

Spinal cord injury, Australia, 2000–01



Peter O'Connor



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Introduction

The prevention and control of injury is 1 of 7 National Health Priority Areas (AIHW & DHFS, 1997a; AIHW & DHFS, 1997b; DHA, 2003). One of the performance indicators for this priority area is the annual incidence rate of spinal cord injury (SCI) from traumatic causes. The Australian Spinal Cord Injury Register (ASCIR), established in 1995, enables the patterns and trends in SCI to be monitored. Australia was the first country to implement a national registry of SCI (O'Connor, 1999).

In order to facilitate national and international comparisons, the case definition that has been adopted for the registration of traumatic cases of SCI in Australia is the US Centers for Disease Control (CDC) clinical definition:

... 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 statistical information on new cases of spinal cord injury (SCI) from traumatic causes that occurred during the financial year 2000–01 in Australia to Australian residents.

This is the sixth statistical report based on data from the ASCIR, reported on the basis of financial year. The previous reports, based on annual data from 1995–96 to 1999–00, were published in the *Australian Injury Prevention Bulletin* (O'Connor & Cripps, 1997; Cripps & O'Connor, 1998; O'Connor & Cripps, 1998; O'Connor, 2000; O'Connor, 2001). Terms used in the report are defined in the Glossary.

In 2000–01 ASCIR was in its seventh year of operation and had nearly 11,000 cases registered.

Overview of spinal cord injury from traumatic causes

There are 6 specialist spinal cord treatment/management units (SUs) located in 5 Australian States. The SUs reported 259 new cases of SCI from traumatic causes in Australia during 2000–01, excluding cases that had suffered no neurological loss at admission and/or separation. The information presented in this report is primarily based on status at admission.

The ASCIR, through a process of cross-checking case registrations with SU admissions, is known to provide complete coverage of the adult cases of SCI in Australia that result in persisting neurological loss. It provides incomplete coverage of paediatric cases of SCI (3 cases were recorded in 2000–01).

Trends in SCI¹

The age-adjusted incidence rate of SCI in 2000–01 was estimated to be 13.6 new cases per million population, a small decrease from 1998–99 (14.0 new cases per million population). The 1991 Australian population was used as the standard population for the calculation of age adjusted rates. Figure 1 shows the age-adjusted rate of SCI for 2000–01 compared with the rates for earlier years.

State or Territory of usual residence

Figure 2 shows the age adjusted incidence rate of SCI from traumatic causes by State and Territory of usual residence.

- It was evident from a comparison of the incidence rates and their 95% confidence intervals (Poisson distribution) that none of the States had an incidence rate significantly different from the national rate or any other state rate.
- Victoria has had the lowest rate of SCI over the period 1995–96 to 2000–01 (although not significantly different from the national rate in any individual year).

¹ Trends based on status at admission may differ slightly from trends based on status at discharge.

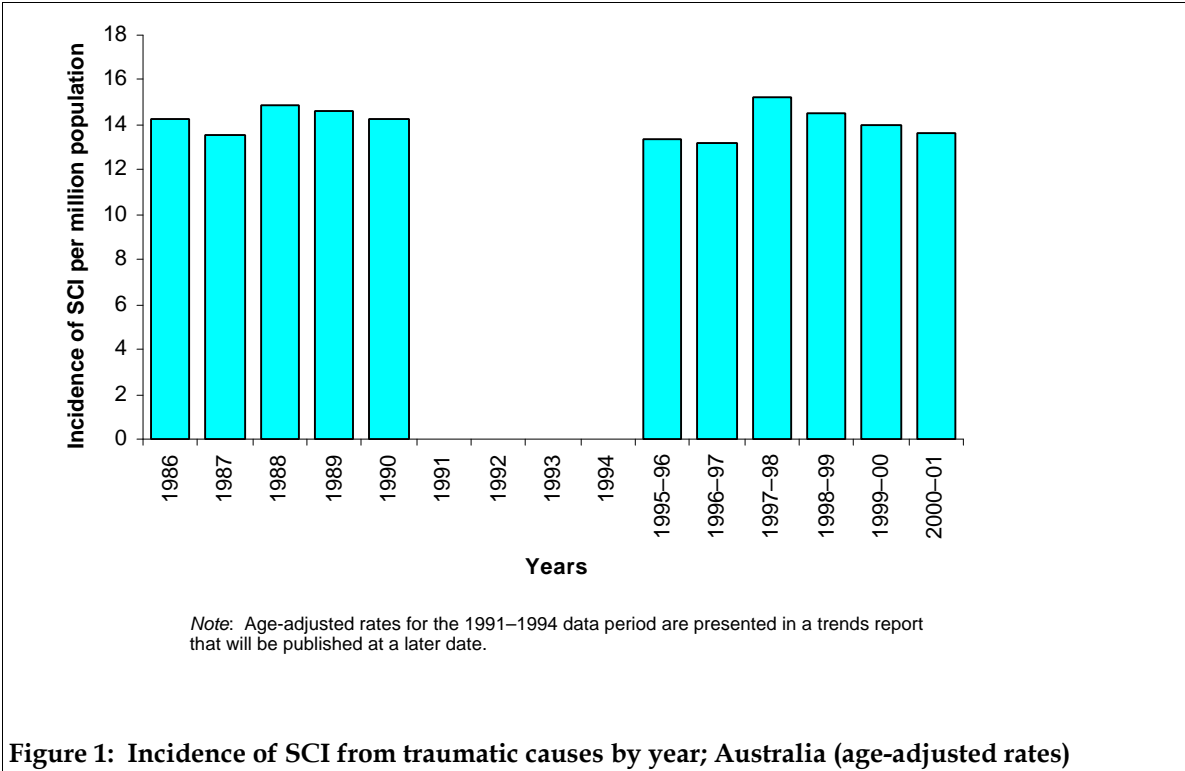


Figure 1: Incidence of SCI from traumatic causes by year; Australia (age-adjusted rates)

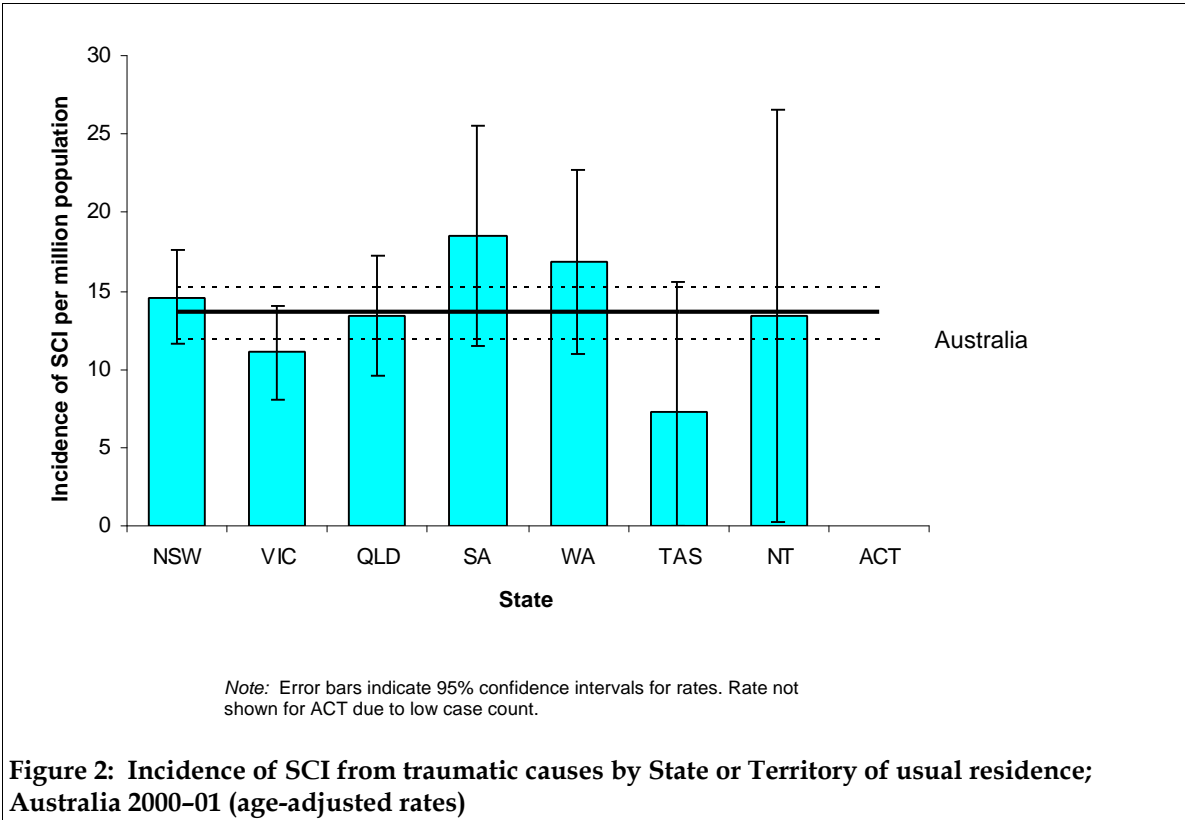


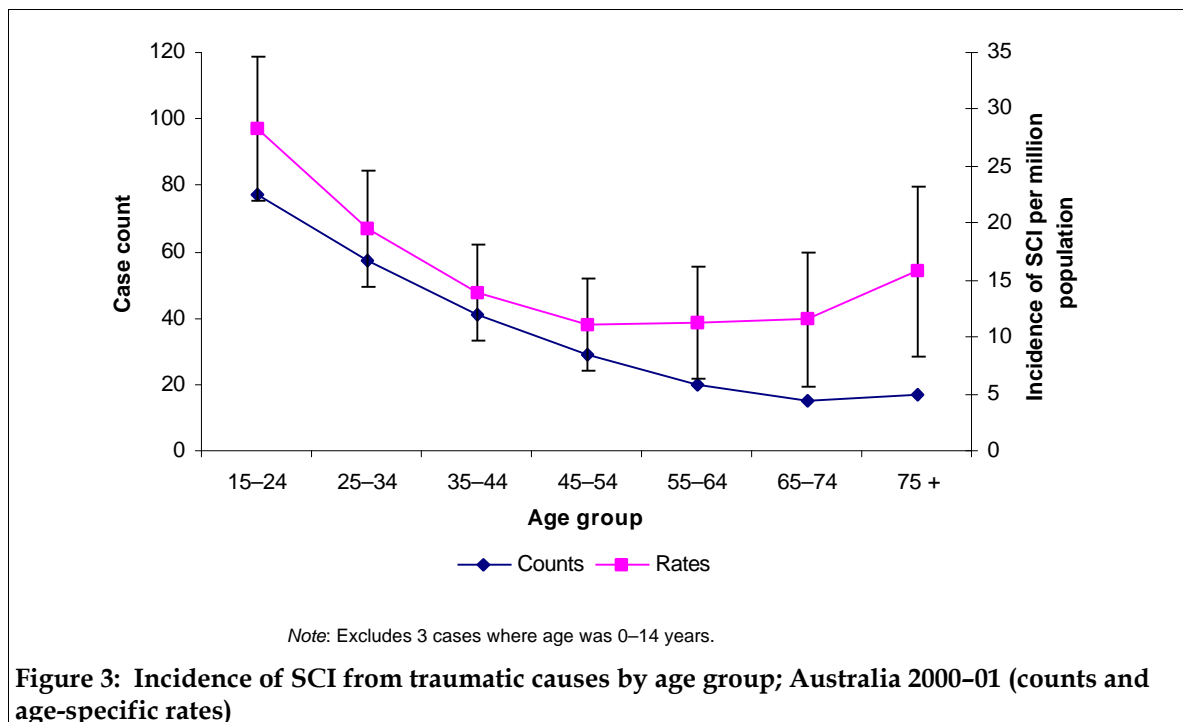
Figure 2: Incidence of SCI from traumatic causes by State or Territory of usual residence; Australia 2000-01 (age-adjusted rates)

Age and sex distribution

The age distribution of SCI from traumatic causes is presented in Figure 3. The age group of 0–14 years was excluded from the figure because of known poor coverage of this group by SUs.

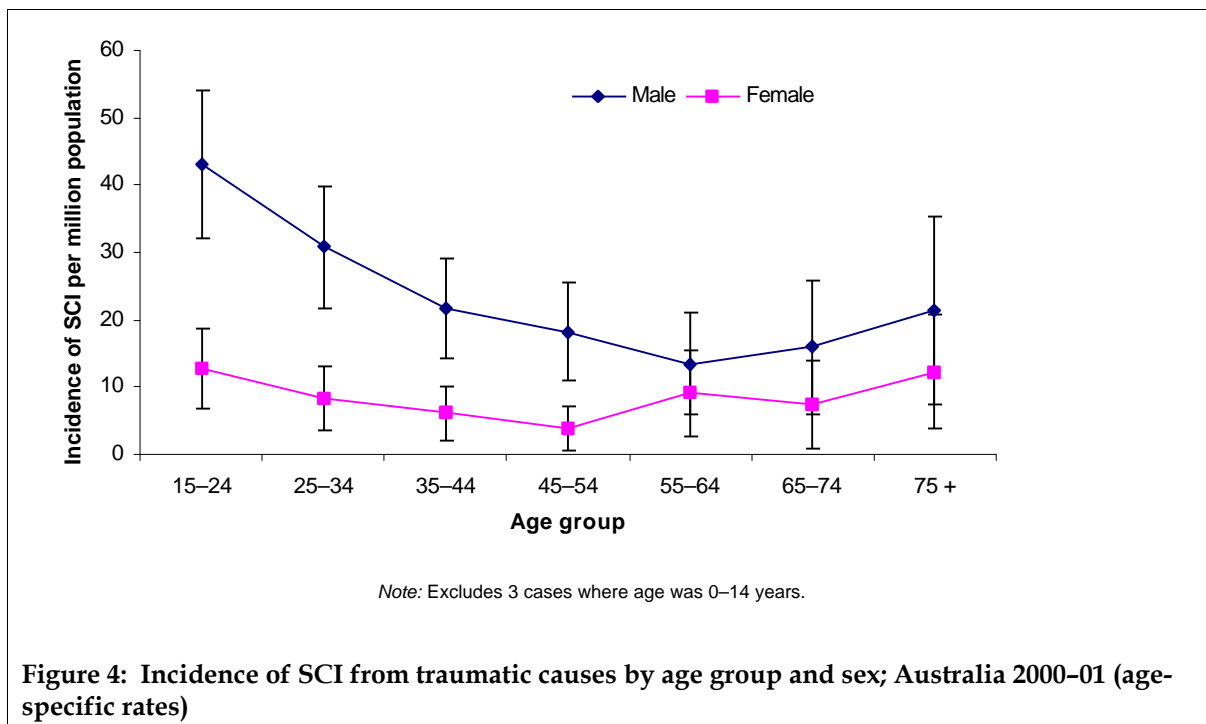
From Figure 3, it was evident that:

- The highest age specific rate, occurred in the age group 15–24 years. With increasing age, the age-specific rate declined substantially to the age group 45–54 years after which it increased.
- The wide 95% confidence intervals on the rates (Poisson distribution) reflect the small case count for individual age groups. When age groups 15–24 years and 25–34 years were combined, it was evident that the rate for this group (24.0 new cases per million of population) was significantly higher than the rate for the older combined age group of 35 years and above (12.9 new cases per million of population).



Of the cases of SCI from traumatic causes aged 15 years and above, 75% were male and 25% were female. The incidence of SCI by age group and sex, presented in Figure 4, shows the following:

- A higher rate of SCI for males at all ages (statistically significant under the age of 55 years).
- A substantial sex difference in a number of the age groups. The male to female rate ratios ranged from a low of 1.5:1 (in the age group 55–64 years) to a high of 4.7:1 (in the age group 45–54 years).



Factors associated with the SCI event

In addition to collecting information on the demographic features of cases of SCI, the ASCIR also collects information about factors associated with the injury event such as external cause of injury, role of human intent, type of place of injury, and type of activity at the time of injury. These factors, which were coded in ASCIR according to the National Injury Surveillance Unit (NISU) National Data Standards for Injury Surveillance (NDS-IS), provide useful information for understanding the causes and prevention of SCI (NISU, 1995).

Intent

Most of the cases of SCI arose from accidental causes (n=244). Five cases arose from suicide attempts and 4 were due to assaults. Six cases arose from causes of other and unspecified intent.

External cause of injury

The external cause of injury for cases of SCI from traumatic causes is presented in Figure 5. It was evident that:

- Transport-related injury accounted for 56% of the cases of SCI (n=144). Thirty-two per cent were motor vehicle occupants (n=82), 21% were unprotected road users (n=54) and 3% arose from other transport modes (n=8). Seventy-four per cent (n=61) of the motor vehicle occupant SCIs and 87% (n=47) of the unprotected road user SCIs were aged 15–44 years.
- Nineteen per cent (n=50) were from high falls (drop of 1 metre or more) and 10% (n=27) were from low falls. Thirty-eight per cent (n=11) of the low falls cases were aged 75 years or older.

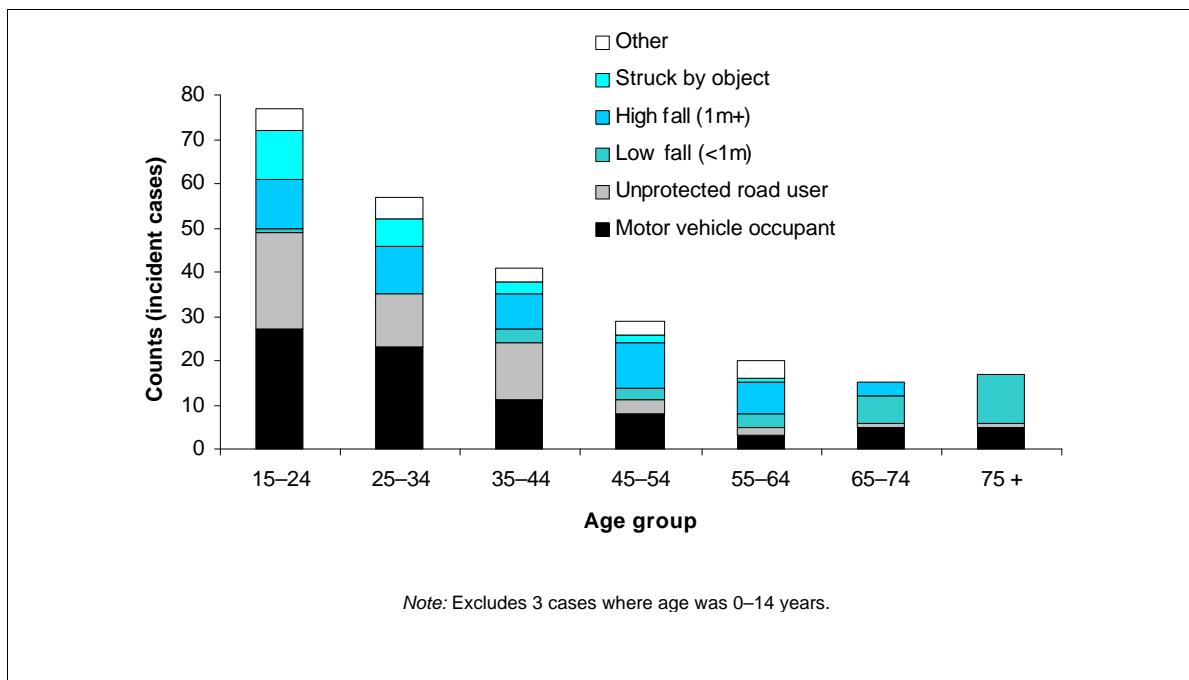


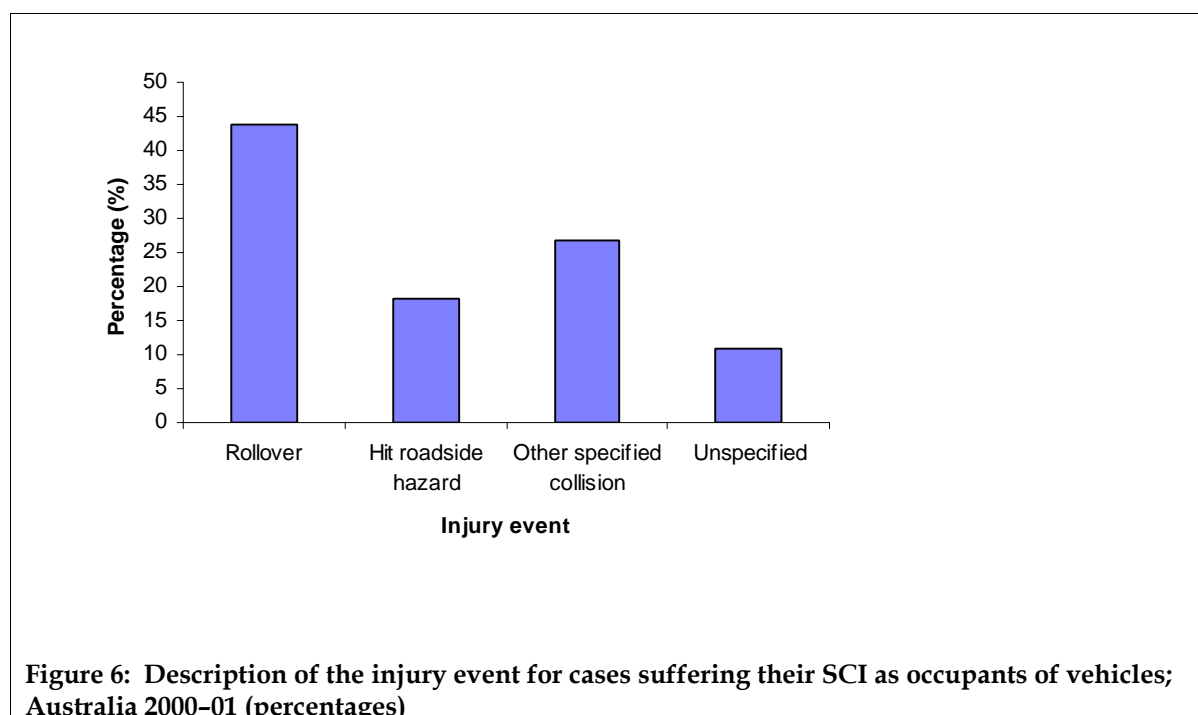
Figure 5: Incidence of SCI from traumatic causes by external cause of injury (major groupings) and age group; Australia 2000-01 (counts)

Motor vehicle occupants

Further assessment of the cases that were occupants of motor vehicles (n=82), using the text description of the injury event provided on the ASCIR registration form, revealed that:

- Forty-four per cent were due to vehicle rollover;
- Eighteen per cent were due to collision with a roadside hazard (i.e. tree, pole or other fixed object); and
- Thirty-eight per cent arose from other and unspecified collisions (Figure 6).

Recent Australian research has shown that the odds of SCI are substantially higher for occupants of vehicles having a high centre of gravity (eg. four-wheel-drive vehicles and passenger vans) compared with sedan-type vehicles (O'Connor, 2002).



Falls in the elderly

The leading cause of injury death and hospitalisation in the elderly (i.e. those aged 65 years or older) is falls (Harrison & Dolinis, 1995; Fildes, 1994). Falls are also an important cause of SCI in the elderly. In 2000-01, 26% of all fall-related SCIs, and 63% of low fall SCIs, occurred in persons aged 65 years or older.

Place of injury

The road environment was the primary place of SCI (46% of cases). Seventeen per cent of cases occurred in the home. Five per cent occurred at commercial and industrial sites. Five per cent occurred on a farming property, excluding a farmhouse. Three per cent occurred in an aquatic environment. The remainder occurred at other and unspecified places.

Eight cases of SCI occurred at an oval and all of these involved rugby being played as a sport.

Type of activity when injured

Most of the people who sustained SCI were undertaking some form of non-sporting leisure activity (n=103, 40%) or domestic activity (n=22, 8%). Twenty-one of the cases (8%) were engaged in a sporting activity, 8 arising from rugby. Fifty cases (19%) were working for income. The remaining cases were engaged in 'other and unspecified' activities (n=63, 24%).

Clinical information

Information on the neurological level of SCI and extent of injury to the cord is routinely reported by SUs.

Neurological level of injury

The neurological level of SCI at admission is presented in Figure 10. The most commonly injured spinal cord segments, amongst the 258 cases with a defined neurological level of injury, were the cervical segments, particularly C4 to C6 (9%, n=22) and segments at the junction of the thoracic and lumbar spine.

Neurologic category

The overall severity of SCI, for cases with a neurological deficit, is usually measured by a combination of the neurological level and extent of injury into 4 neurologic categories (complete tetraplegia, incomplete tetraplegia, complete paraplegia, and incomplete paraplegia). Table 1 presents the counts and column percentages for the 4 neurological categories of SCI, as well as a more specific breakdown of the paraplegia category.

- Of the cases with a specified neurologic category (n=258), 55% had an injury to the cord at the cervical level, resulting in impairment or loss of motor and/or sensory function in the arms as well as in the trunk, legs, and pelvic organs. This degree of impairment is referred to as tetraplegia.
- Forty-five per cent of the cases with a specified neurologic category had an injury at the thoracic, lumbar, or sacral (but not cervical) levels, with an impairment or loss of motor and/or sensory function in these segments of the spinal cord. This degree of impairment 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.
- The most common neurologic category was incomplete tetraplegia (36% of the cases with a specified neurologic category, n=92), followed by incomplete paraplegia (23% of total, n=59), complete paraplegia (22% of total, n=56), and complete tetraplegia (20% of total, n=51).
- Complete injury was most common in the thoracic spinal segments, a finding which is explainable by the small diameter of the spinal canal in this region in relation to the size of the cord (Bauer & Errico, 1991; Bohlman, 1985; Bohlman et al., 1985; White & Panjabi, 1990).

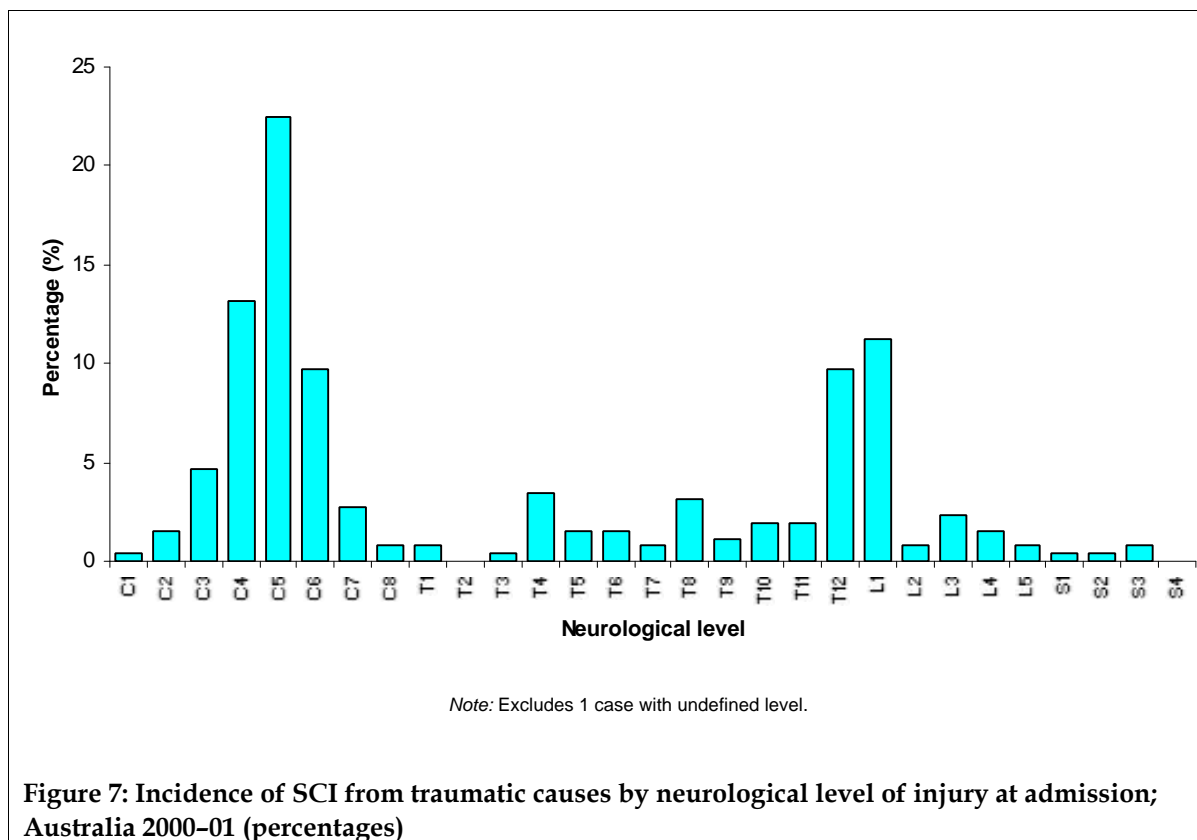


Figure 7: Incidence of SCI from traumatic causes by neurological level of injury at admission; Australia 2000-01 (percentages)

The external cause of injury for cases of SCI from traumatic causes is presented by neurological level in Table 2.

- Motor vehicle occupants most often suffered from injury to the cervical segments of the spine, resulting in tetraplegia.
- Unprotected road users most often suffered paraplegia primarily as a result of injury to the thoracic segments of the spinal cord.
- Cases resulting from low falls generally resulted in tetraplegia.
- High falls most often resulted in paraplegia primarily as a result of injury to the thoracic and lumbar segments of the spinal cord.
- SCI arising from being 'struck by or colliding with an object' overwhelmingly resulted in tetraplegia (e.g. cases related to diving).

Table 1: Incidence of SCI from traumatic causes by neurological level (major grouping) and extent of injury at admission; Australia 2000–01 (counts and column percentages)

Extent of injury	Tetraplegia		Paraplegia						Not specified		Total	
	Cervical		Thoracic		Lumbar		Sacral					
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Complete	51	36	44	65	10	23	2	50	0	0	107	41
Incomplete	92	64	24	35	33	77	2	50	0	0	151	58
Not specified	0	0	0	0	0	0	0	0	1	100	1	0
Total	143	100	68	100	43	100	4	100	1	100	259	100

Table 2: Incidence of SCI from traumatic causes by external cause (major groupings), and neurological level, of injury at discharge; Australia, 2000–01 (counts and column percentages)

External cause	Tetraplegia		Paraplegia						Not specified		Total	
	Cervical		Thoracic		Lumbar		Sacral					
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Motor vehicle occupant	42	29	23	34	14	33	2	50	1	100	82	32
Unprotected road user	23	16	22	32	9	21	0	0	0	0	54	21
Low fall (<1m)	24	17	2	3	2	5	1	25	0	0	29	11
High fall (1m +)	22	15	13	19	14	33	1	25	0	0	50	19
Struck by object	22	15	1	1	1	2	0	0	0	0	24	9
Other cause	10	7	7	10	3	7	0	0	0	0	20	8
Total	143	100	68	100	43	100	4	100	1	100	259	100

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Glossary

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.

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).

New incident case of SCI: a person who suffers an SCI, as defined by the CDC clinical definition, during this reporting period (i.e. in 2000–01).

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, secondary 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 motor cycle riders.

Data issues

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 *Demographic Statistics Catalogue* No. 3101.0 (Australian Bureau of Statistics). Annual rates were calculated using finalised population estimates as at 31 December for each year except 2000–01 which were preliminary estimates.

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 that are compared. Direct standardisation was employed, taking the Australian population in 1991 as the standard.

Confidence intervals

All (or nearly all) cases of SCI are registered, 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.

INJURY RESEARCH & STATISTICS

Spinal cord injury is one of the more debilitating injuries that a person can suffer. Australia was the first country to implement a national population-based register to enable surveillance of spinal cord injury cases to help prevent and control this problem. This report provides information on case registrations for the period 2000–01.

During the financial year, there were 259 new cases of spinal cord injury in Australia. Approximately one-third of these were the result of motor vehicle accidents, 44% of which were due to vehicle rollover. Falls were a significant cause of spinal cord injury in the elderly, with almost two-thirds of low falls reported causing spinal cord injury in this group. Twenty-one cases were engaged in sporting activities, eight of which were due to playing rugby. Fifty cases were work related.

The most common outcome of trauma to the spinal cord was incomplete tetraplegia (92 cases), resulting in impairment of motor and sensory function in both upper and lower limbs.