

Spinal Cord Injury, Australia 1996/97

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Introduction

This report presents statistical information on new cases of spinal cord injury (SCI) from traumatic causes that occurred during 1996/97 in Australia to Australian residents. It is the second statistical report based on data from the Australian Spinal Cord Injury Register (ASCIR). The first report on the national incidence of traumatic SCI, based on data for 1995/96, was published in 1997 in the Australian Injury Prevention Bulletin¹.

The data presented in this report will be compared to the earlier report, where relevant, to highlight any major differences as well as similarities between the two reporting periods. Terms used in the report are defined in the Glossary.

The ASCIR is now in its third year of operation and has over 6,000 cases registered, about 4,000 of which originated from a register that operated from 1986 to 1991. The continuity of reporting of spinal injury data is dependent on the ongoing support of the Director's of Australia's six specialist treatment units.

The ASCIR is managed by the Australian Institute of Health and Welfare's National Injury Surveillance Unit which is a program of the Research Centre for Injury Studies of the Flinders University of South Australia.

Overview of spinal cord injury from traumatic causes

The spinal units (SUs) reported two hundred and sixty-four cases of SCI from traumatic causes, newly incident in 1996/97. Complete enumeration of cases at each SU was confirmed by the Director or Staff. However, registration information was not provided for 12 cases by two SUs (8 cases from New South Wales and 4 from Queensland). The 252 cases for whom case registration information was supplied were characterised as follows:

- 15 had no deficit, mostly admitted for suspected SCI or transient cord concussion;
- 8 were reported to have died on ward during treatment (mainly elderly patients, mean age of 76 years);
- 229 cases were discharged from the SUs with a neurological deficit.

Given the rarity, at present, of neurological recovery from SCI, the cases discharged with a neurological deficit can be regarded as 'persisting cases'. These cases are an important group to monitor because they contribute to the prevalent SCI population whose health care and welfare needs require ongoing management and financial support. The size of the group reflects the cumulative effects of the rate of incidence of SCI, the patient response to retrieval and treatment, and the rate of survival to discharge. The annual incidence rate of persisting cases of SCI from traumatic causes has been selected as one of the indicators of the National Health Priority Area of Injury Prevention and Control².

Trends in persisting cases of SCI

The assessment of the rate of persisting cases of SCI in 1996/97 was affected by missing information for 12 cases. Given that a neurological deficit is the predominant outcome of SCI cases referred to SUs, these 12 cases were included as persisting cases with an age distribution matching that of the reported cases. This enabled a national age adjusted rate to be estimated using direct standardisation, taking the Australian population in 1991 as the standard.

Based on the cases identified as having been discharged from a SU with a neurological deficit (229 cases), plus 12 missing cases, the age adjusted incidence rate of persisting cases of SCI in 1996/97 was estimated to be 13.2 per million of population in 1996/97. This was a slight decrease from 1995/96 (13.4 per million of population).

Figure 1 shows the age adjusted rate of persisting cases of SCI from 1986 to 1990 and 1995/96, as presented in the earlier

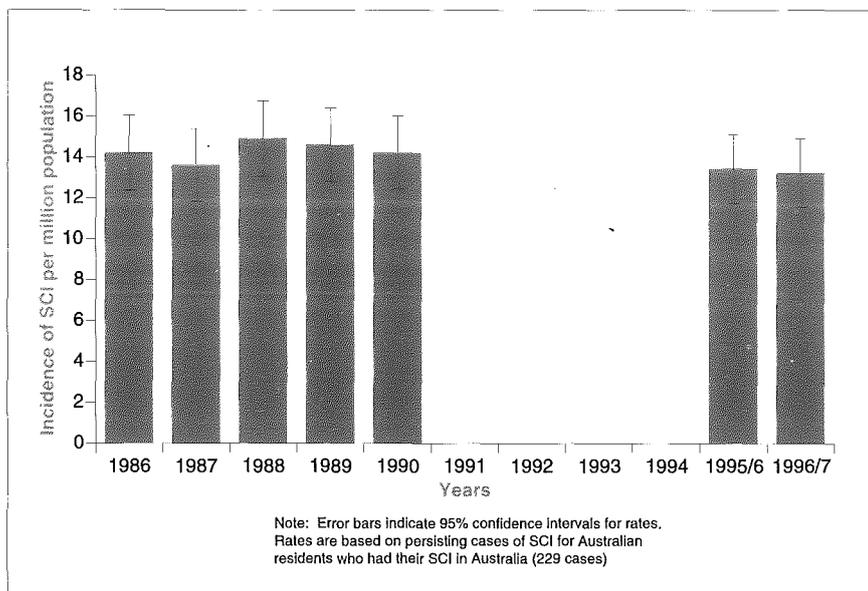


Figure 1: Incidence of persisting SCI from traumatic causes by year, Australia 1996/97 (age adjusted rates)

'Bulletin'¹, and for 1996/97. It is evident that whilst there was no statistically significant difference in the rates of persisting SCI over the period, the reported values had been trending downwards to a small degree from 1988 to 1990 and from 1995/96 to 1996/97. In the absence of information for the period 1991 to 1994 it cannot be determined whether the trend has been uniformly downward from 1988 or whether it has been broken by the year to year fluctuations evident from 1986 to 1988. Registration of all cases incident in the period 1991 to 1994 would improve the utility of the ASCIR in monitoring changes in SCI incidence over time. This would be important for the development and assessment of national targets for SCI reduction. During the 1998 International Medical Society of Paraplegia (IMSOP) Australasian Branch meeting, SU Directors agreed to provide these data to the ASCIR.

State of usual residence

Figure 2 shows the age adjusted rate of incidence of persisting SCI from traumatic causes by state of usual residence. No rate was shown for the Northern Territory due to the non-reporting of injury dates for some cases, uncertainty about the reliability of data on a number of the remaining cases, and a low case count. The incidence rate for the ACT was not reported due to a low case count. The reported incidence rates for New South Wales and Queensland were estimates which included the cases (eight cases and four cases, respectively) whose registration information was missing and whose age distribution was matched to that of the nationally reported cases.

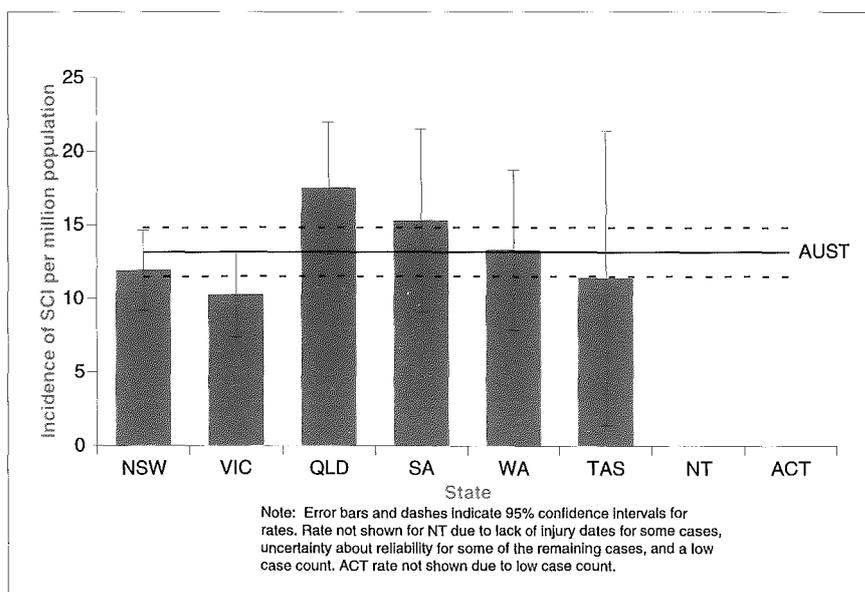


Figure 2: Incidence of persisting SCI from traumatic causes by State of residency, Australia 1996/97 (age adjusted rates)

- It was evident from the 95% confidence intervals on the rates, based on the Poisson distribution, that no State had a rate that was significantly different from the national incidence rate in 1996/97.
- No State had a rate that was significantly different from any other State in 1996/97. This differed from 1995/96 where the rate for Queensland was significantly higher than that of Victoria.
- The incidence rates ranged from a high of 17.5 SCI cases per million of population in Queensland to a low of 10.2 SCI cases per million of population in Victoria, in 1996/97. The Queensland rate remained the highest of any State during 1995/96 and 1996/97.
- All States, except South Australia had a reduction in the point estimate of the incidence rate from 1995/96 to 1996/97. South Australia's incidence rate increased from 11.6 to 15.3 SCI cases per million of population over the period (not statistically significant).

Age and sex distribution

The age distribution of persisting cases of SCI from traumatic causes is presented in Figure 3. No adjustment was made for the 12 missing cases here, nor subsequently in the report, as the interest centred not on the absolute value of the incidence rate or case number, but in its change across age and other parameters. The age group of 0 to 14 years was excluded from the figure because of a suspected poor coverage of this group by SUs. Most of these cases would be treated at paediatric hospitals and would be small in number.

From Figure 3, it was evident that:

- The highest case count, and age specific rate, occurred in the age group 15-24 years. This group accounted for 28 per cent of the persisting cases of SCI from traumatic causes.
- With increasing age, the age specific rate declined to the age group 55-64 years, after which it increased.
- The pattern in the age specific incidence rates of the elderly cases in 1996/97 differed from those reported in 1995/96. In 1996/97 the rate increased from the age group '65-74' to '75 plus', whereas in 1995/96 there was a sharp decline. The 95% confidence intervals on the rates, based on the Poisson distribution, for 1995/96 and 1996/97 indicated that the rate difference for the '75 plus' age group was not significant (not likely to have been affected by the missing cases for 1996/97 referred to earlier). Comparison of the characteristics of the cases in this age group indicated that, whereas in 1995/96 all except one of the seven cases was a fall and none was a motor vehicle occupant, in 1996/97, six of the fourteen cases was a motor vehicle occupant (five were drivers) and the remainder were falls. The apparent variation in the aetiological factors of SCI in this age group is difficult to interpret.
- There was a statistically significant difference in the rates between the age group 15-24 and each of the ten-year age groups from 35-64 years. None of the other apparent differences in the rates between age groups evident in the figure were statistically significant.

Of the persisting cases of SCI from traumatic causes, 80 per cent were male and 20 per cent were female. The incidence of

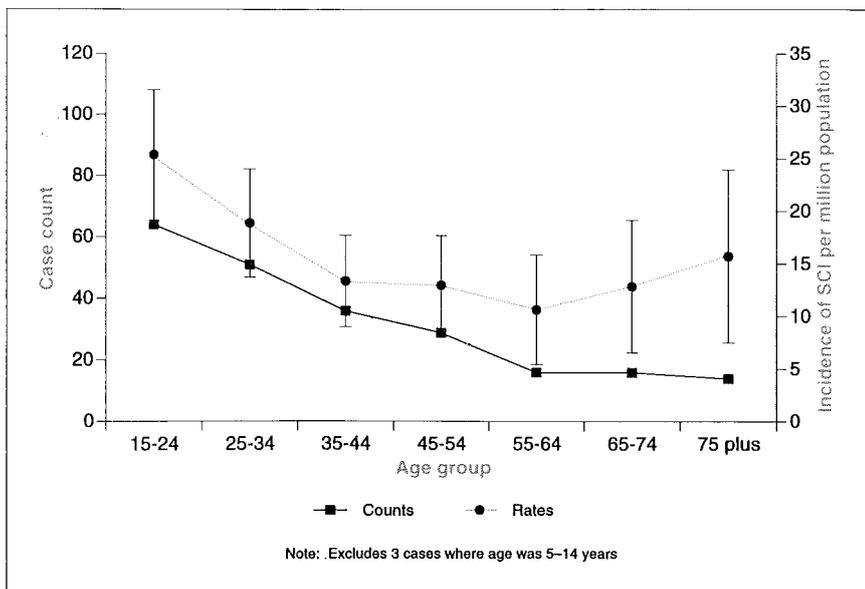


Figure 3: Incidence of persisting SCI from traumatic causes by age group, Australia 1996/97 (counts and age specific rates)

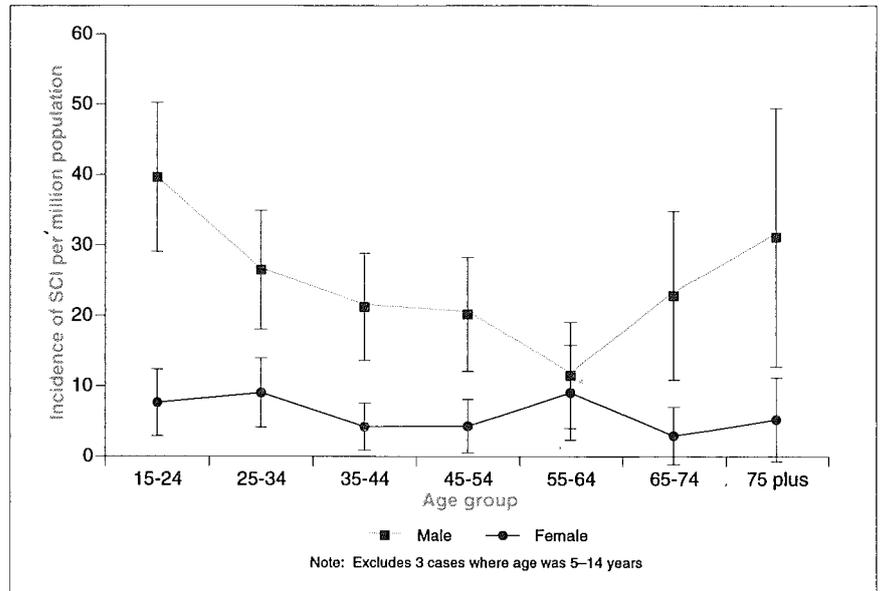


Figure 4: Incidence of persisting SCI from traumatic causes by age group and sex, Australia 1996/97 (age specific rates)

persisting SCI by age group and sex, presented in Figure 4, shows the following:

- A higher rate of SCI for males at all ages except for the 55-64 year age group (statistically significant).
- A substantial sex difference in a number of age groups. The male to female rate ratios ranged from a low of 1.3:1 (in the age group 55-64 years) to a high of 7.7:1 (in the age group 65-74 years).

Factors associated with the SCI event

In addition to collecting information on the demographic features of cases of SCI, the ASCIR also collected 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)³, provide useful information for understanding the cause and prevention of SCI.

External cause of injury

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

- Motor vehicle occupants accounted for the highest proportion of all persisting cases of SCI (27 per cent, n=60). Sixty-seven per cent (n=40) of these cases were in the age group 15-44 years.

- Twenty-three per cent (n=53) were from high falls (drop of 1 metre or more). Eighty-one per cent (n=43) of these cases were in the age group 15-54 years.
- Eleven per cent (n=25) were attributed to diving or other water-related accidents. In the age group 15-24 years, accidents of this type were second only to transport accidents (motor vehicle occupants and unprotected road users) as the cause of SCI. The number of SCIs from this cause in 1996/97 (n=25) was almost twice the number reported in 1995/96 (n=13). Of these cases, 40 per cent (n=10) occurred in the surf, 20 per cent (n=5) in swimming pools, and 40 per cent (n=10) in other water-related accidents†. It is difficult to know what to make of the apparent increase in water-related SCI over such a short period. There have been anecdotal reports in the daily press over the recent summer of an increase in water-related accidents which, if that is true, could further increase the incidence of SCI from this cause in 1997/98. To more fully assess the nature and magnitude of any trends in SCI from diving or other water-related accidents would require a study over a longer time period. Currently, there are some gaps in the available time series information, which are, however, being addressed with the assistance of the Directors of the SUs.
- Eleven per cent (n=24) were from low falls (fall on the same level, or less than 1 metre), and 63 per cent of these cases were aged 55 plus.
- Eleven per cent (n=24) of cases were unprotected road users. Seventy-nine per cent (n=19) of these cases were motor cyclists. Seventy-five per cent (n=18) of the unprotected road users were in the 15-34 year age group.

- Eighteen per cent (n=40) of cases of SCI were coded to other causes, such as struck by person or object (17 cases), horse-related (6 cases), firearms and stabbing (4 cases), other transport (3 cases), and the remaining 10 cases coded to other or unspecified causes.

Clinical information

The monitoring of clinical information on SCI enables the patients' outcomes in response to treatment to be studied and provides, indirectly, 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 degree of impairment is routinely reported by SUs at admission and discharge. Other information that would assist in the monitoring of the health and welfare of this group in the community after their discharge from rehabilitation is not yet fully established and is a future need.

The clinical picture of persisting cases of SCI was affected by incomplete reporting. There were 67 cases for whom the neurological category of injury at discharge was not reported. Analysis of the characteristics of these cases, compared with the other 162 cases for whom neurological category was reported, revealed no significant nor substantial differences on the basis of the neurological level of injury at admission, the extent of injury at admission, ASIA impairment category at admission, age group, and length of stay in hospital. Given that there was no evidence of unrepresentativeness, the following discussion of the clinical features of SCI was based on the 162 cases for whom neurological category was reported.

Neurological level of injury

The neurological level of SCI at discharge is presented in Figure 6.

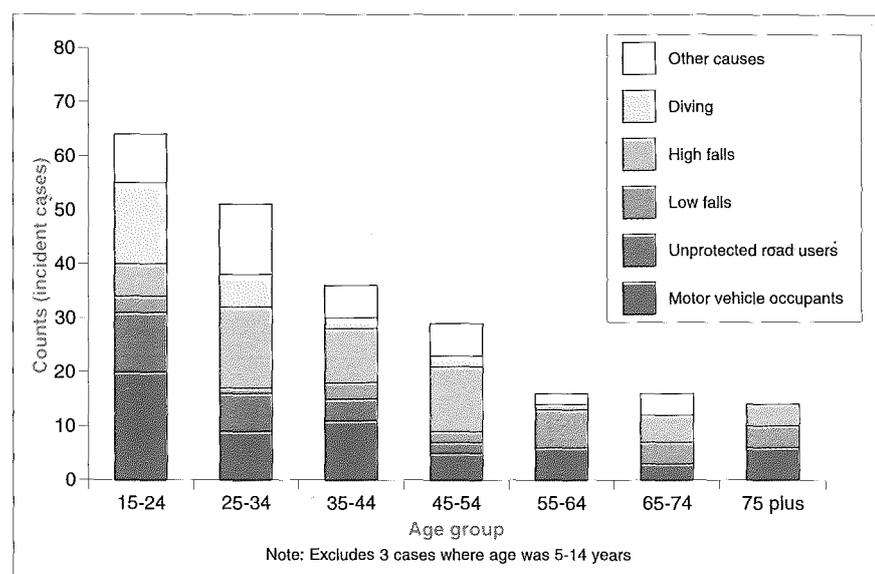


Figure 5: Incidence of persisting SCI from traumatic causes by external cause of injury (major groupings) and age group, Australia 1996/97 (counts)

- Forty-five per cent of the cases (n=73) 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.
- Fifty-five per cent (n=89) 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.

† Note: Diving and other water-related accidents were identified from the structured narrative description of the injury event provided on the 'Case Registration Form' as there was no specific code for this group in NDS-IS version 2.0. The coding will be reviewed to reflect recent changes in external cause coding in NDS-IS version 2.1 and improved activity coding, and will be implemented during 1998

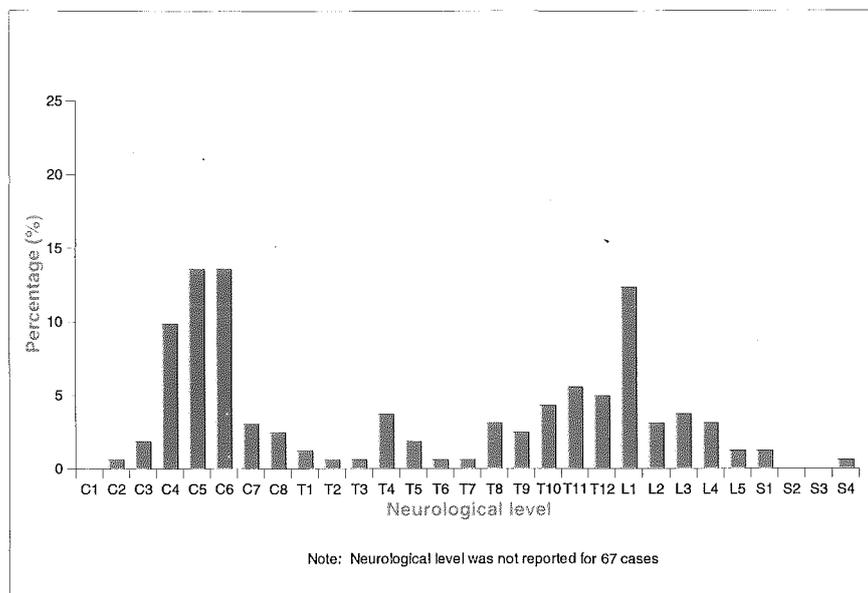


Figure 6: Incidence of persisting SCI from traumatic causes by neurological level of injury at discharge, Australia 1996/97 (percentages)

- Injury to the cervical segments resulting in tetraplegia was more common in 1995/96 (51%, n=92) than in 1996/97 (45%, n=73). This change was not statistically significant.
- The most commonly injured spinal cord segments were the cervical segments, particularly C4 (10%, n=16), C5 (14%, n=22), C6 (14%, n=22), the lumbar segment L1 (12%, n=20), and the lower thoracic segments.
- The frequency of injury to the L1 (n=20) spinal segment in 1996/97 almost doubled the frequency reported in 1995/96 (n=12). This change was not statistically significant. The increase was most apparent in the high falls group (increased to 11 in 1996/97 from 4 in 1995/96). Half of the cases suffered complete impairment at this level.

Neurologic category

The overall severity of SCI is usually measured by a combination of the neurological level and extent of injury into five neurologic categories (complete tetraplegia, incomplete tetraplegia, complete paraplegia, incomplete paraplegia, and complete recovery). Table 1 presents the counts and column percentages for the four neurological categories relevant to a discussion of persisting cases of SCI, as well as a finer breakdown of the paraplegia category.

Table 1: Incidence of persisting SCI from traumatic causes by neurological level (major grouping) and extent of injury at discharge, Australia 1996/97 (counts and column percentages)

Extent of injury	Tetraplegia		Paraplegia								Total	
	Cervical		Thoracic		Lumbar		Sacral		All Paraplegia		Count	%
	Count	%	Count	%	Count	%	Count	%	Count	%		
Complete	29	40	30	63	12	32	0	0	42	47	71	44
Incomplete	44	60	18	38	26	68	3	100	47	53	91	56
Total	73	100	48	100	38	100	3	100	89	100	162	100

Note: Neurologic category was not reported for 67 cases out of the 229 persisting cases of SCI.

- The most common neurologic category was incomplete paraplegia (29% of total, n=47), followed by incomplete tetraplegia (27% of total, n=44), complete paraplegia (26% of total, n=42), and complete tetraplegia (18% of total, n=29).

- Complete injury was most common in the thoracic spinal segments.

The external cause of injury for persisting 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, and the damage to the cord was most often incomplete for both cervical level injuries (61%, n=14) and for injuries at other levels of the cord (67%, n=12).

- Unprotected road users most often suffered thoracic level injuries, most of which resulted in complete damage to the cord (89%, n=8).
- Low falls and diving primarily resulted in cervical level injury, whereas high falls more often resulted in damage to the thoracic and lumbar spine. Whilst incomplete injury was most common amongst the low falls cases (88%, n=14), complete injury was most common amongst the diving (53%, n=9) and high falls cases (51%, n=20).
- Amongst the diving cases that suffered cervical level SCI, sixty-nine percent (n=9) suffered complete damage to the cord. The number of cases of complete tetraplegia from diving was the same as the number for motor vehicle occupants which demonstrates the relative importance of diving as a cause of severe SCI.

Table 2: Incidence of persisting SCI from traumatic causes by external cause (major groupings), and neurological level, of injury at discharge, Australia, 1996/97 (counts and row percentages)

Extent of injury	Tetraplegia		Paraplegia								Total	
	Cervical		Thoracic		Lumbar		Sacral		All Paraplegia		Count	%
	Count	%	Count	%	Count	%	Count	%	Count	%		
Motor vehicle occupants	23	56	8	20	9	22	1	2	18	44	41	100
Unprotected road users	3	20	9	60	3	20	0	0	12	80	15	100
Low falls	14	88	1	6	1	6	0	0	2	13	16	100
High falls	5	13	16	41	17	44	1	3	34	87	39	100
Diving	13	76	2	12	2	12	0	0	4	24	17	100
Other causes	15	44	12	35	6	18	1	3	19	56	34	100
Total	73	45	48	30	38	23	3	2	89	55	162	100

Note: Neurological level and extent of injury was not reported for 67 cases out of the 229 persisting cases of SCI.

ASIA impairment category

To measure the change in the degree of impairment of cases in response to the combined effects of treatment in the acute care facility and during rehabilitation, ASIA impairment category for each case was recorded at admission and at discharge. This measure of impairment was derived from the Frankel cord injury scale^{4,5}. The categories relevant to an assessment of persisting cases of SCI are presented below:

A = Complete. No sensory or motor function is preserved in the sacral segments S4-S5.

B = Incomplete. Sensory but not motor function is preserved below the neurological level and extends through the sacral segments S4-S5.

C = Incomplete. Motor function is preserved below the neurological level, and the majority of key muscles below the neurological level have a muscle grade less than 3.

D = Incomplete. Motor function is preserved below the neurological level, and the majority of key muscles below the neurological level have a muscle grade greater than or equal to 3.

Table 3 presents ASIA impairment categories at admission and discharge.

- For the majority of cases (70%, n=114), there was no change in the degree of impairment between admission and discharge.
- ASIA impairment categories 'A' and 'D' at admission were least likely to change between admission and discharge.
- For twenty-seven per cent of cases (n=44), there was a reduction in the degree of impairment between admission and discharge, particularly from category 'C' to 'D' which signified a clinically important improvement in muscle strength below the neurological level of injury. A number of cases had a particularly significant reduction in impairment from categories 'A' and 'B' to 'D'.

As noted in the 1995/96 report, there was a small number of cases that had an apparent increase in the extent of impairment between admission and discharge. This warrants further attention.

Table 3: Incidence of persisting SCI from traumatic causes by ASIA impairment category at admission and discharge, Australia 1996/97 (counts and percentages)

ASIA category at discharge	ASIA category at admission								Total	
	A		B		C		D			
	Count	%	Count	%	Count	%	Count	%	Count	%
A	70	43	1	1	0	0	0	0	71	44
B	5	3	3	2	1	1	0	0	9	6
C	3	2	4	2	15	9	0	0	22	14
D	3	2	6	4	23	14	26	16	58	36
Not reported	0	0	1	1	1	1	0	0	2	1
Total	81	50	15	9	40	25	26	16	162	100

Note: ASIA impairment category at admission was not reported for 67 cases, and at discharge for 69 cases.

Length of stay

Information on the average length of stay (ALOS) in hospital from the date of injury to the date of discharge from the SU, by neurologic category, is presented in Table 4.

- The ALOS for all persisting cases was about four months, ranging from nearly six and a half months for cases of complete tetraplegia to about three weeks for cases of incomplete paraplegia involving sacral level injury.

- Amongst the cases with paraplegia, the longest length of stay was for cases with thoracic level injury whether complete or incomplete.
- For complete injury, the ALOS decreased with a decrease in the neurological level of injury, from the cervical to the sacral segments of the spinal cord.

Table 4: Incidence of persisting SCI from traumatic causes by neurological level (major grouping) and extent of injury at discharge, Australia 1996/97 (counts and average length of stay)

Extent of injury	Tetraplegia				Paraplegia						Total	
	Cervical		Thoracic		Lumbar		Sacral		All Paraplegia			
	Count	ALOS (days)	Count	ALOS (days)	Count	ALOS (days)	Count	ALOS (days)	Count	ALOS (days)	Count	ALOS (days)
Complete	29	199	30	134	12	111	0	0	42	127	71	156
Incomplete	44	96	18	139	26	73	3	22	47	95	91	95
Total	73	136	48	135	38	85	3	22	89	110	162	122

Note: Neurologic category was not reported for 67 cases out of the 229 persisting cases of SCI.

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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"⁶. The term 'complete injury' is used when there is an absence of sensory and motor function in the lowest sacral segment⁶.

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" (ie. the lowest level that has full function)⁶.

Newly incident case of SCI: a person who suffers an SCI, as defined by the CDC clinical definition, during this reporting period (ie. in 1996/97).

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"⁶.

Persisting case of SCI: a person who is discharged from a SU with a neurological deficit.

Prevalent population: people who have an SCI, as defined by the CDC clinical definition, at a given point in time.

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.

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