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Spinal Cord Injury, Australia 1995/96

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Introduction

Spinal cord injury (SCI) is a significant public health problem in Australia. Although SCI is relatively rare, it is important due to the severity of the outcome in individual, social and economic terms. The prevalent population has been estimated to number in excess of 6,000 and the ongoing costs associated with the long-term care of this population has been estimated to be about 200 million dollars per year.[1]

In 1986, a data collection on SCI was initiated by Mr. J. Walsh, based on cases reported by the six Australian Spinal Units (SUs). During its period of operation, approximately 4,000 cases of SCI from traumatic and non-traumatic causes were registered. The collection was discontinued at the end of 1991. Recognising that National reporting and continuity of registration was important, the National Injury Surveillance Unit (NISU) of the Australian Institute of Health and Welfare (AIHW) funded an external review of the needs and opportunities for SCI surveillance. The results of this review were published early in 1995.[2] The report recommended that a register of SCI cases be re-established. The AIHW National Injury Surveillance Unit, now a Unit of the Flinders University Research Centre for Injury Studies, acted upon this recommendation.

After consultation with the Directors of the six SUs, and piloting of a data collection method in one Unit, the Australian Spinal Cord Injury Register (ASCIR) became operational on 1 July 1995. Cases of spinal cord damage from traumatic causes, and also from non-traumatic causes (e.g. from disease processes such as cancer) that were treated by the SUs, were registered.

In order to facilitate national and international comparisons, the case definition that was adopted for registration of traumatic cases of SCI was the 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".[3]

The ASCIR focuses on a small set of core surveillance data items specified in a data dictionary.[4] The agreed data set includes the following types of information: hospital and patient identifiers, sociodemographic items, service and administrative items, and basic clinical and public health information. In order to maximise the potential for international comparisons, data items and classifications were selected, as much as possible, on the basis of international standards. The neurological level of injury and degree of impairment was coded according to the American Spinal Injury Association (ASIA) International Standards for Neurological and Functional Classification of Spinal Cord Injury (Revised 1992).[5] The level of independence in undertaking daily life activities was measured according to the Functional Independence Measure (FIM).[6] The injury diagnosis data was coded according to the International Classification of Disease[7] (ICD-9-CM) codes and the other items in the agreed data set conformed to the Australian National Health Data Dictionary[8] and the NISU National Data Standards for Injury Surveillance.[9]

This Bulletin reports on newly incident cases of SCI that occurred during 1995/96 in Australia to Australian residents. Whilst the focus is on traumatic SCI, particularly persisting cases, some information is also provided at the end of the Bulletin on non-traumatic cases, activity of the SUs, and data issues. Terms used in the Bulletin are defined in the Glossary.

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[1]Walsh J. Spinal cord injury statistics in Australia-1991. Adelaide: Australian Institute of Health and Welfare, National Injury Surveillance Unit, 1992.

[2] Blumer, C. A review of the needs and opportunities for the surveillance of spinal cord injury. Adelaide: Australian Institute of Health and Welfare, National Injury Surveillance Unit, 1995.

[3] Thurman DJ, Sniezek JE, Johnson D, Greenspan A, Smith SM. Guidelines for surveillance of central nervous system injury. Atlanta: US Department of Health and Human Services, Centers for Disease Control and Prevention, 1995.

[4] Flinders University Research Centre for Injury Studies. Australian Spinal Cord Injury Register: data dictionary. Adelaide: Flinders University Research Centre for Injury Studies, AIHW National Injury Surveillance Unit, 1997.

[5] American Spinal Injury Association. International standards for neurological and functional classification of spinal cord injury. Chicago: American Spinal Injury Association, 1992.

[6] Hamilton BB, Granger CV, Sherwin FS, Zielzny M, Tashman JS. A uniform national data system for medical rehabilitation. In: Fuhrer MJ, editor. Rehabilitation outcomes: analysis and measurement. Baltimore: Brooks, 1987.

[7] World Health Organization. International classification of diseases. (1975 revised). Geneva: WHO, 1977.

[8] Australian Institute of Health and Welfare. National Health Data Dictionary. Version 4. Canberra: Australian Institute of Health and Welfare, 1995.

[9] National Injury Surveillance Unit. National Data Standards for Injury Surveillance, Version 2.0 (December 1995). Adelaide: Australian Institute of Health and Welfare, National Injury Surveillance Unit, 1995.

Overview of spinal cord injury from traumatic causes

Two hundred and sixty-two cases of SCI from traumatic causes, newly incident in 1995/96, were reported by the SUs. Based on this figure, which is likely to understate the true incidence figure (see Data Issues), the population based incidence rate of SCI was estimated to be at least 14.7 per million in Australia in 1995/96. There is a paucity of international comparative information on traumatic SCI. To the present authors knowledge, Australia is the only country that has a truly national register of SCI. In the United States of America, there is a `National SCI Database' that has been developed based on data reports from 18 federally-sponsored regional Model Spinal Cord Injury Care Systems[10]. According to Stover et al.[10] that database "is not designed to determine either incidence (number of new cases of SCI occurring in the United States each year) or prevalence (number of existing cases of SCI in the United States at any given time) of SCI" (p. 21). Their review of data from the Model Systems indicated that there were wide variations in the incidence rates reported, arising from a combination of factors including differences in the case inclusion and reporting criteria, and differences in the underlying population characteristics and social and geographic environment. As a consequence of these variations, their estimate of the US national incidence rate of SCI of "30 to 40 cases per million population" (p. 24) in the 1990's, has an understandable lack of precision. Further international collaboration is needed to ensure that comparative information is available that can facilitate an improved assessment of the causes, prevention and treatment of SCI.

[10] Stover SL, DeLisa JA, Whiteneck GG. Spinal cord injury: clinical outcomes from the Model Systems. Maryland: Aspen Publishers, 1995.

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Persisting cases of SCI

Of the newly incident cases of SCI in Australia in 1995/96, twelve cases were reported to have been discharged from a SU with no deficit, mostly admitted for suspected SCI or transient cord concussion, and ten were reported to have died on ward during treatment, mainly elderly patients (mean age of 66 years). Two hundred and forty cases were discharged from a SU with a neurological deficit. Given the rarity of neurological recovery from SCI at this time, these cases can be regarded as `persisting cases'. The persisting cases are an important group to monitor because they are the people whose health care, welfare and other 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 number of new persisting cases of SCI reported by the SUs should be a good measure of this condition. SU directors report that nearly all persisting cases would be referred to a SU, either immediately or after stabilisation at another hospital. An exception is the few cases of SCI in childhood treated at paediatric hospitals. Based on the case number reported by the SUs, the age-adjusted incidence rate of persisting cases of SCI was 13.4 per million of population in 1995/96.

In the remainder of the discussion of traumatic SCI, attention focuses on the characteristic of the persisting cases.

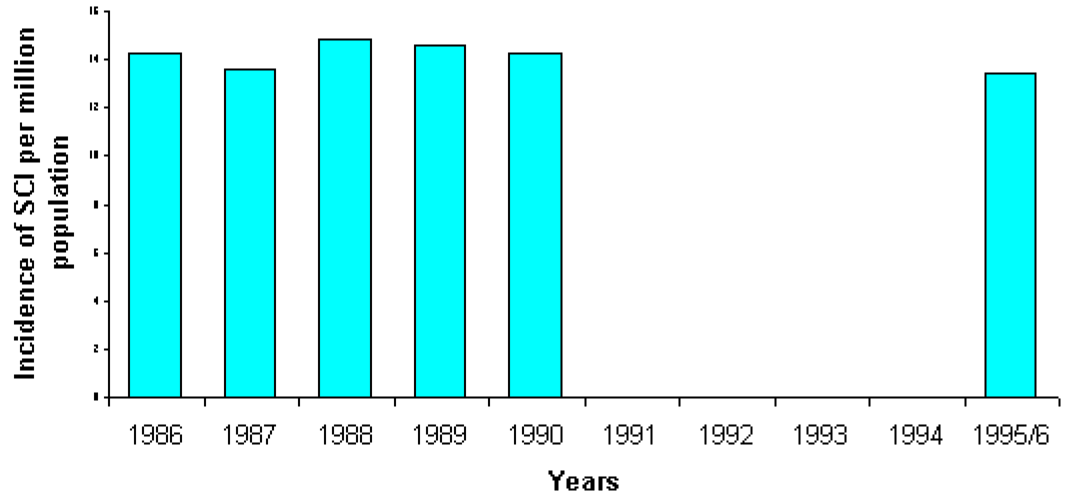
Trends in persisting cases of SCI

Information on the changing trends in SCI has been limited by the lack of continuous quantitative data. ASCIR is addressing this need through:

a. inclusion of the data collected by Walsh from 1986 to 1991,
b. retrospective case note surveys of admissions during the years 1991-1994/95 (completed for SA), and
c. by the auditing of readmissions with respect to registration status.

Figure 1 shows the age adjusted rate of persisting cases of SCI from 1986 to 1990, based on the Walsh dataset (excludes 1991 due to poor coverage in that year), and for 1995/96, based on ASCIR. It is evident that the 1995/96 rate is close to the rates of the earlier period. This is perhaps surprising given that the trends in injury from road crashes, which are the most frequent cause of SCI, have declined substantially over the period (recent statistical reports indicate a 30% decline in fatalities 1986-95[11] and a 25% decline in hospitalisations reported to Police 1988-94[12]). Further analysis is needed to determine the reasons why there has not been a decline in persisting SCI. If the trend in the incidence of all SCI (including early deaths and deaths on ward, persisting cases, and cases with only temporary neurological deficit) is in fact declining in parallel with the road injury trends, then one plausible explanation for a static rate of persisting cases is that improved retrieval, early management and rehabilitation of SCI has increased the number of cases that survive to discharge from a SU.

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



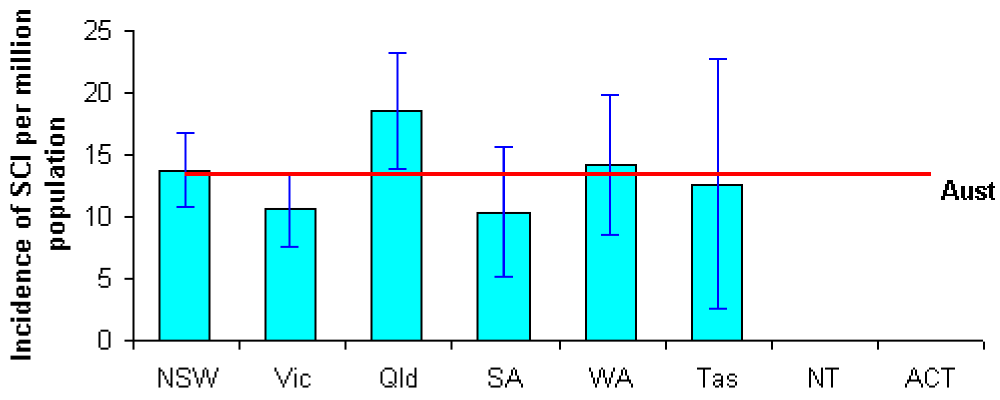
[11] Federal Office of Road Safety. Road fatalities, Australia: 1995 statistical summary. Canberra: Federal Office of Road Safety, 1996.

[12] Federal Office of Road Safety. Road crashes resulting in hospitalisation, Australia: 1994 statistical summary. Canberra: Federal Office of Road Safety, 1996.

State of usual residence

Figure 2 shows the age adjusted rate of incidence of persisting SCI from traumatic causes by State of usual residence. Incidence rates for the ACT and Northern Territory are not shown due to low case counts reported by the SUs for residents of these jurisdictions. It is evident from the 95% confidence intervals, based on the Poisson distribution, that no State had an incidence rate that was significantly different from the National incidence rate. Queensland had an incidence rate that was significantly higher than the Victorian incidence rate. No other State differences were statistically significant.

Figure 2: Incidence of persisting SCI from traumatic causes by State of residency, Australia 1995/96 (age adjusted rates)

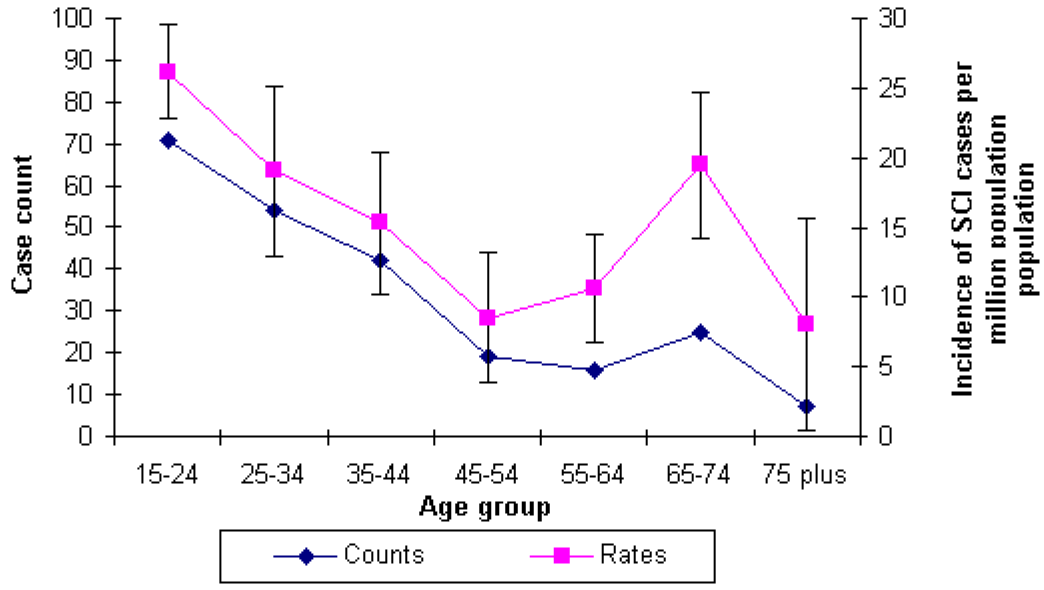


Note: Error bars indicate 95% confidence intervals for rates.
Rates not shown for NT and ACT due to low case count.

Age and sex distribution

The age distribution of persisting cases of SCI from traumatic causes is presented in Figure 3. The age group of 10 to 14 years was excluded from the figure because of a suspected poor coverage of this group by the SUs. It is evident that the highest case count and age specific rate occurred in the age group 15-24 years (age specific rate was 26/1,000,000 of population). This age group comprised 30% of the persisting cases of SCI from traumatic causes. With increasing age, the age specific rate declined to the age group 45-54 years, after which there was a relatively strong increase from the age groups 55-64 years to 65-74 years. 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 years to 64 years. The only other statistically significant difference in the rates was between the age groups 25-34 years and 45-54 years. None of the other differences in the rates between the age groups, that are apparent in the figure, were statistically significant.

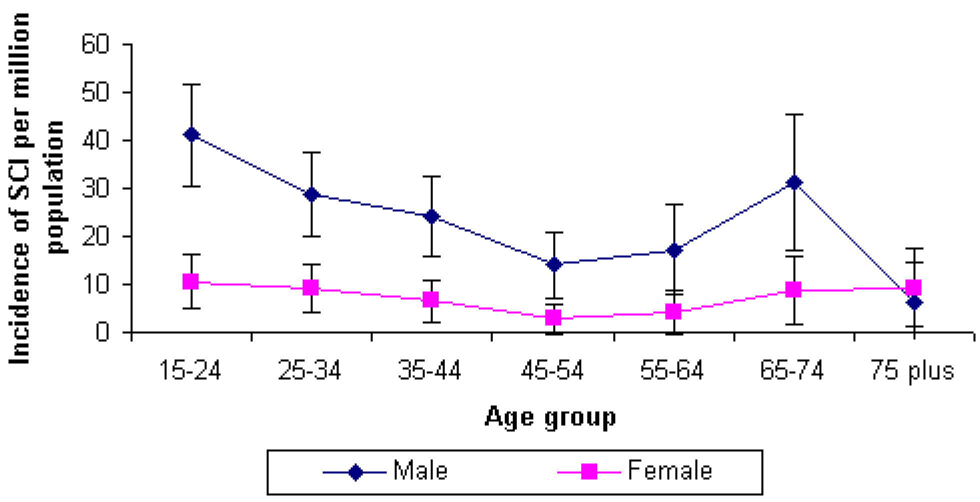
Figure 3: Incidence of persisting SCI from traumatic causes by age group, Australia 1995/96 (counts and age specific rates)



Note: excludes 5 cases where age was 10-14 years and 1 case where age was not reported

Of the persisting cases of SCI from traumatic causes, 77 per cent were male and 23 per cent were female. Figure 4 shows that the male rate was substantially higher than the female rate at all age groups except for the 75 plus age group. The difference in the rates was statistically significant for all age groups with the exception of 55-64 years and the 75 plus age group. The ratio of the male to female rates ranged from 3.1:1 (in the age group 24-34 years) to 5.1:1 (in the age group 45-54 years).

Figure 4: Incidence of persisting SCI from traumatic causes by age group and sex, Australia 1995/96 (age specific rates)



Note: excludes 5 cases where age was 10-14 years and 1 case where age was not reported, and 1 case where sex was not reported

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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, including the external cause of injury, role of human intent, type of place of injury and type of activity at the time of injury. This included coded variables and also a structured narrative describing the injury event. The narrative detailed what the victim was doing at the time of the injury event, what went wrong to precipitate the injury sequence, and what actually inflicted the injury. It provided a rich source of information that extended the information available from the coded variables.

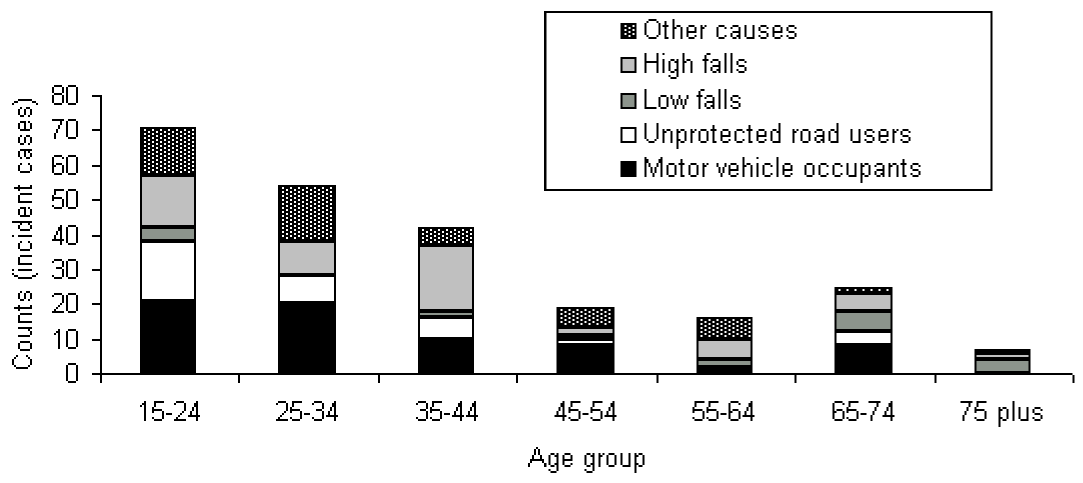
External cause of injury

The external cause of injury (defined according to the National Data Standards for Injury Surveillance[9] which is based on the International Classification of Disease[7] external cause codes) for persisting cases of SCI from traumatic causes is presented by age group in Figure 5. Motor vehicle occupants accounted for 29% (n=69) of all persisting cases of SCI; high falls 21% (n=50); unprotected road users 15% (n=37); low falls 8% (n=20); diving 5% (n=13); and other causes 21% (n=51, including one case of unspecified cause).

Motor vehicle occupants comprised the largest group of cases in the age group 15-34 years. Examination of the structured narrative provided the following information on the SCI of motor vehicle occupants:

- Twenty-five cases of motor vehicle rollovers were reported. No mention of collision with another vehicle was reported for these cases, suggesting that they were single vehicle rollovers due to loss of control. Fourteen of the rollovers occurred on non-urban roads. Impact of the head on the vehicle roof during rollover was reported in six cases.
- Alcohol use was reported in 7 cases.
- Non-use of seat belts was reported in seven cases, six of whom were involved in rollovers.

Figure 5: Incidence of persisting SCI from traumatic causes of injury (major groupings) and age group, Australia 1995/96 (counts)



Note: excludes 5 cases where age was 10-14 years and 1 case where age was not reported

Spinal cord injury to unprotected road users occurred most frequently in the age group 15-24 (n=12). Analysis of the structured narrative indicated that 15 cases of SCIs to unprotected road users resulted from collision with a motor vehicle, over all age groups.

Low falls (i.e. falls on the same level or from less than one metre in height) were more frequently a cause of SCI in the elderly (65 years and over). Examination of the structured narrative for cases aged 65 years and over revealed the following information:

- The injury occurred in the home for 6 of the 10 cases.
- Dizziness was reported in 2 of the cases.
- Alcohol was involved in 2 of the cases.

High falls (i.e. falls from a height of one metre or higher) occurred relatively frequently in all age groups. Examination of the structured narrative revealed the following information:

- 15 of the 50 high falls were from ladders, roofs, balconies and stairs.
- 15 occurred while at work, particularly in the 25 to 54 year age group (n=11).

The 13 diving-related SCIs occurred mainly in the surf (6 cases) and in swimming pools (4 cases). The remaining diving-related SCI cases occurred in rivers and off piers.

Activity when injured

The activity that the person was engaged in when they suffered their spinal cord injury was coded in ASCIR according to the NISU National Data Standards for Injury Surveillance.[9] This information, when extended with reference to the structured narrative, contributed to a fuller understanding of the injury event than was possible from the external cause alone. It was particularly useful for identifying sporting and work related injuries. The following dot points summarise the features of sports related SCI:

- 19 cases of SCI were attributed to sport.
- 9 cases occurred during rugby scrums or tackles or during football matches.
- Other sporting activities accounted for the remaining 10 cases: judo, go-carting, hockey, soccer, and racing (car, motor cycle, and pedal cycle).

For work-related activities, the following was reported:

- 44 cases of work-related SCI were described.
- 14 of these cases occurred while driving to work or returning home from work while 30 occurred at the work site.

- The external cause of injury at the work site was high fall (14 cases), struck by object (8 cases), horse related (4 cases), and other causes (4 cases).

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[7] World Health Organization. International classification of diseases. (1975 revised). Geneva: WHO, 1977.

[9] National Injury Surveillance Unit. National Data Standards for Injury Surveillance, Version 2.0 (December 1995). Adelaide: Australian Institute of Health and Welfare, National Injury Surveillance Unit, 1995.

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Clinical information

The clinical picture of persisting cases of SCI was affected by incomplete reporting.

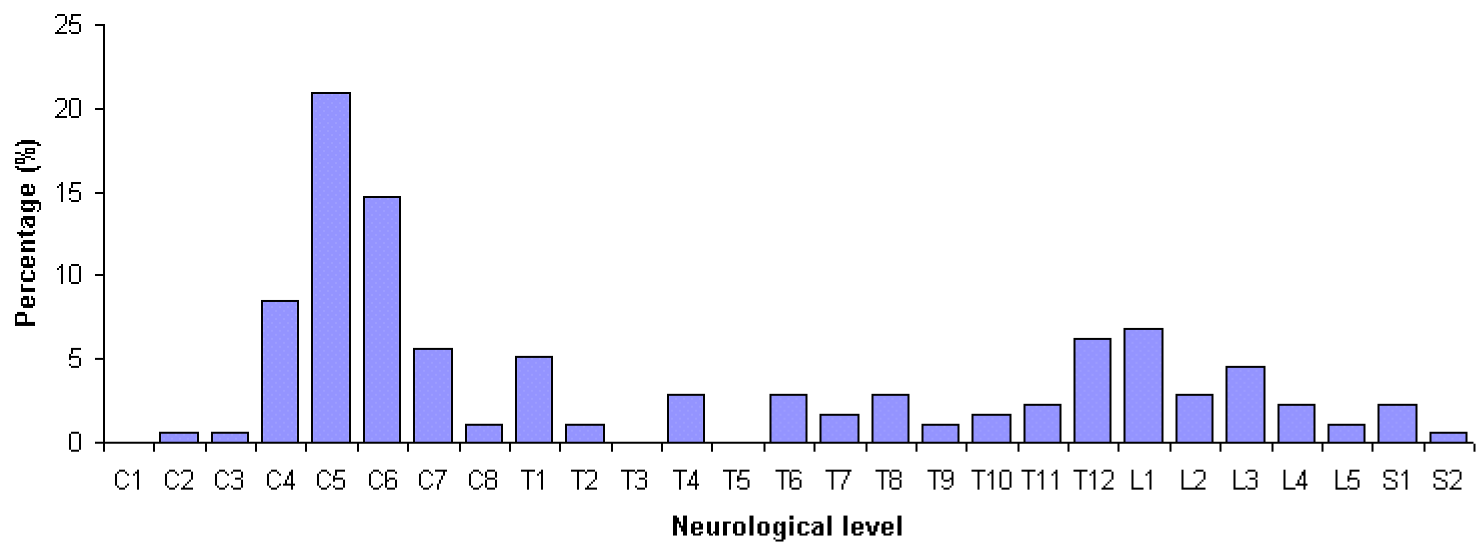
There were 62 cases for whom the neurological level of injury at discharge was not reported and a further one case for whom the extent of injury was not reported. Analysis of the characteristics of these cases compared with the other 177 cases for whom neurological level and extent of injury was reported revealed no significant nor substantial differences on the basis of the neurological level of injury at admission, the extent of injury at admission, age group, and length of stay in hospital. Given that there was no evidence of unrepresentativeness, the following discussion of the neurological level, extent of injury and length of hospital stay was based on the 177 cases for whom neurological level and extent of injury was reported.

ASIA impairment category was not reported at discharge for 42 of the 240 persisting cases of SCI. Comparison of these cases with the 198 cases for whom that information was reported, revealed no significant nor substantial differences on the basis of neurological level of injury at admission, extent of injury at admission, age group, length of stay in hospital, and ASIA impairment category at admission. Given that there was no evidence of unrepresentativeness, the following discussion of the ASIA impairment category at discharge was based on the 198 cases for which those data were reported.

Neurological level of injury

Figure 6 presents the neurological level at discharge (n=177). The most commonly injured segments of the spinal cord were C5 (21%), C6 (15%), C4 (9%), L1 (7%), T12 (6%) and C7 (6%). Fifty-two per cent of the cases (n=92) had an injury to the cervical segments, resulting in `Tetraplegia'. With Tetraplegia, there is impairment of function in the arms as well as in the trunk, legs, and pelvic organs. Forty-eight per cent of the cases (n=85) had an injury to the thoracic, lumbar or sacral (but not cervical) segments of the spinal cord, resulting in `Paraplegia'. With Paraplegia, arm functioning is spared, but, depending on the level of injury, the trunk, legs, and pelvic organs may be involved. For Paraplegia, the most common level of injury was L1, followed by T12 and T1.

Figure 6: Incidence of persisting SCI from traumatic causes by neurological level of injury at discharge, Australia 1995/96 (percentages)



Note: Neurological level was not reported for 63 cases

Neurologic category

The overall severity of SCI is usually measured by a combination of both the neurological level and extent of injury. The standard combination involves the creation of five neurologic categories: incomplete paraplegia, complete paraplegia, incomplete tetraplegia, complete tetraplegia, and complete recovery.[10] In the context of a discussion of persisting cases of SCI the last category is excluded.

Table 1 presents the counts and column percentages for neurologic level and extent of injury (n=177). Complete injury was a more prominent feature of injury to the thoracic segments of the spine (n=24, 49%), than it was for the cervical (n=34, 37%), lumbar (n=7, 23%), or sacral (n=1, 20%) segments of the spine. Complete cord injuries are relatively common among patients with thoracic fractures and dislocations because the spinal canal in this region is small in relation to the size of the cord.[13] [14] [15] [16] Based on all cases, the most common neurologic category (for all cases, n=177) was incomplete Tetraplegia (n=58, 33%), followed by incomplete Paraplegia (n=53, 30%), complete Tetraplegia (n=34, 19%), and complete Paraplegia (n=32, 18%).

Table 1: Incidence of persisting SCI from traumatic causes by neurological level (major grouping) and extent of injury at discharge, Australia 1995/96 (counts and column percentages)

Extent of injury	Tetraplegia		Paraplegia								Total	
	Cervical		Thoracic		Lumbar		Sacral		All Paraplegia			
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Complete	34	37	24	49	7	23	1	20	32	38	66	37
Incomplete	58	63	25	51	24	77	4	80	53	62	111	63
Total	92	100	49	100	31	100	5	100	85	100	177	100

Note: Neurologic category was not reported for 63 cases out of the 240 persisting cases of SCI

The external cause of injury for persisting cases of SCI from traumatic causes is presented by neurological level of injury in Table 2. Motor vehicle occupants were most likely to suffer from injury to the cervical segments of the spinal cord. Complete injury occurred to 40% (n=19) of the occupants. Unprotected road users were most likely to suffer from injury to the thoracic segments of the spine. Complete injury occurred to 32% (n=8) of the unprotected road users. Whereas Tetraplegia was most common amongst motor vehicle occupants, Paraplegia was most common amongst unprotected road users. Low falls (i.e. falls on the same level or from less than one metre in height) exclusively resulted in cervical level damage. Cervical level damage to the spinal cord was also common in high falls (i.e. falls from a height of one metre or higher). Complete injury occurred to 18% (n=2) of the low falls cases and to 41% (n=21) of the high falls cases.

Table 2: Incidence of persisting SCI from traumatic causes by external cause (major groupings), and neurological level, of injury at discharge, Australia, 1995/96 (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	29	62	10	21	6	13	2	4	18	38	47	100
Unprotected road users	9	36	12	48	4	16	0	0	16	64	25	100
Low falls	11	100	0	0	0	0	0	0	0	0	11	100
High falls	25	49	14	28	11	22	1	2	26	51	51	100
Other causes	18	42	13	30	10	23	2	5	25	58	43	100
Table Total	92	52	49	28	31	18	5	3	85	48	177	100

Note: Neurological level and extent of injury was not reported for 63 cases out of the 240 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, rehabilitation and other factors, the ASIA impairment category[5] of each case was recorded at both admission and discharge. This measure of impairment was derived from the Frankel cord injury scale.[17] [18] 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.

A comparison of the ASIA category at admission and discharge is presented in Table 3. This information facilitates an assessment of the degree of change in impairment between admission and discharge. The ASIA category was reported at discharge for 198 cases but for four of these it was not reported at admission. The table is therefore based on the 194 cases for whom that information was reported both at admission and discharge.

For the majority of cases (n=141, 73%), there was no change in the degree of impairment between admission and discharge. This was particularly true for the admission ASIA categories of `A' and `D'. For a small number of cases (n=4, 2%) there was an apparent increase in the extent of impairment between admission and discharge. This could reflect a coding error either at admission or discharge, rather than a real increase in impairment, but warrants a further assessment. For one quarter of the cases (n=49, 25%) there was a reduction in the extent of impairment. Numerically, this reduction was particularly strong from a category `C' at admission to a category `D' at discharge (n=19, 10%), indicating a clinically significant improvement in muscle functioning for these cases. The reduction in impairment from category `A' at admission to category `D' at discharge (n=7, 4%) is clinically very significant. It demonstrates an improvement from a state of no sensory or motor functioning in the sacral segments S4-S5, to sensory preservation and useful motor functioning in the majority of key muscles below the neurological level of injury.

Table 3: Incidence of persisting SCI from traumatic causes by ASIA impairment category at admission and discharge, Australia 1995/96 (counts and percentages)

	ASIA category at admission									
	A		B		C		D		Total reported	
ASIA category at discharge	Count	%	Count	%	Count	%	Count	%	Count	%
A	62	32	1	1	1	1	0	0	64	33
B	7	4	16	8	0	0	1	1	24	12
C	3	1	8	4	25	13	1	1	37	19
D	7	4	5	3	19	10	38	20	69	36
Total reported	79	41	30	16	45	24	40	22	194	100

Note: ASIA impairment category was not reported at admission and/or discharge for 46 cases.

Length of hospital stay

Table 4 presents 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 for the 177 cases for which neurologic category was reported. It shows that the ALOS was much longer for Tetraplegia than for Paraplegia. The ALOS was longest for complete Tetraplegia, followed by complete Paraplegia, incomplete Tetraplegia, and incomplete Paraplegia. The ALOS decreased with a decrease in the neurological level of injury, from the cervical through to the sacral segments of the spine, for both complete and incomplete injuries.

Table 4: Incidence of persisting SCI from traumatic causes by neurological level (major grouping) and extent of injury at discharge, Australia 1995/96 (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	34	252	24	160	7	97	1	53	32	143	66	199
Incomplete	58	119	25	95	24	60	4	27	53	74	111	98
Total	92	168	49	127	31	68	5	32	85	100	177	135

Note: Neurologic category was not reported for 63 cases out of the 240 persisting cases of SCI

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[5] American Spinal Injury Association. International standards for neurological and functional classification of spinal cord injury. Chicago: American Spinal Injury Association, 1992.

[10] Stover SL, DeLisa JA, Whiteneck GG. Spinal cord injury: clinical outcomes from the Model Systems. Maryland: Aspen Publishers, 1995.

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[15] Bohlman, HH, Freehafer, A, Dejak, J. The results of treatment of acute injuries of the upper thoracic spine with paralysis. J Bone Joint Surg Am 1985; 67: 360-369.

[16] White A, Panjabi M. Clinical biomechanics of the spine. Second Edition. Philadelphia: JB Lippincott Company, 1990, p. 333.

[17] Frankel HL, Hancock DO, Hyslop G et al. The value of postural reduction in the initial management of closed injuries of the spine with paraplegia and tetraplegia. Paraplegia 1969; 7(3): 179-192.

[18] Tator CH, Rowed DW, Schwartz ML. (eds): Sunnybrook cord injury scales for assessment of neurological injury and neurological recovery in early management of acute spinal cord injury. New York: Raven Press, 1982: 7.

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Profile of the newly incident cases of spinal cord damage from non-traumatic causes

Sixty-seven cases of spinal cord damage from non-traumatic causes, newly incident in 1995/96, were reported by the SUs. There was a substantial difference in the number of cases reported by State of residence (see below) which is most unlikely to reflect real differences in incidence. The pattern of reporting by State suggests that the total number of cases reported by the SUs cannot be taken to be an accurate measure of the national incidence of this condition. It is unknown to what extent it understates the true incidence figure.

State	Number	Percentage
NSW	9	13
QLD	11	17
SA	15	22
VIC	28	42
WA& NT	4	6
Total	67	100

Demographically and clinically, the non-trauma cases were quite distinct from rthe trauma cases. Females comprised 52% of the non-trauma cases compared with 24% of the trauma cases. Whilst the mean age of the trauma cases was 38 years, the mean age of the non-trauma cases was 53 years. The aetiology of non-traumatic SCI was most commonly identified as tumour or tumour related factors, aortic aneurysm, spinal stenosis, spinal abscess and transverse myelitis. The neurological level of the damage to the spinal cord amongst the non-trauma cases was most commonly in the thoracic segments (53%) and incomplete neurological damage was most common (88%). The average length of hospital stay of the non-trauma cases was 84 days compared with 135 days for persisting cases of SCI from traumatic causes.

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Activity of Spinal Units in 1995/96

In addition to collecting information about newly incident cases of SCI from traumatic and non-traumatic causes, ASCIR also collected information on readmissions to the SUs. The readmission process identified cases for registration who's SCI incident occurred prior to the commencement of the Walsh data collection, in 1986, and in the period between cessation of that collection and the commencement of ASCIR (i.e. 1992-mid 1995). It also identified cases that were missed during the period of the Walsh data collection. The process increased the coverage of ASCIR and it also assisted with the monitoring of the health conditions of the prevalent population that were managed by the SUs.

The reporting of incident cases and readmissions to ASCIR between 1 July 1995 and June 30 1996 is presented by State and SU in Table 8. The SUs reported 340 new cases of SCI, incident in 1995/96. Two hundred and seventy-three of these were from traumatic causes, of which 262 occurred to Australian residents in Australia (11 occurred either to Australian residents who were overseas at the time that they had their injury or to non-residents who had their SCI in Australia). Sixty-seven cases were due to non-traumatic causes.

As a result of the readmission process, 224 cases were registered whose SCI incident occurred prior to the commencement of ASCIR, and 148 readmission forms were forwarded detailing the health conditions of the prevalent population that were managed by the SUs.

Table 5: Reporting of incident cases and readmissions to ASCIR between 1 July 1995 and June 30 1996 by State and Spinal Unit, Australia, 1995/96

	Newly incident cases*		Cases incident prior to the commencement of ASCIR	Total incident cases reported	Readmission forms forwarded to ASCIR
	Traumatic	Non-traumatic			
State and Spinal Unit					
New South Wales					
Royal North Shore Hospital / Moorong	59	6	27	92	12
Prince Henry Hospital	27	2	8	37	8
Victoria					
Austin Hospital	65	28	61	154	42
Queensland					
Princess Alexandria Hospital	73	11	25	109	1
South Australia					
Royal Adelaide Hospital / Hampstead	24	17	27	68	14
Western Australia					
Royal Perth Hospital	25	3	76	104	79
All Spinal Units	273	67	224	564	148

*Complete ascertainment of newly incident cases of SCI was confirmed by each SU.

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Data issues

National incidence of traumatic SCI

The number of newly incident cases of SCI reported by the SUs is likely to understate the true national incidence figure for the following reasons:

a. It excludes cases that died from their SCI or other injuries prior to hospital admission. Detection of damage to the spinal cord and assessment of its contribution to death is often very difficult. Cain et al.[19], in an assessment of cervical spine injuries in road traffic crashes in South Australia from 1981 to 1986 found that post-mortem radiography of the cervical spine detected almost twice as many cervical injuries as were identified in routine post-mortem examination. Also, Leditschke et al.[20] found that damage to the spine was missed in 8% of radiographic examinations. Whilst these studies provide information on the extent to which damage to the spinal cord may be missed, the information is of limited utility for the purposes of estimation of SCI incidence at national level because there is no routine reporting of post-mortem results.

b. It excludes cases of traumatic SCI managed at other hospitals that meet the CDC clinical definition. It has not been possible to date to determine the extent to which other hospitals treat SCI cases due to limitations in the available hospital inpatient separations data. It is probable that other hospitals manage cases of SCI especially where neurological deficit was of short duration or the patient died prior to transfer to a SU. Also, it is has been suggested that children suffering spinal cord damage, expected to number less than four per year, are generally managed in paediatric hospitals.

Age adjustment

All-ages rates have been adjusted to overcome the effect of differences in the proportions of people of 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 newly incident spinal cord injuries treated at SUs are submitted to ASCIR for registration, so sampling errors do not apply to these data. However, the time periods used to group the cases (ie. Fiscal years) are arbitrary. Use of another period (e.g. Calendar year) can result in different rates. Where case numbers are small, as they are with spinal cord injury, the effect of chance variation on the 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 more significant pattern.

[19] Cain, CMJ, Ryan, GA, Fraser, R et al. Cervical spine injuries in road traffic crashes in South Australia, 1981-86. Aust. NZ J Surg 1989; 59: 15-19.

[20] Leditschke, J, Anderson, RMD, Hare, WSC. The cervical spine in fatal motor vehicle accidents. Clinical and Experimental Neurology 1992; 29: 263-271.

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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"[5]. The term `complete injury' is used when there is an absence of sensory and motor function in the lowest sacral segment[5].

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"[5] (i.e. the lowest level that has full function).

Newly incident case of SCI:
: a person who suffers an SCI, as defined by the CDC clinical definition, during this reporting period (i.e. in 1995/96 in this Bulletin).

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" [5].

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"[5]. 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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[5] American Spinal Injury Association. International standards for neurological and functional classification of spinal cord injury. Chicago: American Spinal Injury Association, 1992.
