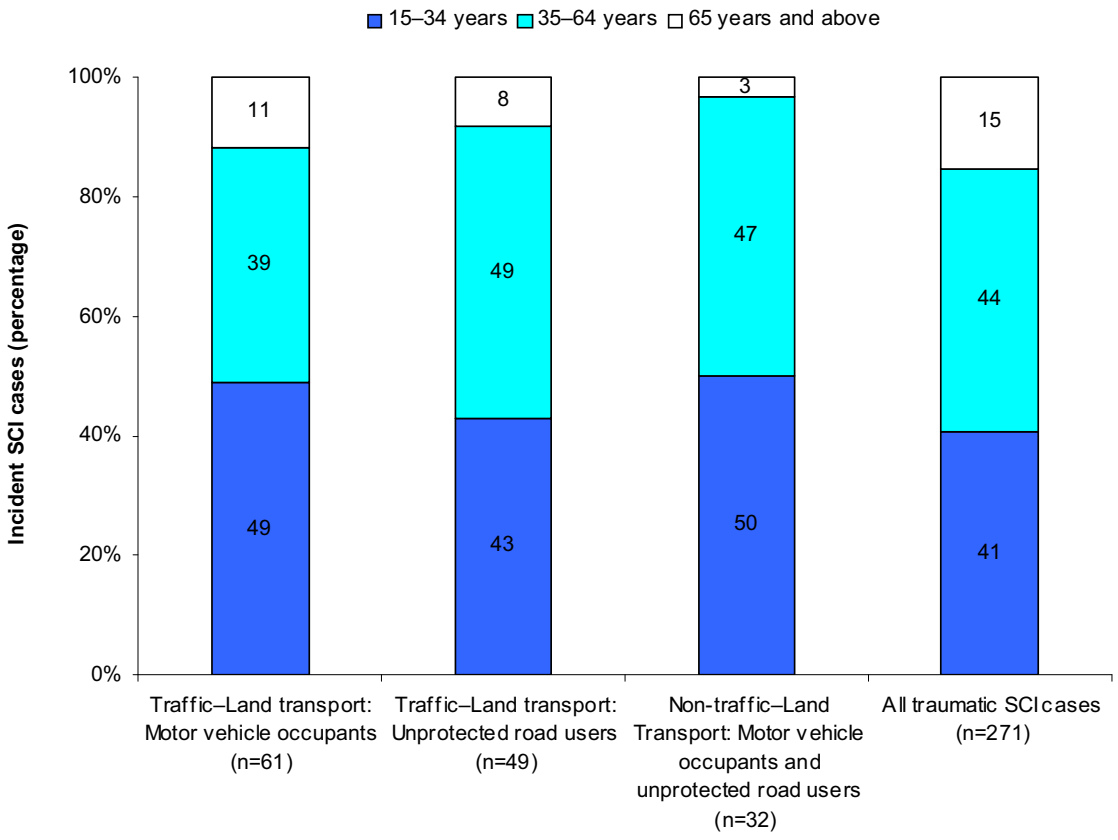


Figure 5.1: Incidence of SCI from traffic and non-traffic land transport accidents by age group, Australia 2006–07 (percentages of each group)

In motor vehicle accidents, high energy transfer to occupants is common and can result in high severity injury to many body regions, including the spinal column. For example, 38% (*n* = 23) of the cases in the *Traffic–Land transport: Motor vehicle occupants* group sustained injuries to the cervical spinal segments resulting in tetraplegia (Table 5.2) and almost three-quarters of these tetraplegic cases (*n* = 17) were the result of vehicle rollover.

Head injuries, including loss of consciousness, were also reported in 23% (*n* = 14) of motor vehicle accident cases. Additional injuries sustained in motor vehicle accidents included internal damage, particularly to the thoracic cavity (e.g. pneumothorax and haemothorax, fractured ribs and sternal bones), injuries to the abdomen, and various fractures to upper and lower limbs.

In cases involving rollover (*n* = 36), 47% (*n* = 17) of the occupants had injury to the cervical segments of the cord resulting in tetraplegia. Fifty-three per cent (*n* = 9) of these cases resulted in complete tetraplegia. Eighteen of the remaining rollover cases (*n* = 19) had injury to the thoracic and lumbar spinal segments resulting in paraplegia and 44% of these cases had complete injury to the cord resulting in complete paraplegia. One case had no neurological level of injury reported.

Table 5.2: Incidence of persisting SCI from traumatic causes by mechanism of injury and neurological level of injury 90 days post admission or at discharge; Australia, 2006–07 (counts and row percentages)

	Neurological level 90 days post admission or at discharge																	
	Tetraplegia		Paraplegia															
	Cervical		Thoracic		Lumbar		Sacral		All paraplegia		No neurological injury		Neurological level not available from SU		Neurological not reported		Group Total	
Mechanism	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent
Traffic—Land transport: Motor vehicle occupants	23	38	21	34	11	18	*	*	32	52	*	*	*	*	*	*	61	100
Traffic—Land transport: Unprotected road users (motor cyclists, pedal cyclists, pedestrians)	23	47	16	33	6	12	*	*	23	47	*	*	*	*	*	*	49	100
Non-traffic—Land transport: Motor vehicle occupants	4	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	100
Non-traffic—Land transport: Unprotected road users (motor cyclists, pedal cyclists, pedestrians)	11	39	11	39	4	14	0	0	15	54	0	0	*	*	*	*	28	100
Low falls	26	65	7	18	*	*	*	*	11	28	*	*	0	0	*	*	40	100
High falls	13	34	16	42	6	16	0	0	22	58	*	*	0	0	*	*	38	100
Struck or collision by person or object	10	45	5	23	4	18	*	*	10	45	*	*	0	0	*	*	22	100
Water-related	17	81	*	*	0	0	0	0	*	*	*	*	0	0	*	*	21	100
Other	*	*	*	*	4	50	0	0	5	63	0	0	0	0	*	*	*	100
All mechanisms	**129**	**48**	**78**	**29**	**38**	**14**	*	*	**119**	**44**	**6**	**2**	**4**	**1**	**13**	**5**	**271**	**100**

* Cell counts of 3 or fewer, and related percentages, are not shown in tabulation.

5.1.2 Traffic—Land transport: Unprotected road users

Unprotected road users are users of land transport without the protection of a structure such as a car body. They include motorcyclists (drivers or pillion passengers), pedal cyclists and pedestrians and account for 18% (*n* = 49) of all cases of SCI during 2006–07 (Table 5.1).

Forty-three per cent (*n* = 21) of these unprotected road user cases in 2006–07 were in the age group 15–34 years compared with 41% (*n* = 110) of all traumatic SCI cases. Only 8% (*n* = 4) of unprotected road user cases were at ages 65 years or older (Figure 5.1). Of all unprotected road users traffic-related cases, 76% (*n* = 37) were motorcyclists, 18% (*n* = 9) pedal cyclists and 6% (*n* = 3) pedestrians. Motorcyclists in the 15–44 year age group (*n* = 27) represented 73% of motorcycle cases at all ages and 16% of all SCI cases in this age group. For pedal cycle and pedestrian cases, 75% of the cases were in the age group 15–54 years.

The neurological level of injury in unprotected road users in traffic was cervical in 47% of the cases (*n* = 23), the same proportion was found for thoracic, lumbar and sacral cases (47%, *n* = 23). Neurological level of injury was not reported or unavailable for 3 cases (Table 5.2).

Forty-nine per cent (*n* = 24) of 2006–07 cases of SCI among unprotected road users in traffic had complete lesion of the spinal cord. Twenty of these 24 cases (83%) involved motorcyclists or their passengers.

5.1.3 Non-traffic—Land transport

Non-traffic land transport related accidents occurred primarily off-road on farms, trail or mountain bike tracks, beaches, race tracks and other undeveloped recreational areas. Fifty per cent (*n* = 16) of these cases were in the age group 15–34 years (Figure 5.1).

When compared with all traumatic SCI cases, the number of non-traffic motor vehicle occupants and unprotected road user cases was proportionally higher in young ages (ages 15–34 years) and more similar at ages 35–64 years (Figure 5.1). Non-traffic motor vehicle occupant case numbers were low (*n* = 4).

Thirteen percent (*n* = 4) of the non-traffic group were motor vehicle occupants and 87% were unprotected road users. Fifty-four per cent (*n* = 15) of these unprotected road users were motorcyclists (drivers, no pillion passengers), 32% (*n* = 9) were pedal cyclists and the remainder (*n* = 4) were pedestrians or drivers of a motorised transport device (quad bike). When compared with non-traffic unprotected road user cases reported in 2005–06, motorcyclists decreased proportionally by 6% in 2006–07 and pedal cyclists were proportionally higher (32% versus 15%).

The age profile for non-traffic motorcyclists differed from that of traffic motorcyclists with proportionally twice as many motorcyclists aged 15–24 years in the non-traffic group than the traffic group (47% versus 22%). Non-traffic and traffic pedal cyclists were similar in number, with generally younger ages in the non-traffic group.

For the non-traffic group, the number of tetraplegia and paraplegia cases was proportionally the same as the number in the traffic group.

Forty-seven per cent (*n* = 15) of 2006–07 cases of SCI among the non-traffic group had complete lesion of the spinal cord, with 33% (*n* = 6) of motorcyclists having complete paraplegia.

5.1.4 Falls

Falls, both low (on the same level, or from a height of less than 1 metre) and high (from a height of 1 metre or more), accounted for 29% (*n* = 78) of SCI cases during the 2006–07 reporting period (Table 5.1).

In 2006–07, the number of high falls reported were sharply reduced in number compared to high falls reported in 2005–06 (38 cases versus 60 cases). This reduction occurred in all jurisdictions except Victoria. Low falls were more frequent in 2006–07 than in 2005–06 (40 cases versus 35 cases) and were proportionally more than four times as common as high falls at ages greater than 65 years, but proportionally less at ages below 65 years (Figure 5.2).

Seventy per cent of low falls (*n* = 28) occurred in the patient's home while they were doing personal activities or as a result of medical conditions (seizures, dizziness or cardiovascular disease). Alcohol intoxication was reported in 8 low fall cases.

Slipping or tripping occurred in about 17% of low fall cases in people aged 65 and older. Older people are at risk of fall-related injuries particularly fractures of the upper and lower limbs and the neck and trunk (Cripps & Carman 2001).

Low falls resulted in tetraplegia in 65% of cases (*n* = 26) as a result of injury to the cervical spinal segments (Table 5.2). Paraplegia was less common (*n* = 11) and involved injury to thoracic, lumbar and sacral spinal segments. Among those aged 65 years and older, tetraplegia occurred in 61% (*n* = 14) with extent of injury to the cervical segments of the cord being incomplete in all but two of the cases.

Forty-nine per cent (*n* = 38) of the injurious falls were from a height of 1 metre or more. Eighty-seven per cent of those whose injury resulted from falling from a height were aged between 15–64 years, compared with 43% of those involved in low falls (Figure 5.2).

Twenty-two per cent (*n* = 8) of high falls occurred while the patients were working for income using ladders or scaffolding on building sites, during construction work, cutting trees, training horses, or working on transport vehicles (Table 5.3). In 2005–06, 18 cases of this type were reported.

High falls (*n* = 6) involved activity which can be described as work, but not for income, such as doing handyman jobs around the home. All but one person fell off of a ladder. Eighty-three per cent of the people who fell during 'handyman' types of activities (*n* = 5) were aged 54 years and above. In 2005–06, 15 cases of this type were reported.

Leisure and sporting activities accounted for 13% (*n* = 5) of the cases. Thirteen per cent of cases involving high falls (*n* = 5) were by people who were intoxicated, with 4 of the cases occurring in the 45–54 year age group.

Falling from a height resulted in tetraplegia in 34% of the cases (*n* = 13) and paraplegia in 58% (*n* = 22) of the cases (see Table 5.2). These proportions are similar to the results reported in 2005–06 though case numbers of both levels were lower in 2005–06 than in the previous year. Fifty per cent (*n* = 35) of the cases resulting from high falls had an incomplete lesion of the cord and 42% had complete lesion of the cord. Of the remaining cases, 3% had no lesion and for 5% of the cases, no extent of injury was reported at the time of writing this report.

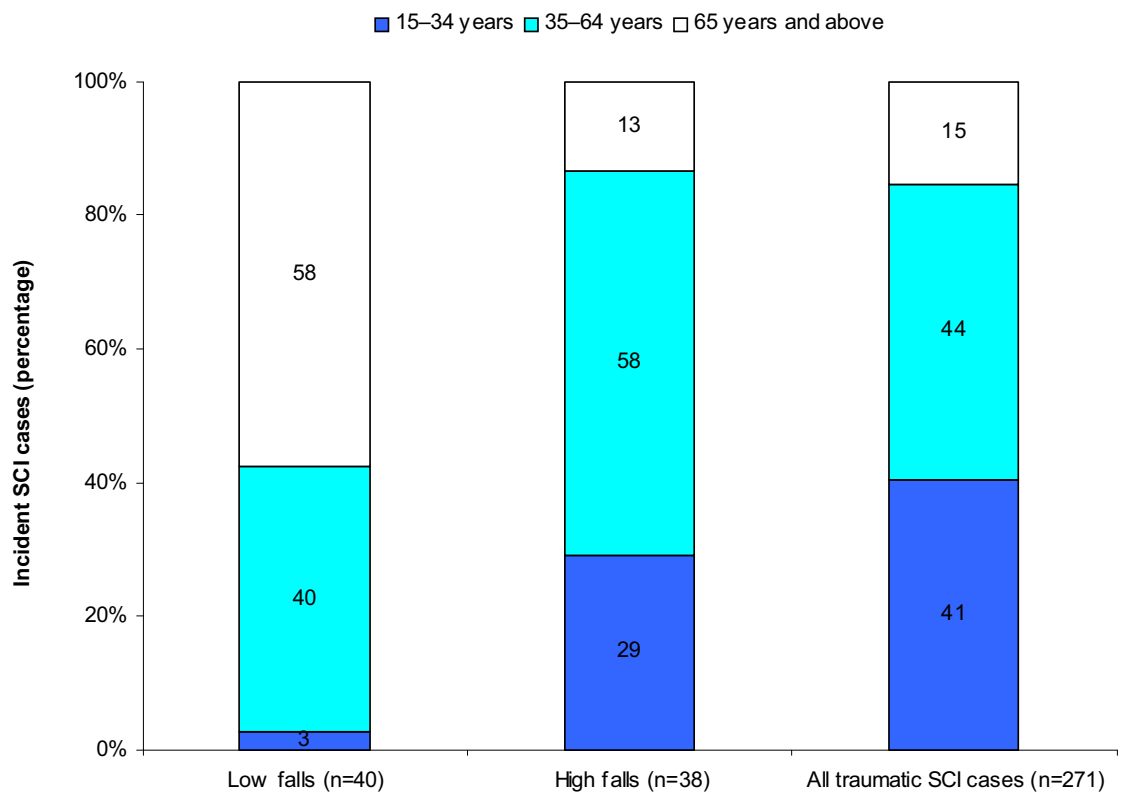


Figure 5.2: Incidence of persisting SCI from low and high falls by age group, Australia 2006–07 (percentages of each group)

5.1.5 Struck by or collision with a person or object

Eight per cent (n = 22) of the SCI cases reported during 2006–07 were the result of being struck by or collision with a person or object (Table 5.1). Fifty-nine percent (n = 13) of the SCI cases occurred in age group 15–34 years compared with 41% (n = 110) of all traumatic SCI cases (Figure 5.3).

Thirty-six per cent (n = 8) of the injuries occurred when the person was struck by machinery or crushed or hit by falling objects while at work. In the remaining cases (n = 14), injury occurred as a result of assault, impacting the ground surface, or another person's body during contact sports such as rugby (see also Section 5.2).

Forty-five per cent of the cases (n = 10) had injury to the cervical spinal segments and 10 of the remaining 12 cases had injuries to the thoracic, lumbar and sacral spinal segments (Table 5.2). One case had no lesion of the cord and the other case's neurological level of injury was not reported at the time of writing this report. Thirty-two per cent (n = 7) had complete lesion of the cord.

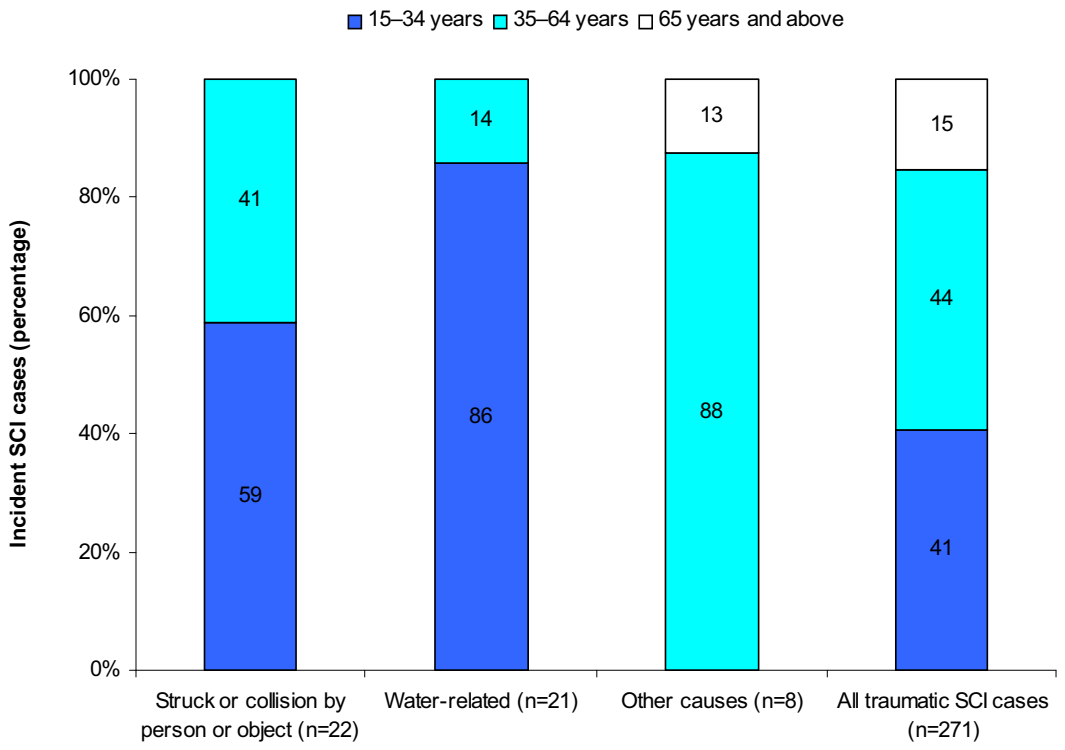


Figure 5.3: Incidence of persisting SCI from being hit or struck by object, diving or surfing, and other accidents by age group, Australia 2006–07 (percentages of each group)

5.1.6 Water-related

Water-related accidents accounted for 8% (n = 21) of the SCI cases reported during 2006–07 (Table 5.1) and 86% (n = 18) of these cases occurred in people under the age of 35 years (Figure 5.3).

Eighty-one per cent (n = 17) of reported water-related SCI cases involved injury to the cervical spinal segments (Table 5.2), with almost a half of these cases (n = 8) sustaining complete injury to the cord after they dived into a body of water probably without being aware of the depth and impacted with the bottom.

Forty-eight per cent of the injuries (n = 10) were the result of people diving into shallow water, 29% (n = 6) related to surfing or body surfing, and 19% (n = 4) occurred in swimming pools.

Alcohol was involved in 6 of the diving injury cases.

5.1.7 Other causes

Three per cent of the SCI cases (*n* = 8) reported during 2006–07 had an external cause of injury that was not included in the other major groups of external causes detailed in Table 5.1. These other external causes of injury to the spinal cord included injuries from air crashes, lifting heavy objects, machine related injuries and complications of medical treatment. These injuries occurred over a broad range of ages, but primarily in the age group 35–64 years (Figure 5.3).

Sixty-three per cent of SCI cases (*n* = 5) in the *Other causes* group sustained injury to the thoracic and lumbar spinal segments resulting in paraplegia and 2 cases had injury to cervical spinal segments. Five cases had complete lesion of the cord which occurred to cervical, thoracic and lumbar spinal segments.

5.2 Type of activity at time of injury

Activity at the time of injury was obtained from structured injury narratives of all traumatic cases of SCI reported during 2006–07 which were coded according to the NDS-IS, Level 1 activity categories (*n* = 271). These categories, together with the mechanism of injury and the place at which injury occurred, allowed cases to be grouped into categories so that sectors with relevant responsibility and authority can be identified and targeted for injury prevention. Table 5.3 details these mechanisms of injury, and the activity being undertaken at the time of the injury.

Eight per cent of the SCI cases (*n* = 21) occurred during sporting activities, and 57% of these occurred in people under the age of 35 years. Sports-related SCI cases occurred during contact sports, motorised sports (car, trail bike and motorcross racing), pedal cycle races, water-related sports (water skiing, diving and surfing), and paragliding.

Sixty-two per cent of the SCIs from sporting activities occurred to the cervical spinal segments resulting in tetraplegia, with complete lesion of the cord occurring in just under a third of these cases.

Three cases of SCI occurred during the contact sport of rugby (two being Rugby League players), and all resulted in injury to the cervical spinal segments. The SCIs occurred during group tackles in all 3 cases. All players were adults.

For motorised sports (*n* = 8), almost two-thirds of the cases involved injury to the cervical spinal segments, the remaining cases had injury to the thoracic segments. Half of these motorised sports cases had complete lesion of the cord.

In the other sports-related cases (*n* = 10), 60% (*n* = 6) involved injury to the cervical spinal segments and the remaining 4 cases involved injury to the thoracic spinal segments.

Leisure activities such as diving or jumping into bodies of water, falls from balconies or onto rocks, falling off jet skis, surfing and other recreational activities resulted in SCI in 30 cases (2 cases had no neurological injury status reported at the time of writing this report), 7 of whom were intoxicated at the time (Table 5.3). The highest number of SCI cases (*n* = 12) occurred as a result of diving into swimming pools and other bodies of water. Injury to the cervical spinal segments occurred in two-thirds of the leisure activity cases.

Injury to the spinal cord while working for income was also common, accounting for 14% (*n* = 37) of the cases. Thirty-eight percent of the cases of SCI that occurred while working (*n* = 14) were to workers under the age of 35 years. Accidents while driving motor vehicles (*n* = 15) resulted in tetraplegia in 38% (*n* = 5) of the cases where neurological level of injury was reported (*n* = 13). In 2006–07 eight cases while working for income were due to a fall from a height, compared with 16 in the previous year.

Other SCIs sustained while working for income occurred as a result of high falls from ladders, scaffolding, and from other parts of buildings on building sites (*n* = 3), from trees, and from motor vehicles (*n* = 3), or involved being hit or struck by trees, machinery or by ramps, booms and horse floats (*n* = 8).

SCI occurred in 12 cases while people were working, but not for income, and 75% of these cases involved males aged 55 years and older. These injuries occurred primarily around the home during 'handyman' activities that resulted in falling from ladders while cleaning gutters, and falling while pruning trees or being hit by falling branches. High falls were the mechanism of injury in half of the cases and resulted in injury to the thoracic spinal segments in two-thirds of the cases (*n* = 4).

Four per cent of the SCI cases (*n* = 11) occurred while people were involved in personal activities in their place of residence, at social venues or on the street. Seventy-five per cent of these cases (*n* = 9) were the result of a low fall, and the remaining cases high falls or from being hit or struck by an object.

Fifty-five per cent of these cases resulted in tetraplegia. Older people were particularly at risk of SCI from low falls that occurred during activities such as preparing for sleep or rising from bed, when in bathrooms, or when rising from chairs or couches.

Other and unspecified activity accounted for the remaining 156 cases of SCI (Table 5.3). One of the SCIs occurred while people were being nursed or cared for and sustained injury to the lumbar spinal segments. The remaining cases were categorised as *'Other/Unspecified'* as the activity at time of injury was not reported in the injury narrative and 61% (*n* = 95) of these cases were drivers or passengers involved in motor vehicle accidents. Forty-seven per cent of the *'Other/Unspecified'* cases resulted in tetraplegia.

Table 5.3: Incidence of SCI from traumatic causes by mechanism of injury and activity; Australia 2006–07 (counts and column percentages)

	Sports		Leisure		Working for income**		Other type of work		Personal activity		Other***/ Unspecified		Not reported		Group total	
Mechanism	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Traffic–Land transport: Motor vehicle occupants	0	0	0	0	7	19	*	*	0	0	53	34	0	0	61	23
Traffic–Land transport: Unprotected road users (motorcyclists, pedal cyclists, pedestrians)	0	0	*	*	8	22	0	0	0	0	38	24	*	*	49	18
Non-traffic–Land Transport: Motor vehicle occupants and unprotected road users	12	57	0	0	*	*	*	*	0	0	17	11	*	*	32	12
Low falls	0	0	*	*	*	*	*	*	9	82	23	15	0	0	40	15
High falls	*	10	*	*	8	22	6	50	*	*	17	11	*	*	38	14
Struck by or collision with a person or object	5	24	*	*	8	22	0	0	*	*	5	3	0	0	22	8
Water-related	*	*	19	63	0	0	0	0	0	0	0	0	0	0	21	8
Other	0	0	0	0	4	11	*	*	0	0	*	*	0	0	8	3
All mechanisms	**21**	**100**	**30**	**100**	**37**	**100**	**12**	**100**	**11**	**100**	**156**	**100**	*	**100**	**271**	**100**

* Cell counts of 3 or fewer, and related percentages, are not shown in tabulation.
** Includes travel to and from work (*n* = 3)
*** Includes Being nursed or cared for (*n* = 1)

6 Glossary

ASIA: refers to the American Spinal Injury Association

Duration of initial care: is the period of time from the date of injury to the date of discharge from the spinal unit (SU) to a patient's previous home, or to a new home, nursing home or other accommodation. This period of care includes retrieval of the patient from the scene of the accident, stabilisation in a hospital or intensive care unit, acute care in a SU and other wards, and rehabilitation.

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.

Incident case of SCI: a person who suffers an SCI, as defined by the CDC clinical definition, during a reporting period.

Neurological level of SCI: refers to the most caudal segment of the spinal cord with normal sensory and motor function on both sides of the body (i.e. the lowest level that has full function).

Paraplegia: refers to 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.

Tetraplegia: refers to 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. It is generally preferred outside the US.

Unprotected road users: refers to pedestrians, pedal cyclists and motorcycle riders.

Appendix 1

Structure and operation of ASCIR

The Australian Spinal Cord Injury Register (ASCIR) is a national register of incident cases of spinal cord injury which occur in Australia and overseas to Australian residents. The ASCIR operates as a collective venture of the Directors of all 6 spinal units in Australia and the National Injury Surveillance Unit (NISU), a Collaborating Unit of the Australian Institute of Health and Welfare (AIHW). The ASCIR is funded as part of the NISU program, which is managed and operated by the Flinders University Research Centre for Injury Studies (RCIS).

ASCIR governance and management is under the auspices of the ASCIR Operation and Management Board. The current members of the Board consist of the Chair (a spinal unit Director), AIHW Data Custodian for ASCIR data, three spinal unit Directors, two spinal unit physicians/researchers, and two other members who have experience in the operation of registers.

This management structure optimises the operation and use of the ASCIR. It ensures maintenance and development occurs with input from ASCIR stakeholders, fosters collaboration between the RCIS/NISU and spinal unit Directors and research staff, and assists the person with the role of AIHW Data Custodian to fulfil the requirements of that role.

NISU, a Collaborating Unit of AIHW, is responsible for the security, proper operation and use of ASCIR data. The AIHW Data Custodian at NISU (Associate Professor James Harrison, Director) is responsible to the AIHW for ensuring that the operation of the Register and the use of Register data comply with AIHW policies and procedures. The Data Custodian also 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*.

Two groups of patients are admitted to spinal units: new incident cases and prevalent cases. From July 1, 1995 all new incident SCI cases were registered at the 6 spinal units by registrars, ward clerks, or other attending health care workers.

The registration process begins in the spinal unit after patient stabilisation. The Director at each participating Unit is responsible for data collection and patient consent arrangements in their Unit. Consent arrangements differ between Units.

During the acute phase, the first page of the case registration form is completed, a copy sent to NISU and the original filed in the patient's case notes. Upon arrival at NISU, the data are checked for completeness and transcribed into the ASCIR database. In the case of electronic data reporting, the data are entered using a data uploading program in the Register's software. This process is the beginning of case registration of new incident SCI cases.

In terms of data reported, the scope of the first form includes patient history, demographic information, clinical assessment of patients during their acute stage of SCI, and a description of the event that led to their SCI.

At discharge of the patient from rehabilitation, the second part of the case registration form is completed. This form records details of their clinical status at discharge and any complications during the course of treatment and rehabilitation. A copy is forwarded to NISU to complete the registration process and the original is filed in the patient's case notes.

In order for the ASCIR to capture other non-registered prevalent cases, the registration status of each case is assessed as patients are admitted to the spinal unit. If patients are not identified as incident SCI cases and if they have not been registered previously, case registration forms are completed for each patient using incident SCI admission details from their case notes for the acute admission and rehabilitation phase of their episode of care. A readmission form is also completed for their current admission. In this way, the coverage of the Register is improved over time.

Data issues

Scope and ascertainment of SCI case registration data

All consenting patients identified as incident SCI cases admitted to all 6 spinal units are reported to NISU for case registration. Complete enumeration of cases is confirmed by unit Directors or staff at the end of each reporting period (financial year 1 July through 30 June). Ascertainment of persisting traumatic SCI cases is high and these cases are the focus of the report. Almost all such cases that are admitted to a SU are included. The great majority of all cases of persisting traumatic SCI are thought to be included in the Register, with the partial exception of cases occurring at age extremes. Nearly all cases are added to the Register during the initial period of hospitalisation following injury. A small number of other cases are added when they attend a SU at a later time. We are not aware of reasons to think that ascertainment differs between SUs. Formal investigation of ascertainment would require a case-linked, population-based study. Paediatric cases (patients aged less than 15 years) are generally treated in paediatric hospitals and have generally not been included in the Register. Hence, the report focuses on the age range 15 years and older. Case registration of SCI from non-traumatic causes is known to be incomplete. These patients are often treated in other hospitals' specialised units (e.g. oncology) rather than at spinal units. Such cases are described briefly in this report.

Rates

Incidence rates have been calculated as cases per million of the usually resident population of Australia. Population data were obtained from the Australian Institute of Health and Welfare and are similar to data presented in the Demographic Statistics Catalogue No. 3101.0 (ABS 2006). Annual rates were calculated using finalised population estimates as at 31 December for each year.

Except where otherwise stated, all-ages rates have been adjusted to overcome the effects of differences in the proportions of people at different ages (and different injury risks) in the populations being compared. Direct standardisation was employed, taking the Australian population in 2001 as the standard.

Tabulations and data reported

Where cell counts are 3 or fewer, the value and related percentage are not shown in tables. The omission of these values is to prevent potential patient identification and breach of patient confidentiality. Cell values and related percentages greater than cell counts of 3 may also be omitted if row or column calculations would reveal omitted cell values less than 3.

Confidence intervals

The ASCIR is designed to register all new cases of SCI at ages 15 years and older, so sampling errors do not apply to these data. However, the time periods used to group the cases (i.e. financial years) are arbitrary. Use of another period (e.g. 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 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 out of 20 occasions. An extreme rate in a single period of enumeration should not be ignored simply because of a wide confidence interval—a time series may show such a rate to be part of a trend.

Assignment and aggregation of NDS-IS codes

During case registration, incident cases of SCI from traumatic causes are routinely coded to NDS-IS Level 1 to meet the most basic requirement of injury surveillance. Injury data is coded to three data items: *External Cause – major groups and intent groups*, *Place of injury occurrence* and *Activity when injured*. In addition, a short narrative description of the circumstances of occurrence is collected.

To provide a smaller set of external cause categories that describe major mechanisms of injury that usually result in SCI, major groups of NDS-IS external causes (30 categories) were allocated to nine mechanism of injury categories. The structured injury narrative was used to cross check the existing external cause codes reported and to provide a consistent and accurate allocation process. Mechanism of injury and the NDS-IS main 'external cause' codes aggregated are summarised in Table A1.1.

Assignment to ASGC remoteness zones

The Australian Bureau of Statistics (ABS) has made available several concordance products to enable users to convert data for one type of geographic area (e.g., postcode) to another (e.g., Australian Standard Geographical Classification (ASGC) zones). Postcodes present in the ASCIR case records were recoded according to concordance tables sourced from the ABS into one of 6 available ASGC zones. For more information on the ASGC and conversion of data using concordance products please refer to the following ABS publication: Statistical Geography Volume 1 Australian Standard Geographical Classification (ASGC) 2006 (cat no. 1216.0).

Table A1.1: Mechanisms of injury and their relationship to NDS-IS external causes

Mechanism of injury	NDS-IS Level 1 code	Notes
Traffic–Land transport: Motor vehicle occupants	1, 2	Includes only cases where *Place of injury occurrence* is 7 (Street or highway [public road]). Excludes cases where *Place of injury occurrence* is 8–12. *Activity when injured* for occupants of motor vehicles who are not involved in leisure activities are coded to 8 (Other specified activity)
Traffic–Land transport: Unprotected road users (motorcyclists, pedal cyclists, pedestrians)	3, 4, 5, 6	Includes cases where *Place of injury occurrence* is 7 (Street or highway [public road]). Excludes cases where *Place of injury occurrence* is 8–12.
Non-traffic–Land transport: Motor vehicle occupants	1, 2	Includes cases where *Place of injury occurrence* is 8–12. Excludes cases where *Place of injury occurrence* is 7 (Street or highway [public road]).
Non-traffic–Land transport: Unprotected road users (motorcyclists, pedal cyclists, pedestrians)	3, 4, 5, 6	Includes cases where *Place of injury occurrence* is 8–12. Excludes cases where *Place of injury occurrence* is 7 (Street or highway [public road]).
Low falls (on the same level, or from a height of less than 1 metre)	9	
High falls (from a height of 1 metre or more)	8, 10	Includes falls from a horse.
Struck by or collision with a person or object	24, 30, 31,	Excludes cases (usually coded 31) that indicate from structured injury narrative water-related injuries.
Water-related	31	Includes cases (usually coded 31) that indicate from structured injury narrative water-related injuries.
Other	7, 19, 20, 25, 28, 29	Includes cases such as other transport, firearm, cutting, piercing object, electricity, other and unspecified external causes.

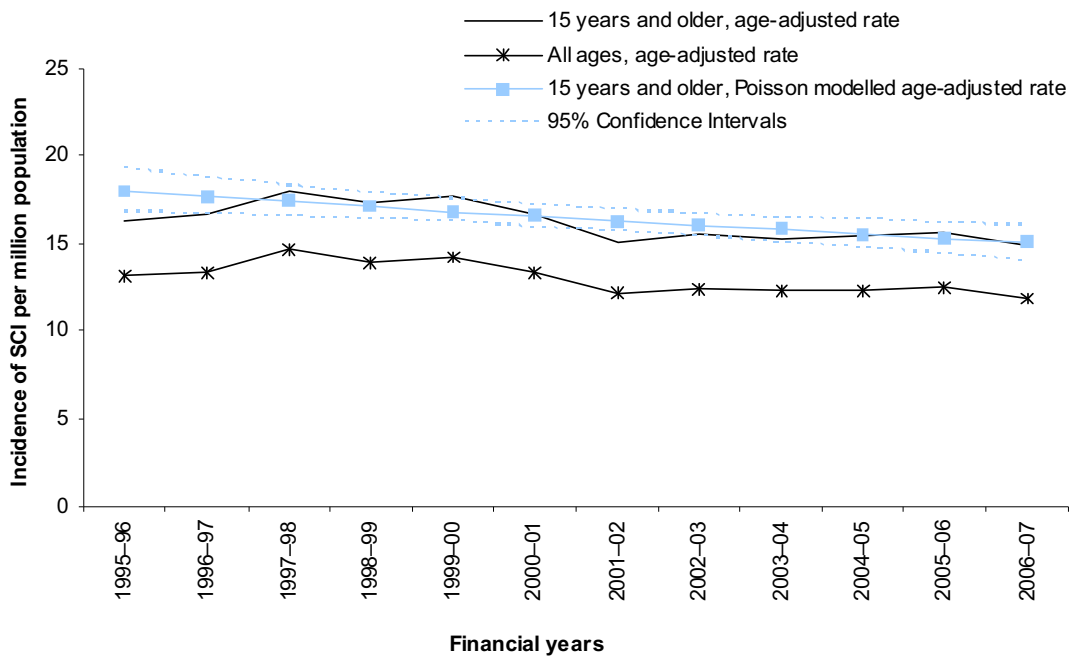


Figure A1.1: Incidence of persisting SCI from traumatic causes by financial year; Australia

In this report, trends in the incidence of persisting SCI from traumatic causes are presented in two ways. Both differ from the approach used in reports published before 2006. This section describes how the methods differ and compares the values obtained from each (Figure A1.1).

Figure 3.1 presents annual rates, age-adjusted by the direct method to the Australian population in 2001. Age-adjustment was used to allow for effects of change in the age composition of the Australian population. Analysis was restricted to ages 15 and older because that is the age-range for which ASCIR is considered to have good case ascertainment. These values are shown in Figure A1.1 as the series labelled '15 years and older, age-adjusted rate'. The values are as reported in previous editions of this document.

Figure A1.1 also presents results of Poisson modelling of age-adjusted rates. The modelled trend line shown is based on age-specific rates, which have been adjusted to take account of changing age composition. Analysis was restricted to the group aged 15 and older for the reason given above. Annual rates are shown in Figure A1.1 as the series '15 years and older, Poisson modelled age-adjusted rate'.

In reports published before 2006, we have generally reported all-ages rates of SCI, adjusted by the direct method. Rates calculated in this way are shown in Figure A1.1 as the series 'All-ages, age-adjusted rate'. This method does not allow for the likely under-ascertainment by the ASCIR of traumatic SCI cases occurring in those aged less than about 15 years. The values resulting from use of this method are about 20% lower than rates for those aged 15 years and older.

True rates of traumatic SCI in childhood are probably lower than rates in early adulthood. Hence, a version of the 'All-ages age-adjusted rate' series based on completely ascertained SCI at all ages would probably be higher than the series 'All-ages age-adjusted rate' as shown in Figure A1.1 and lower than the series '15 years and older, age-adjusted rate'.

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AIHW

Severe spinal cord injury (SCI) is a very debilitating and costly injury.

This report presents information from the Australian Spinal Cord Injury Register (ASCIR) on 348 newly incident cases from trauma and disease in 2006–07. During the year, 272 new cases of SCI from traumatic causes were registered in Australia, an age-adjusted incidence rate of 14.9 cases per million population. The most common clinical outcome of SCI from traumatic causes was incomplete tetraplegia (98 cases).

Transport related injuries (52%) and falls (29%) accounted for over three-quarters of the 271 cases of traumatic SCI (one case under the age of 15 years was excluded from these analyses). Cases also occurred during sport (n = 21) and working for income, including travel to and from work (n = 37). Falling was the most common type of event leading to traumatic SCI at older ages.

The ASCIR is a collaborative activity of the AIHW National Injury Surveillance Unit and all of the specialist spinal units in Australia.

ISBN 978 1 74024 818 1