

## Original Article

# A demographic profile of traumatic and non-traumatic spinal injury cases: a hospital-based study from India

P Agarwal<sup>1</sup>, P Upadhyay<sup>1</sup> and K Raja<sup>\*1</sup>

<sup>1</sup>Department of Physiotherapy, Manipal College of Allied Health Sciences, Manipal Academy Of Higher Education, Manipal, India

**Study design and subjects:** Retrospective descriptive analysis of data of patients with spinal injuries admitted to a tertiary referral medical center from January 1, 2003 to December 31, 2004.

**Objectives:** To identify the demographic profile of patients with spinal injuries admitted in this hospital.

**Setting:** Medical records department, Kasturba Hospital, Manipal, Karnataka, India.

**Methods:** A total of 207 patients with traumatic and non-traumatic spinal injuries were included in the study. The patient characteristics that were included were age groups, neurologic status, mode and neurological level of injury, management and recovery pattern.

**Results:** Ratio of men to women who sustained spinal injuries was 3.6:1. The maximum number of patients was in the age range of 20–39 years. The different levels of spine that sustained injuries were cervical spine (36.2%), thoracic spine (34.3%) and lumbar spine (29.5%). There were 118 patients with neurological deficit. Mechanisms of injury recorded were fall from height (58.9%), fall of weight (7.2%), motor vehicle accidents (21.3%) and non-traumatic causes (12.6%). Of these 207 spinal injury patients, 74.4% were managed conservatively, whereas 25.6% patients were managed surgically.

**Observation:** This study gives a preliminary overview of the characteristics of patients with spinal injuries in this hospital.

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**Keywords:** demographics; spinal injuries; paraplegia; morbidity

## Introduction

The incidence as well as the prevalence of spinal injuries has been on the rise with the incidence rate being estimated to be from 15 to 40 cases per million world wide.<sup>1</sup> The developments in the management of spinal cord injury (SCI) have led to decrease in morbidity and mortality rates, thereby increasing the prevalence of patients with varying degrees of functional limitations.

There is extensive ongoing research on epidemiological aspects of SCI from different parts of the world. The differences reported, relate to mechanism of injury (MOI), age group, gender distribution, race and ethnicity,<sup>2</sup> morbidity and mortality rates. The trend in demographics<sup>3</sup> as well as recovery<sup>4,5</sup> in spinal injury patients has been reported to be changing in recent times.<sup>1</sup>

In a study by Nobunaga *et al*,<sup>6</sup> significant trends in changing demographics were observed. These included

older ages at the time of injury, increasing proportions of injuries occurring in the racial and ethnic minority populations, and decreasing proportions of injuries because of motor vehicle crashes and sports.

In a study conducted in our hospital in 1986, Chacko *et al*<sup>7</sup> observed that the commonest cause of spinal injuries was fall from trees. Rescue and retrieval systems for the patients were inadequate. By examining trends prevalent at that time, the authors opined that prevention strategies should be targeted at persons who were at the greatest risk for injury.

There is a dearth of reliable statistics concerning spinal injury in India. In order to understand the demographic aspects of spinal injuries in India, it is necessary to document characteristics of subjects in different parts of the country. It is important to have a database, as the primary levels of health care in the community are inadequate in India.

Owing to the lack of an effective primary care system, all patients with trauma are automatically referred to

\*Correspondence: K Raja, Department of Physiotherapy, Manipal College of Allied Health Sciences, Manipal Academy Of Higher Education, Manipal 576104, India

general hospitals. Hence, data collected at our hospital would be a fair indicator of trends in South-West India, as it is a major tertiary referral hospital serving a population of approximately 21 million.

## Objective

To evaluate the demographic characteristics and recovery processes in new spinal injuries reported at our center in the years 2003 and 2004.

## Methods

Records of all new consecutive admissions of patients with spinal injuries from January 1, 2003 to December 31, 2004 were collected from the medical records department of the hospital and reviewed.

Data that were recorded consisted of age, gender, MOI, neurological level of injury, methods of management, recovery of the patient till January 2005, status at discharge from hospital and neurological condition at discharge.

Neurological level and extent of injury were defined using the international standards set forth by the American Spinal Injury Association (ASIA). The neurological level of injury was defined as the most caudal segment of the spinal cord with normal sensory and motor function on both sides of the body. Recovery was categorized as complete, incomplete and no recovery. Injury to vertebral body alone without cord damage was recorded separately under the category of spinal injury without neurological deficit.

Etiology of injury was categorized into four groups. Motor vehicle accidents (MVA) included accidents that occurred while the subject was traveling in a vehicle as well as pedestrians hit by vehicles. Fall of weight included falling of heavy objects from a height as well as fall of a person while carrying loads either on the head or back. Fall from a height included falls from buildings and trees. Miscellaneous causes included non-traumatic causes like cranio-vertebral anomalies, rheumatoid arthritis and systemic diseases leading to spinal injuries.

The protocol for management of patients with spinal injuries with/without neurological deficit followed in this hospital during the period of the study was as follows. Patients having unstable fractures with/without neurological deficit were managed by surgical means. This excluded people who refused surgery.

Patients with stable fractures and no neurological deficit and those with osteoporosis were managed conservatively with initial traction or postural reduction followed by immobilization in a spinal orthosis. A few patients with neurological deficit were managed conservatively, the reasons for which were financial, patient/family choice owing to socio-cultural reasons and associated medical conditions, which made surgery unsuitable for the patient.

The period of immobilization varied according to the type of injury and the mode of management. Patients

were immobilized for a minimum period of 6 months in a spinal orthosis following surgery. Implant removal following surgery was performed after one and a half years. In patients with neurological deficit who were managed conservatively, immobilization extended up to 1 year.

## Results

The total number of new cases reported during the period of the study was 207 (Figure 1). Of these, 181(87.4%) patients had traumatic spinal injuries, which included 30 women and 151 men. Among the subjects with traumatic injuries, 107 patients sustained neurological injuries (50.5% at cervical level, 24.3% at thoracic level and 25.2% at lumbar level). 74 patients sustained only vertebral injuries without neurological deficit.

There were 26 (12.6%) patients (15 women, 11 men) with non-traumatic history of spinal injury. Of these, 11 patients had neurological deficit (54.5% at the cervical level, 18.2% at the thoracic level and 27.3% at the lumbar level), whereas 15 patients sustained only vertebral injury.

*Gender* – The ratio of men to women who sustained spinal injuries (with and without neurological deficit) was 3.6:1. Men (83.4%) outnumbered women in the group, which had sustained traumatic injuries, while women (57.7%) outnumbered men when the cause of spinal trauma was non-traumatic in origin (Table 2).

*Age* – The largest number of patients were in the age range of 20–39 years (86) closely followed by that of 40–59 years (73) (Table 1).

*Level of injury* – The cervical spine accounted for the maximum number of injuries (36.2%), followed by the thoracic (34.3%) and the lumbar (29.5%) spines (Table 1).

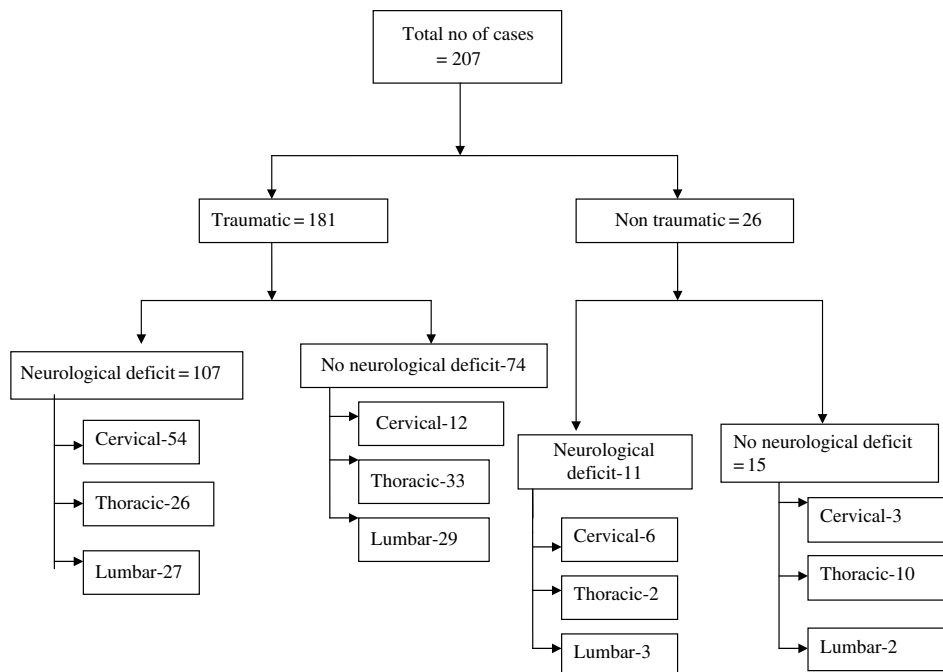
### *Etiology of injury*

Fall from a height (58.9%) was observed to be the most common MOI, followed by MVA (21.3%), fall of weight (7.2%) and non-traumatic causes (12.6%).

Fall from a height led to fewer injuries to the cervical spine (27%) than the thoracic spine (36.1%) and the lumbar spine (36.9%). Fall of weight led to more injuries to the cervical spine (66.7%) than the thoracic spine (20%) and lumbar spine (13.3%). MVAs were responsible for more injuries to the cervical spine (54.5%) than the thoracic spine (25%) and the lumbar spine (20.5%). There were remarkable differences in MOI among men and women (Table 2).

### *ASIA impairment scale*

Of the 207 patients, 89 patients had only vertebral injuries without involvement of the spinal cord. Of the 118 patients who sustained cord injuries of varying severity, the distribution was: ASIA impairment scale (AIS) grade A, 33.9%; grade B, 18.6%; grade C, 17.8%; grade D, 30.5% (Table 3).



**Figure 1** Distribution of cases in various categories

**Table 1** Demographic profile of patients

Characteristics	Number (%)
Total no. of cases	207
Males	162 (78.3)
Age group (years)	
0–19	13 (6.3%)
20–39	86 (41.5)
40–59	73 (35.3)
> 60	35 (16.9)
MOI	
Fall from height	122 (58.9)
Fall of weight	15 (7.2)
MVA	44 (21.3)
Miscellaneous	26 (12.6)
Level of injury	
Cervical	75 (36.2)
Thoracic	71 (34.3)
Lumbar	61 (29.5)
Neurologic deficit	118 (57)
No neurologic deficit	89 (43)
Surgical management	53 (25.6)
Conservative management	154 (74.4)
Mortality	04
Discharge against medical advise	18
Osteoporosis	12

**Table 2** Gender differences in mode of injury and recovery pattern

	Women (N- 45) n (%)	Men (N- 162) n (%)
Fall from height	21 (46.7)	101 (62.3)
Fall of weight	06 (13.3)	09 (5.5)
MVA	03 (6.7)	41 (25.3)
Non traumatic	15(33.3)	11 (6.8)
Neurologic deficit	18	100
Incomplete recovery	09 (50)	30 (30.0)
Complete recovery	07 (38.9)	24 (24.0)
No recovery	2 (11.1)	32 (32.0)
Not available	Nil	14 (14.0)

*Neurological status and recovery*

Among the patients with neurological deficit 118 (57%), there were more men (84.7%) than women (15.3%). Of these patients, maximum subjects were in the incomplete recovery group (33%) followed by that in the no recovery group (28.8%) and complete recovery (26.3%) group. Data for recovery were not available in 11.9% of subjects all of whom were men (Table 2).

*Etiology of injury and neurological status*

Among the patients who sustained injury with neurological deficit (118), falls from a height accounted for the largest number of cases (59.3%) as compared to fall

**Table 3** Neurological levels of injury with ASIA grades

Level of injury (n)	A	B	C	D
	N (%)	N (%)	N (%)	N (%)
Cervical – (60)	18 (30)	13 (21.7)	14 (23.3)	15 (25)
Thoracic – (28)	8 (28.6)	4 (14.3)	5 (17.8)	11 (39.3)
Lumbar – (30)	13 (43.3)	3 (10)	4 (13.3)	10 (33.3)

of weight (10.2%), MVA (21.2%) and non-traumatic causes (9.3%) (Table 1).

### Management

Patients in the conservative group (74.4%) were managed with complete bed rest and polypropylene spinal jacket immobilization. Among those with neurological deficit, 55% were managed conservatively, whereas the others underwent surgical procedures of decompression and stabilization. Surgical management was decided upon, based on medical need, consent from the family and economic factors.

There were 53 patients (six women, 47 men) who underwent surgical procedures as a part of their treatment among whom 47 patients (six women, 41 men) had neurological deficit, whereas six (all men) patients had no neurological deficit.

Of the 47 patients with neurological deficits who underwent surgical procedures (41 men, six women), 27.6% patients (two women and 11 men) had complete recovery, 31.9% (three women and 12 men) had incomplete recovery, whereas 25.5% of patients (one woman and 11 men) had no recovery.

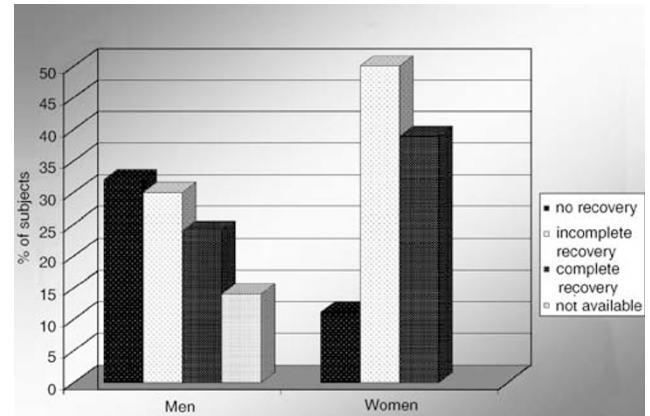
Of the 71 patients with neurological deficit who were managed conservatively (12 women and 59 men), 25.3% (five women, 13 men) achieved complete recovery, 33.8% (six women, 18 men) achieved incomplete recovery, whereas 31% (one woman, 21 men) had no recovery.

Data for recovery pattern were not available for 14 patients (all men). This included patients with neurological deficit who were managed surgically (14.9%) and conservatively (9.8%).

### Gender differences in recovery patterns (Table 2) (Graph 1)

Women showed better neurological recovery than men. Of 162 men, who sustained spinal injuries, 100 (61.7%) men sustained neurological deficits. Of these patients, 32 (32%) had no recovery in their neurological status, whereas 30 (30%) had incomplete recovery and 24 (24%) could achieve complete recovery. Data for the recovery of 14 (14%) men were not available in the records, which could be due to loss to follow-up of those patients.

Of the 45 women who sustained spinal injuries, only 18 (40%) sustained neurological deficit. Of these patients, two (11.1%) had no recovery in their neurological status, whereas nine (50%) had incomplete recovery and seven (38.9%) achieved complete recovery.

**Graph 1** Gender differences in recovery pattern

### Discharge against medical advice, mortality and osteoporosis

There were 18 patients who discharged against medical advice, four patients with neurological deficit who died in the hospital and 12 patients (11 women, one man) who were diagnosed as having osteoporosis when admitted to the hospital following spinal injuries. The subjects who were diagnosed with osteoporosis had sustained the injury due to trivial trauma like slipping on the floor.

### Discussion

SCI poses a great social and economic burden on society. Often the spinal injured subject is in the prime of life and the sole breadwinner. With the lack of socialized medicine in our country, the family is called upon to bear the expenses of hospitalization and ongoing care. Hence, it is very important that we understand the characteristics of the disability to ascertain modifiable factors. The trends seen in this study are discussed below.

### Age

As evident from the results of this study, the largest number of patients was in the age range of 20–39 years closely followed by that of 40–59 years. This is comparable to the age range observed in a study<sup>7</sup> carried out in the same institution 20 years ago, wherein most patients were in the third or fourth decade of life. Occupational factors like climbing trees, which is very common in this part of India was observed to be the most common cause of fall from a height. This is the most productive age group and the victims are often the primary providers for their families.

### Etiology

Etiology of SCI appears to have a major effect on the level and extent of neurological deficit as well as recovery.<sup>1</sup> Occupational factors leading to spinal injuries as noted within this study included falls from

trees, electric poles and buildings. Literature from developed countries, report that MVA accounts for the maximum number of spinal injuries.<sup>8</sup> However, MVAs accounted for only 21.25% of cases in this study. Fall from a height was observed to be the cause of the maximum number of reported cases in the past<sup>7</sup> as well as in the present study in India. Non-traumatic insult to the cord was noted as an etiological factor as well. However, the number of patients who presented with this etiology were few as compared to that reported in a previous study where individuals with non-traumatic SCI represented a significant proportion of SCI rehabilitation admissions.<sup>9</sup>

It is important to note that this study found that fall from a height posed the greatest risk for spinal injuries, which included falls from trees during manual collection of the produce, falls from buildings during construction as well as workers on electricity posts. Use of safety harnesses is seldom practiced in these occupations. Although harnesses have been developed to ensure safety during climbing of trees, they are rarely used by subjects who consider them to be a hindrance to their occupation. It is essential that governmental policy make wearing of safety harnesses during high risk jobs mandatory.

#### Gender distribution

Previous studies have reported that the percentage of men affected was found to be more than that of women.<sup>1,3</sup> Comparable results were found in the present study. The etiology in women was the same as that of men with fall from a height accounting for the maximum number of spinal injuries. This could be due to their participation in high risk jobs like construction. Biologic factors that is aging with osteoporosis was also found to be a contributing factor for injuries among women in our study. However, gender differences found in our study must be interpreted with caution, as there was a wide difference in the numbers of men and women who were studied. One of the possible reasons for this is the most common etiology that was observed. Women are at risk of falls only during construction work. Work involving climbing trees and electric posts are not jobs normally done by women in India. Conversely, women are more likely to carry loads on their heads than men. However, this was not reflected in the study. These factors must be studied further.

#### Management

It was observed that more than 50% of the patients studied had sustained neurological deficit following trauma. Not all patients with neurological deficits underwent surgical procedures. The reluctance to undergo surgery could have played a major part in the morbidity levels of these patients. McKinley *et al*<sup>10</sup> have reported that outcomes following surgery immediately after cord insult are significantly better compared to conservative management. It is notable in our study that

many patients refused surgery despite advice from the medical personnel. Reasons cited were predominantly economic factors.

#### Level of injury

It was noted in our study that falls from a height was more likely to injure the lumbar spine, whereas fall of weight and MVA contributed to more cervical spine injuries. These observations are similar to those reported in a previous study by Jackson *et al*.<sup>1</sup> Cars and buses in India do not always have head rests and other safety mechanisms to decrease the effects of whiplash injuries. This factor might have contributed to cervical injuries being more common in MVA.

#### Recovery pattern

Recovery pattern was grouped as 'no recovery', 'incomplete recovery' and 'complete recovery'. In all the three groups, women fared better than men. (Graph 1)

This finding supports recent research on the effect of gender in neurological recovery following SCI whereby women are observed to improve in their neurological status more than men.<sup>11</sup> Many studies have shown that estrogen has neuro-protective properties when the CNS is challenged with disease or injury.<sup>12-14</sup> Our study does not provide any direct evidence on the role of estrogen in SCI recovery. The recovery pattern seen in this study may be attributed to gender-related behavioral traits that result in less severe forms of injury in women as compared to that in men. In addition the disproportionate numbers of men and women make it difficult to draw conclusions.

#### Implications

This study indicates the need for intensive public education. A number of agencies, institutions and organizations are needed to form strategic plans to address injury prevention. The three broad approaches for injury prevention programs are:

- *Environmental modification*, for example shock absorbent guardrails on the highways, improved lighting – all of which contribute to making our environment safer.
- *Legislation* that requires change in behaviors like mandatory use of safety harnesses when engaged in high risk jobs and vehicles, free essential medical services, including surgery when deemed necessary.
- *Education* of persons at risk for injury. Programs should be designed to give information about the types of injury, mechanisms of injury, what people can do to minimize risks and why it is worth their effort to do so. This should include the instructions for use of safety harness for people whose occupations involve climbing trees/heights. Public education focusing on transport of subjects suspected of having sustained a SCI is also essential.

In terms of the direction of future study, a longitudinal study with larger number of patients with spinal injuries must be undertaken to investigate the long-term effects of the injury on functional status, community integration and quality of life measures. Other parameters, such as carers' stress and their quality of life might also be included. With increasing number of patients with traumatic and non-traumatic spinal injuries in the years to come, our data set, along with those from other local designated SCI centers, could be combined to form a national database.

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