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Spinal Cord Injury, Australia 1997/98

Peter O'Connor and Raymond Cripps

Introduction

This report presents statistical information on new cases of spinal cord injury (SCI) from traumatic causes that occurred during 1997/98 in Australia to Australian residents. It is the third annual statistical report based on data from the Australian Spinal Cord Injury Register (ASCIR). The previous reports, based on data for 1995/96 and 1996/97, were published in the Australian Injury Prevention Bulletin.[1,2] Continual improvement in the administration and reporting arrangements of the ASCIR has enabled more timely reporting of national statistics on SCI than has been the case previously.

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

The ASCIR is now in its fourth 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 ASCIR is a cooperative arrangement of the six Australian spinal units and the Research Centre for Injury Studies (RCIS) of the Flinders University of South Australia. The Australian Institute of Health and Welfare funds a program of work of the RCIS that includes the operations of the register.

Overview of spinal cord injury from traumatic causes

The spinal units (SUs) reported three hundred and fourteen cases of SCI from traumatic causes, newly incident in 1997/98. The SU Directors confirmed complete enumeration of cases. However, registration information was not provided for 14 cases by one of the SUs in New South Wales. Of the remaining cases (n=300):

- 32 had no deficit, mostly admitted for suspected SCI or transient cord concussion;
- 4 were reported to have died on ward during treatment (mainly elderly patients, mean age of 76 years).

Given the rarity, at present, of neurological recovery from SCI, the remaining cases (n=264) were regarded as 'persisting cases'. It is noted, however, that at the time of production of this report, this agency has not been notified of complete discharge details for all newly incident cases, especially for those that remain on ward, and that the number of persisting cases is an estimate.

The persisting 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 Control.[3]

Trends in persisting cases of SCI

The assessment of the rate of persisting cases of SCI in 1997/98 was affected by missing admission and discharge information for 14 cases. Given that a neurological deficit is the predominant outcome of SCI cases referred to SUs, these 14 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.

The age adjusted incidence rate of persisting cases of SCI in 1997/98 was estimated to be 15.2 per million of population, an increase from 1996/97 (13.2 per million of population). The case count (n=278) was the highest recorded over the eight-year period for which reliable annual data was available, being 40 cases higher than the average yearly figure for the combined years 1986–1990, 1995/96 and 1996/97

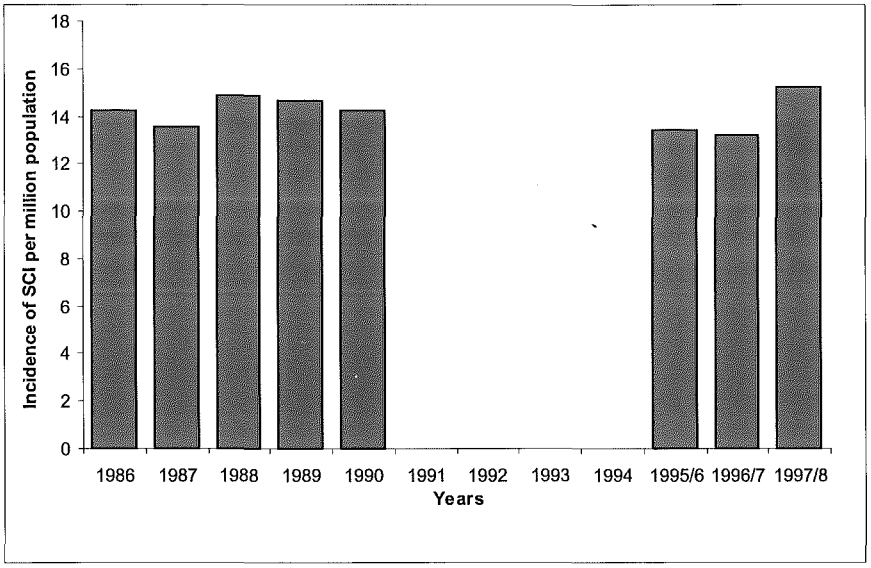

Figure 1: Incidence of persisting SCI from traumatic causes by year, Australia 1997/98 (age adjusted rates)

(average=238 cases per year). The case count for Western Australian residents more than doubled from 1996/97 to 1997/98 (from 23 to 47 cases, respectively). This increase was cross checked, by examination of individual records for 1996/97 and 1997/98, and validated by medical and ancillary staff, and was indeed found to be a real increase (although a few cases initially identified as persisting cases at the time that this report was prepared, were subsequently found to have been discharged normal or very incomplete when this special audit was conducted). The increase was not attributable to any single cause but tended to be greater for some demographic groups than others. It is difficult to know what factors are behind the increase. A planned future analysis of State trends in SCI from 1986 may throw some light on the year to year fluctuations noted for Western Australia, this year, and for other States, in previous years.

Considering that the estimated cost of the long term care of SCI ranges from about $600,000 for a paraplegic to more than $4 million for a ventilator dependent tetraplegic,[4] the increase in SCI nationally represents the potential for a substantial cost increase.

Figure 1 shows the age adjusted rate of persisting cases of SCI for 1997/98 with the rates for earlier years. It is evident that there have been year to year fluctuations in the rate of SCI over the period, with no consistent trend being apparent. A more complete assessment of trend will be undertaken when data for the period 1991 to mid-1995 is made available by all SUs, as agreed during the 1998 meeting of the International Medical Society of Paraplegia (IMSOP) Australasian Branch.

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 rate for New South Wales was an estimate which included the 14 cases whose registration information was missing and whose age distribution was matched to that of the nationally reported cases.

- It was evident from the 95% confidence intervals on the rates, based on the Poisson distribution, that Western Australia was the only State that had a rate significantly above the national incidence rate in 1997/98.
- The Western Australian rate for 1997/98 (26.7 per million of population) was double the rate for that State during 1996/97 (13.3 per million of population). Assessment of the 95% confidence intervals on these rates, based on the Poisson distribution, demonstrated that this difference was statistically significant. The increase in the case count (from 23 in 1996/97 to 47 in 1997/98) represents the potential for a substantial increase in the cost of SCI in that State.
- The Western Australian rate was significantly higher than the rates of New South Wales, Victoria and Queensland during 1997/98. No other State differences were significant. The lowest rate of SCI occurred in Victoria.

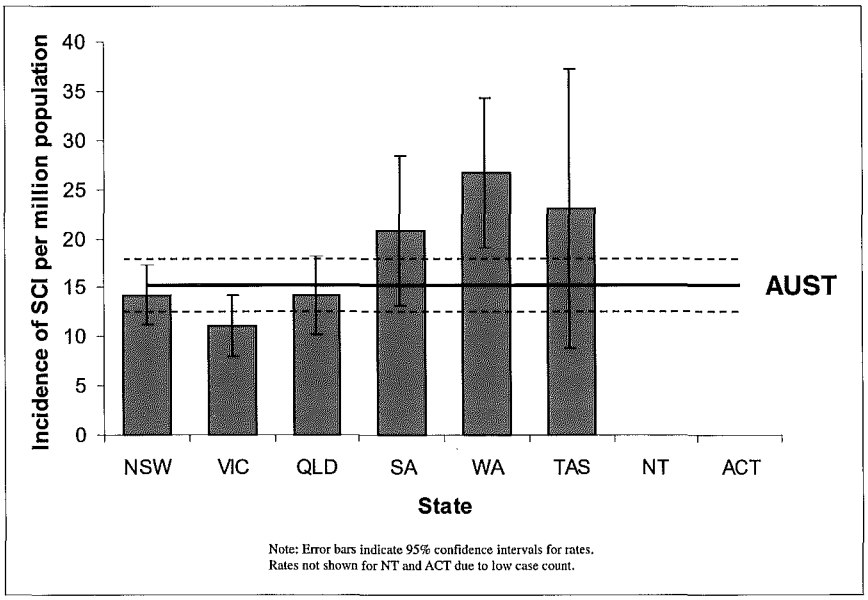

Figure 2: Incidence of persisting SCI from traumatic causes by State of residency, Australia 1997/98 (age adjusted rates)

- The incidence rate of SCI in South Australia increased steadily over the last three years (11.6 per million of population in 1995/96, 15.3 per million of population in 1996/97, 20.8 per million of population in 1997/98). State trends will be assessed in detail once complete data is registered for all States for the period 1991 to mid-1995.

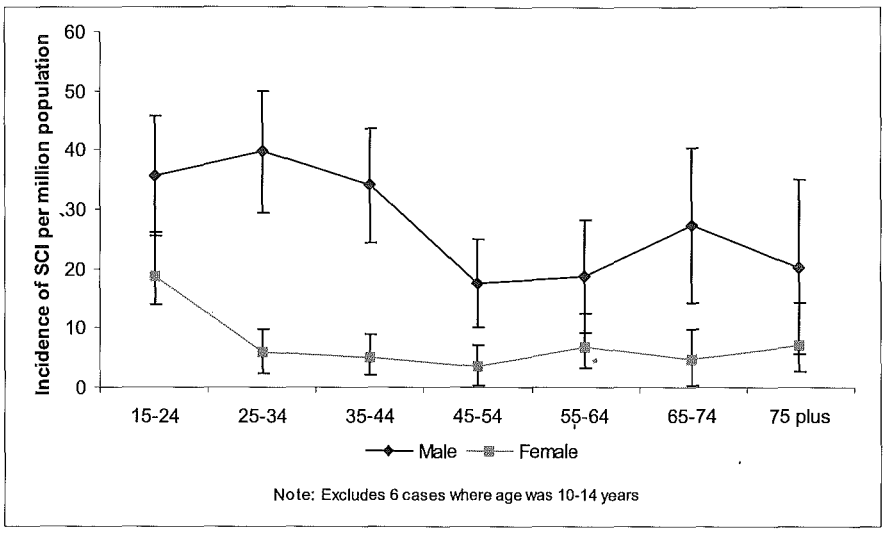

Figure 4: Incidence of persisting SCI from traumatic causes by age group and sex, Australia 1997/98 (age specific rates)

Age and sex distribution

The age distribution of persisting cases of SCI from traumatic causes is presented in Figure 3. The case counts and rates shown in Figures 3 and 4 are estimates which include the 14 cases whose registration information was missing and whose age and sex distribution was matched to that of the nationally reported cases. 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. With increasing age, the age specific rate declined substantially to the age group 45–54 years, after which it increased moderately to age group 65–74 years and then decreased moderately beyond this age group. The most substantial decline in the case count and rate occurred from age group 35–44 years to 45–54 years.
- The wide confidence intervals on the rates (95% confidence intervals on the rates, based on the Poisson distribution) reflect the small case count for individual age groups. When age groups 15–24 years, 25–34 years and 35–44 years were combined, it was evident that the rate for this group (23.1 per million of population) was significantly higher, statistically, than the rate for the older combined age group of 45 years and above (12.4 per million of population).

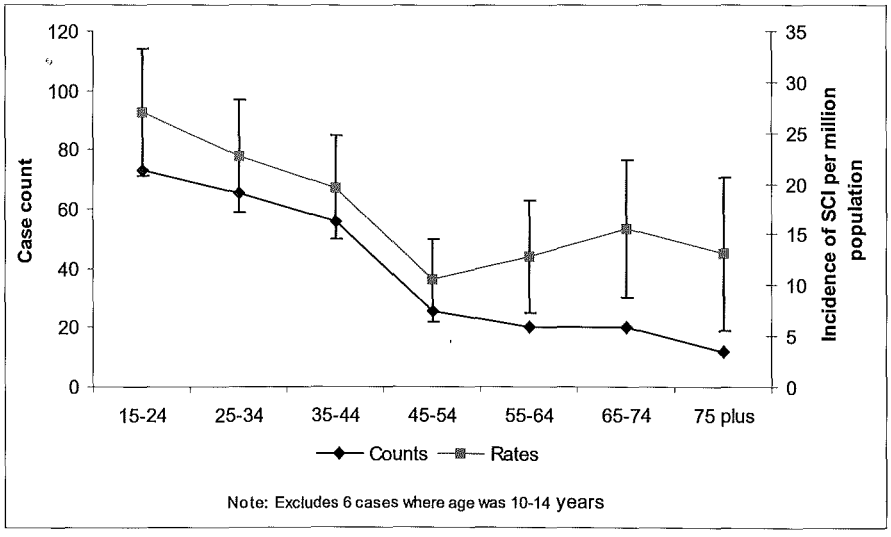

Figure 3: Incidence of persisting SCI from traumatic causes by age group, Australia 1997/98 (counts and age specific rates)

Of the persisting cases of SCI from traumatic causes aged 15 years and above, 79 per cent were male and 21 per cent were female. The incidence of 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 1.8:1 (in the age group 75 plus) to a high of 6.8:1 (in the age group 25–34 years).

When compared to 1995/96 and 1996/97, a number of differences in the age/sex distribution in 1997/98 were noted:

- The female rate of SCI in the age group 15–24 years increased relative to the male rate. Whilst the difference in the rates of males and females in this age group in 1997/98 was large, it was not statistically significant.
- There was a substantial increase in the male rate for the age groups 25–34 years and 35–44 years primarily due to a doubling in the cases in this age group in Western Australia.

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),[5] 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:

- Transport related injury accounted for fifty per cent of all persisting cases of SCI (n=140). Thirty-six per cent were motor vehicle occupants (n=99) and fifteen per cent were unprotected road users (n=41). Seventy-eight per cent (n=109) of the cases of transport related SCI were aged 15–44 years.
- Sixteen per cent (n=44) were from high falls (drop of 1 metre or more) and twelve per cent (n=32) were from low falls. Sixty-seven per cent (n=51) of these cases were in the age group 15–54 years.
- Eight per cent (n=22) were attributed to water-related accidents, including diving. About a third of these cases were aged 15–24 years (n=8).

Comparison of the pattern of external cause over recent years revealed the following:

- A substantial increase from 1996/97 to 1997/98 in transport related SCI in the age groups 15–24 years, 25–34 years and 35–44 years (up by 76%, from 62 cases to 109 cases, respectively). The increase in motor vehicle occupant SCI (80%, from 40 cases to 72 cases, respectively) was most evident for Western Australian residents and to a lesser extent New South Wales residents, but was also evident for Queensland and South Australia.
- Vehicle rollover was a more frequently reported cause of SCI for motor vehicle occupants in 1997/98 (49%) than 1996/97 (39%). The increase was most dramatic in Western Australia (13 cases reported in 1997/98 versus 2 cases in 1996/97). Increases were also noted in New South Wales, South Australia and Victoria.
- The number of SCIs from water-related accidents in 1997/98 (n=22) remained higher than reported in 1995/96 (n=13) and was only slightly below the 1996/97 figure (n=25).

To more fully assess the nature, magnitude and statistical significance of any trends in SCI by external cause and State would require data over a longer time period. This will be undertaken once a complete series of data is available for all States from 1986.

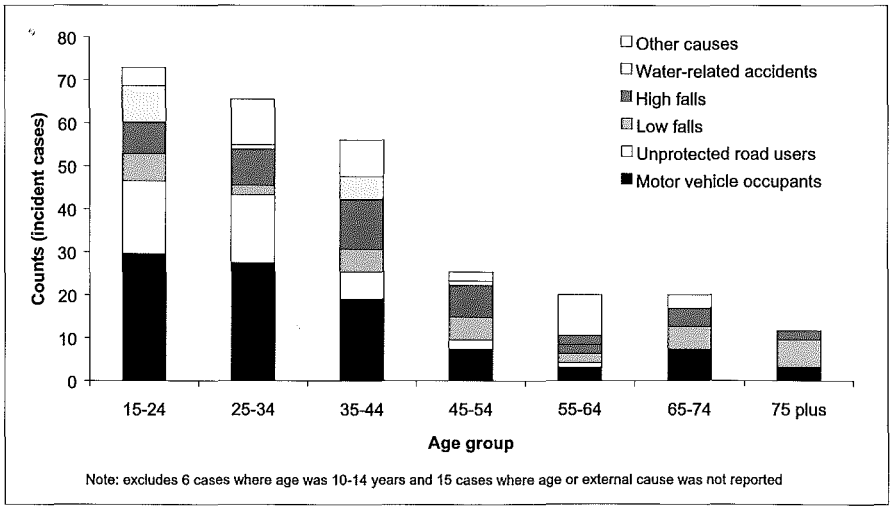

Figure 5: Incidence of persisting SCI from traumatic causes by external cause of injury (major groupings) and age group, Australia 1997/98 (counts)

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.

The clinical picture of persisting cases of SCI was affected by incomplete reporting for some data items. For example, there were eighty cases (29%) for whom either the neurological level or extent of injury at discharge was missing. It was apparent that the cases with missing clinical information at discharge tended to be, more often than other cases, classified as complete tetraplegics at admission. An examination of the dates of injury of these cases and expected length of stay suggested that many would not have been discharged at the time that this report was being prepared. Exclusion of these cases from the analysis would have biased the results. Given that the neurological level (major grouping) and extent of injury rarely change between admission and discharge, especially for complete tetraplegics, the clinical information at admission was used where missing at discharge for all tabulations except those concerning the comparison of 'ASIA impairment category'[6] between admission and discharge (Table 3) and length of stay (Table 4).

In future years, this issue of the Bulletin will be re-focussed on the features of SCI at admission so that reporting can be finalised shortly after the completion of each financial year without the need for the troublesome adjustment and case selection required to deal with missing clinical discharge data. Reports dealing with other issues, such as features at discharge and change in clinical status between admission and discharge, length of stay and trends in SCI will be published as the availability of complete information permits.

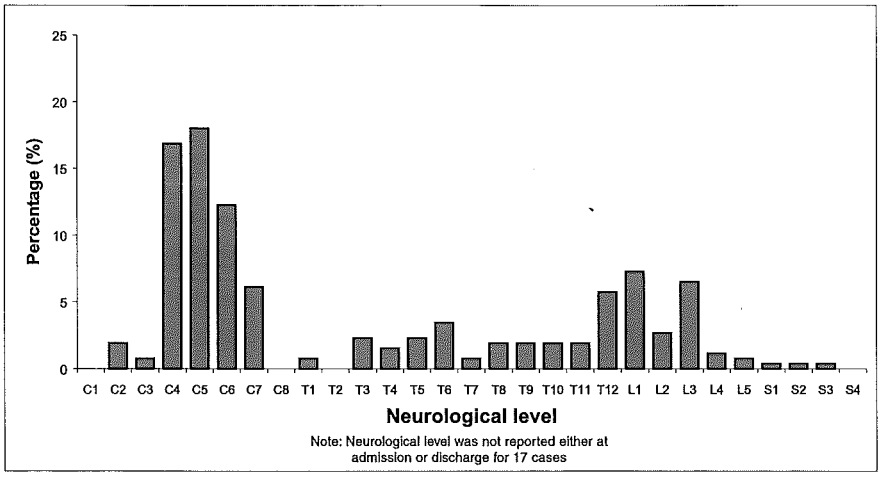

Figure 6: Incidence of persisting SCI from traumatic causes by neurological level of injury at discharge, Australia 1997/98 (percentages)

Neurological level of injury

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

- Where neurological level was reported (n=261) the most commonly injured spinal cord segments were: the cervical segments, particularly C5 (18%, n=47), C4 (17%, n=44), and C6 (12%, n=32); the lumbar segments L1 (7%, n=19) and L3 (7%, n=17); and the lower thoracic segments, particularly T12 (6%, n=15).
- Injury to the cervical segments resulting in tetraplegia was more common in 1997/98 (55%) than 1995/96 (51%) and 1996/97 (45%). The increase was particularly notable for the cervical segments C4 and C5 which accounted for thirty-five per cent of reported cases of SCI in 1997/98 compared with twenty-three per cent in 1996/97 and twenty-nine per cent in 1995/96.

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 neurologic categories relevant to a discussion of persisting cases of SCI, as well as a finer breakdown of the paraplegia category.

- Fifty-five per cent of the cases (n=153) 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-one per cent (n=115) 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 total, n=101), followed by incomplete paraplegia (21% of total, n=58), complete paraplegia (21% of total, n=57), and complete tetraplegia (17% of total, n=46).
- 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, with incomplete damage to the cord being most common at this level (57%, n=35).
- Unprotected road users most often suffered thoracic level injuries, which generally involved complete damage to the cord (79%, n=15).
- Water-related SCIs almost exclusively involved the cervical segments of the spine.

Table 1: Incidence of persisting SCI from traumatic causes by neurological level (major grouping) and extent of injury at discharge, Australia 1997/98 (counts and column percentages)

Extent of injury	Tetraplegia		Paraplegia											
	Cervical		Thoracic		Lumbar		Sacral		All Paraplegia		Not reported		Total	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Complete	46	30	46	72	10	21	1	33	57	50	0	0	103	37
Incomplete	101	66	18	28	38	79	2	67	58	50	3	30	162	58
Not reported	6	4	0	0	0	0	0	0	0	0	7	70	13	5
Total	153	100	64	100	48	100	3	100	115	100	10	100	278	100

Table 2: Incidence of persisting SCI from traumatic causes by external cause (major groupings), and neurological level, of injury at discharge, Australia, 1997/98 (counts and row percentages)

Extent cause of injury	Tetraplegia		Paraplegia											
	Cervical		Thoracic		Lumbar		Sacral		All Paraplegia		Not reported		Total	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Motor vehicle occupants	61	62	16	16	16	16	1	1	33	33	5	5	99	100
Unprotected road users	13	32	19	46	8	20	1	2	28	68	0	0	41	100
Low falls	25	78	3	9	4	13	0	0	7	22	0	0	32	100
High falls	12	27	14	32	15	34	1	2	30	68	2	5	44	100
Water-related accidents	20	91	1	5	0	0	0	0	1	5	1	5	22	100
Other causes	21	55	11	29	5	13	0	0	16	42	1	3	38	100
Not reported	1	50	0	0	0	0	0	0	0	0	1	50	2	100
Total	153	55	64	23	48	17	3	1	115	41	10	4	278	100

- Low falls and water-related accidents primarily resulted in cervical level injury, whereas high falls more often resulted in damage to the thoracic and lumbar spine. It is interesting to speculate on the reasons for this pattern of results. It is probable that different mechanisms of injury are involved in high falls versus low falls and diving-related accidents, with the latter probably having a higher frequency of impact to the head with consequent loading onto the cervical spine. More detailed information than is available on the register would be required to test this hypothesis.

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[6] for each case was recorded at admission and at discharge. This measure of impairment was derived from the Frankel cord injury scale.[7,8] 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 cases that had this information recorded on the register (n=161).

Table 3: Incidence of persisting SCI from traumatic causes by ASIA impairment category at admission and discharge, Australia 1997/98 (counts and percentages)

ASIA category	ASIA category at admission									
	A		B		C		D		Total	
at discharge	Count	%	Count	%	Count	%	Count	%	Count	%
A	**54**	34	1	1	0	0	1	1	56	35
B	5	3	**5**	3	2	1	0	0	12	7
C	7	4	5	3	**9**	6	0	0	21	13
D	5	3	9	6	28	17	**30**	19	72	45
Total	71	44	20	12	39	24	31	19	161	100

Note: ASIA impairment category at both admission and discharge was not reported for 117 cases

- For the majority of cases (61%, n=98), 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-six per cent of cases (n=42), 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 previous reports,[1,2] there was a small number of cases that had an apparent increase in the extent of impairment between admission and discharge.

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 for all cases discharged in 1997/98 irrespective of whether the injury date was in 1997/98 or a previous year. This table is not strictly comparable with those presented in the earlier reports which were based only on cases where the injury date and discharge date were in the same year.

- The ALOS for all persisting cases discharged in 1997/98 was eighteen weeks, ranging from more than thirty one weeks for cases of complete tetraplegia to about four 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.

Table 4: Incidence of persisting SCI from traumatic causes by neurological level (major grouping) and extent of injury at discharge, Australia 1997/98 (counts and average length of stay)

Extent of injury	Tetraplegia		Paraplegia											
	Cervical		Thoracic		Lumbar		Sacral		All Paraplegia		Not reported		Total	
	Count	ALOS (days)	Count	ALOS (days)	Count	ALOS (days)	Count	ALOS (days)	Count	ALOS (days)	Count	ALOS (days)	Count	ALOS (days)
Complete	34	223	33	146	9	130	0	0	42	143	2	175	78	179
Incomplete	87	104	15	142	33	74	2	29	50	91	8	69	145	98
Total	121	138	48	145	42	86	2	29	92	115	10	90	223	126

Note: Discharge date was not reported for 117 cases

Future plans

Now that the statistical reporting of SCI in Australia is bedded down, attention can be given by the Research Centre for Injury Studies (RCIS) to other issues concerning the prevalent population. Given that little information is available on the health and welfare of this population after their discharge from rehabilitation, the RCIS will be undertaking a project in 1999 to identify the information required and to determine the methods of collection of this data. A future report will assess survival period. From time to time, reports concerning the outcomes of research based on the Register will be published. An analysis of time series trends in SCI by State will be initiated in 1999.

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Glossary

ASIA impairment category: The American Spinal Injury Association (ASIA) has developed a classification system for spinal cord injury. The ASIA impairment category[6] (detailed in the text of the present report) is based on the Frankel Classification.[7,8]

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 segment.[6]

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 1997/98).

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".[6] 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.

Communications

Inquiries, comments and letters are welcome. Please address these to:

Mr Peter O'Connor
Research Centre for Injury Studies
National Injury Surveillance Unit
Flinders University of South Australia
Mark Oliphant Building,
Laffer Drive, Bedford Park South Australia 5042.

Phone: (08) 8374 0970
Fax: (08) 8374 0702
Email: peter.oconnor@nisu.flinders.edu.au

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