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# Epidemiological Profile of traumatic spinal cord injuries in the National Referral Hospital, Bhutan

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## ABSTRACT

**Introduction:** The number of traumatic spinal cord injuries associated with a fracture is on the rise which is compounded by the rise in the number of motor vehicle accidents in the country. The aim of the study was to assess the frequency, cause, pattern, and demographic profile of traumatic spinal cord injuries in the Bhutanese population. **Methods:** A retrospective study was conducted at National Referral Hospital from 2018 to 2020. Hospital records of patients, treated for traumatic spinal cord injury were reviewed. **Results:** Of the total of 100 patients with traumatic spinal injury admitted during the study period, there were 69 males (69%) and 31 females (31%). The mean age was 44.18 years (±16.625 SD). Falls (61%) was the most common cause of spine injury followed by road traffic accident (27%). Lumbar spine injury was most common (42%) followed by cervical spine (31%) and thoracic spine (23%) injuries. Of the 100 patients with spinal injury 63 patients did not have associated cord injuries while 37% of the patients had associated spinal cord injuries and of those with spinal injuries, 20% of them had complete spinal cord injury (SCI) and 17% had incomplete SCI. Regarding treatment, 42% of the spine injury patients underwent surgical procedures while 58% were managed conservatively. The mean length of hospital stay after the spinal injury was 6.62 days (± 26.06 SD, range 1-215). **Conclusions:** The study found that the most common cause of spine and associated cord injuries were falls followed by road traffic accidents. By collaborating with the traffic and road safety division, our study findings have the potential to significantly reduce road traffic accidents and enhance preventive measures. Additionally, we can provide valuable education to families regarding rehabilitation and social support, ultimately leading to improved outcomes and better quality of life for individuals living with spinal cord injuries.

**Keywords:** Falls; Road traffic accident; Spinal cord injury.

## INTRODUCTION

Globally, it was found that most spine injuries were caused by road traffic accidents (RTAs), together with low and high falls. Road traffic and high fall accidents are typical etiology in young patients, whereas the role of low falls and associated osteoporosis increases trauma in older population[1]. Motor vehicle crashes (MVC) were the leading cause of traumatic spinal cord injury accounting for almost 39.5 % of all cases[2,3]. In the low and middle income countries, it was observed that the traumatic spine injuries were occurring in a young males[3]. Spine trauma is a global health concern. Road traffic accidents and falls are the commonest cause of spine trauma[4]. Among the spine injury, cervical segments are most frequently involved, leading to tetraplegia. Spinal cord injury (SCI) causes a serious lifelong impact to the patients, families and society[5]. The highest incidence and the heaviest economic impact of SCI are mostly seen in developed countries[6]. Although spine fracture represents only a minority of the trauma, its influence on patient's social and financial environment is very significant[7]. The traumatic spinal cord injuries have a tremendous social cost associated with expensive health care treatment, loss of productivity and long-term rehabilitation[8].

The incidence and prevalence of traumatic SCI differs from country to country and also among different regions of the country[1]. The incidence rate of spinal cord injury internationally ranges from 10.4 to 83 cases per million population[9]. Although it is safe to assume that there may be significant number of people sustaining spinal injuries in the developing countries, there is dearth of epidemiological studies on SCI in this part of the world[9]. The lack of information on spinal injuries and consequential impairments potentially add to the lack of appropriate services as well. The incidence of SCI in the North America and Europe has risen over the last three decades[10] and can be attributed to numerous research and attention accorded to the problem.

While majority of spinal injuries is attributed to the motor vehicle accidents[8,11], especially in high-income countries, other causes of trauma such as falls, sports injury, and other recreational activities are also increasingly reported[1,10,12]. Furthermore, it was reported that fall from height (59.64%) was the common cause of SCI among the people of Sikkim and North

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Eastern India while RTA contributed to about 35.08%[1]. At the structural level of injury, a study reported that lower thoracic (T12) and upper lumbar (L1) are common site of injury followed by cervical spine (C2)[11]. Contrarily, in rugged hill regions of North East India, cervical spine injury was reported as the commonest followed by lower thoracic region[1].

Another study reported increased percentage of tetraplegics indicating the increased number of people living with severe morbidity and functional limitations as a consequence of the injury[13].

Although, there are numerous studies on neuroprotective and neurogenerative strategies in preclinical research, no effective pharmacotherapy exists till date for the SCI patients[13]. The focus therefore is mainly on preventive and rehabilitative aspect for the patient with an SCI. An important component of preventive strategy includes early diagnosis of the spine fractures and the associated spinal cord injury so that morbidity and mortality are largely prevented[5,11]. Injury prevention and its importance has long been recognized in countries like Canada where there are public health and prevention initiatives, targeting young people who are at high-risk group for SCI[8]. In addition, high-income countries have facilities and services to provide comprehensive medical care and treatment for the patient with spinal cord injuries[13].

Although spine injuries are frequently seen in hospitals in Bhutan and especially at Jigme Dorji Wangchuck National Referral Hospital (JDWNRH), baseline data on the incidence and spectrum of spinal cord injuries in Bhutan has not been established till date. JDWNRH, being the only health center with the facility for spine surgeon, all the patients from across the country are being referred for further management at this center.

Therefore, a retrospective study was conducted with the aim to assess the frequency, cause, pattern, and demographic profile of traumatic spinal cord injuries in the Bhutanese population. The study, therefore, provides the baseline data on the epidemiology of traumatic spinal cord injuries in Bhutan.

## Materials and method

After obtaining approval from the Research Ethics and Board of Health (Ref No. REBH/Approval/2021/104 dated: 23/11/21, a retrospective study was conducted in the national referral hospital. Records of patients admitted between January 2018 and December 31,2020 in the orthopaedic ward were reviewed. The orthopedic ward admitted approximately 3,800 patients in 2018 to 2020, there were 100 patients with traumatic spinal cord injuries who were included in the study.

The data were retrieved from Hospital medical records, emergency trauma records and orthopaedic surgical logbook. Gender, age, occupation, mechanism of injury, pattern of spine fractures, level of spine injury, neurological status, treatment and length of stay were collected. Data were extracted into Microsoft Excel and means, frequencies, and percentages were analyzed by using SPSS version 25.0 software.

## RESULTS

### Demographic characteristics

As shown in Table 1, a total number of 100 patients with traumatic spinal injury were admitted during January 2018-December 2020. The mean age was 44.18 years ± 16.62, with 69% males (*n*=69) and 31% females (*n*=31). Forty-one patients (41%)of the patients were farmers and 11 out 31 women patients recorded housewife as their occupation.

Most of the injuries were found in the young and middle-aged groups were the most affected (41/100 in 21-40 years, 35/100 in 41-60 years). Twenty-one patients (21%) of the patients were over 60 years old. With the increasing age, a greater number of compression fractures were seen in patients aged over 60 years and most of them had intact neurological status.

### Mechanism of injury

The most common cause of traumatic spinal cord injury was due to falls from height (61%) followed by road traffic accidents (27%).

There was one case of injury due to violence. Two old ladies sustained spine injuries when a wind blew up the tent and hit them on their backs. Other causes of the spine injury were four of them were hit by a log while logging and two of them were gored by a bull in the field.

**Table 1. Sociodemographic profile of the patient with traumatic spinal cord injuries in the National Referral Hospital, 2018-2020 (*n*=100)**

| Variables | *n* (%) |
|---|---|
| **Gender** | |
| Male | 69 (69%) |
| Female | 31 (31%) |
| **Age in years mean(±SD)** | 44.18(16.62) |
| ≤ 20 | 3 (3%) |
| 21-40 | 41(41%) |
| 41-60 | 35 (35%) |
| >60 | 21(21%) |
| **Occupation** | |
| 1. Farmer | 41(41%) |
| 2. House wife | 11(11%) |
| 3. Civil servant | 4(4%) |
| 4. Private sector | 8(8%) |
| 5. Business | 5(5%) |
| 6. Student | 4(4%) |
| 7. Dependent | 13(13%) |
| 8. Laborer | 3(3%) |
| 9. Others (Mechanic, painter, arm force, carpenter) | 11(11%) |

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| | |
|---|---|
| **Mechanism of injury** | |
| 1. Fall from height | 61 |
| 2. MVA | 27 |
| 3. Assault | 1 |
| 4. Jumped from building | 1 |
| 5. Hit by log | 4 |
| 6. Bull gore | 2 |
| 7. Others | 4 |
| **Pattern of spine fracture** | |
| 1. Compression fracture | 36 |
| 2. Burst fracture | 43 |
| 3. Fracture dislocation | 14 |
| 4. Avulsion fracture | 1 |
| 5. Non displaced fracture | 6 |
| **Level of spine injury** | |
| 1. Cervical | 31 |
| 2. Thoracic | 23 |
| 3. Thoraco-lumbar | 4 |
| 4. Lumbar | 42 |
| **Neurological status** | |
| 1. Intact | 63 |
| 2. Incomplete | 13 |
| 3. Complete | 20 |
| 4. Cauda equina syndrome | 4 |
| **Treatment** | |
| 1. Non- operative | 58 |
| 2. Operative | 42 |
| **Length of stay in days mean (±SD)** | 16.62 (±26.06) |
| Range | 1-215 |

**Neurological status and level of spine injury**

Sixty-three patients (63%) of the patient admitted with traumatic spine injuries did not experience concomitant spinal cord injuries and retained normal neurological functions. However, 20% of the patients admitted with spine injuries had complete cord injury while 13% had incomplete SCI, and 4% of the patients presented with Cauda equina syndrome. Spinal cord injuries were mostly associated with the injuries at cervical and thoracic spine levels. The cord injuries were also associated with 'burst' type of fracture, fracture-dislocation, and multiple column fractures of the vertebral column.

Lumbar spine fractures were most common (*n*=42), followed by cervical spine fracture (*n*=31), and the thoracic spine fracture (*n*=23). Although, injury at the lumbar spine was reported highest, over 83% (*n*=35) had no associated cord injuries or neurological symptoms. However, cauda equina syndrome was highest at 9.5% (*n*=4) among the lumbar spine-associated cord injuries while 4.8% (*n*=2) had complete SCI and 2.4% (*n*=1) had incomplete SCI associated with lumbar spine injuries.

Injuries at the cervical spine level had the highest associated cord injuries at 58% (*n*=18) with 50% (*n*=9) complete SCI and 50% (*n*=9) incomplete SCI, while 41.9% (*n*=13) did not have any associated cord injuries.

Although 23% of the spine injuries were recorded at the thoracic level, had complete SCI (75%, *n*=9) were at this level. Fifty-two patients (52%) of the thoracic spine injuries had associated cord injuries with 75% sustaining complete SCI and 25% (*n*=3) sustaining incomplete SCI.

**Management**

Operative treatments were chosen for 42% of the patients (42/100). All patients with burst fractures and fracture-dislocation were treated operatively. Surgical procedures done were posterior triple wiring, anterior cervical discectomy and fusion (ACCF), and posterior decompression with instrumentations. All surgical procedures were done immediately or within the first week of the injury. Fifty-eight patients (58%) of the patients received non-surgical management of the spine injuries. Non-surgical treatments included providing and fitting hard collars, halo vest, thoracolumbar orthoses, and lumbar corsets. No patients had received any form of steroid therapy or injection as the initial management.

**Length of stay**

The average length of stay was 6.62 days (± 26.06 SD, range 1-215). Patients with complete SCI had stayed longer than those with incomplete SCI and intact neurological status. A patient who was the victim of violence sustained fracture-dislocation at the cervical vertebrae (C3-4) with quadriplegia stayed the longest in the hospital for 215 days.

**Complications**

A total of seven patients had other associated injuries such as rib fractures, subarachnoid hemorrhage, lung contusion, humerus fracture, tibia fracture, and soft tissue injuries.

Two patients had expired in the intensive care unit due to certain cardio-respiratory complications. They were transferred there from the ward after they developed complications. Both of them were above the age of 60 and had sustained cervical spine injuries.

## DISCUSSION

SCI affects the patients' physical, psychological and social well-being which results in a heavy burden on families and the healthcare system[14]. Therefore, it is very important to understand the epidemiology of traumatic spinal cord injury to help the health care system carry out preventive and rehabilitative measures[14]. World Health Organization has predicted that motor vehicle accidents (MVA) would be a major cause of traumatic SCI in the coming decades if preventive measures are not taken[15]. Although

MVA and falls are the main causes of injury, fall tends to be one of the main causes of traumatic SCI[14]. Males were more likely to sustain spinal cord injury than females[15].

We found that males sustain traumatic SCI more than females. The most commonly affected age group was between 21-40 years at 41% followed by 41-60 years at 35 %. The age distribution of traumatic spinal cord injury is similar to the results of many studies conducted around the world. The younger the mean age of spinal cord injury means more burden to the country as they are the most productive age group and their productivity is significantly affected by the increased disability-adjusted life years. The mean age of spinal cord injury was seen as higher in developed countries due to the longer life expectancies and better health care systems – both at injury prevention and immediate response level[15]. Although falls and MVA were the common causes of traumatic spinal cord injury, the study found that falls as the commonest cause of traumatic spinal cord injury in our study. Traditionally MVA was thought and considered as the common cause of injury leading to traumatic SCI[8]. However, in a recent review, MVA was responsible for only about 40% to 50% of spinal cord injuries[16] while fall accounted for an equal percentage of SCI. Incidentally, in our study falls had significantly (61%) caused the traumatic spine and associated cord injuries. The lack of motorable road networks in rural Bhutan could also explain why MVA is the lesser cause of traumatic SCI was as observed by Rahimi-Movaghar and colleagues[15] in developing countries. Although our study did not include the different types of falls – the nature of work the farmers do in rural Bhutan could explain the potential risk of falls that they are exposed to – such as climbing trees, cliffs and negotiating the rugged terrain. The Obviousness of males being affected more than females is the participation of males in the physical nature of activities such as in the outdoor fieldwork and construction industries. A study reported that farmers, laborers and unemployed were the three occupational groups that are at risk of SCI and our study revealed the same[14].

There is an association between the cause of injury and the site of spinal injuries such that falls were associated with lumbar fracture whereas MVA resulted in cervical fractures[14]. The common causes of spinal injuries were from fall (61%) and the common site of injury was lumbar facture (42%) further complementing the association of etiological nature and concomitant level of spine injuries.

Spinal trauma and SCI are two different entities even though the mechanism of the injury is the same. The management and outcome of the spine injury and cord injuries are different[15]. In SCI, the neurologic deficit is often fixed and irreversible but vertebral fractures may or may not be associated with the neurologic deficit[15]. The outcome will depend on the presence or absence of a neurological deficit. In our study, 63 % of the patient had intact neurological functions. Spinal trauma can be treated either operatively on non-operatively depending on the stability of the spine and neurological status. Posterior decompression and stabilization are the common surgical procedures performed that reduces hospital stay and promotes early rehabilitation. We also noted that patients with complete SCI tend to stay longer in the hospital and they tend to have more complications.

Spinal injuries, especially with associated cord injuries and consequent disruption of neurological functions affect the patients and families significantly. Significant morbidity, disability, and death due to spinal trauma are reported in many studies[17]. It is very important to take preventative measures for spinal injuries and cord injuries as there is no curative treatment available today. Mortality due to traumatic SCI is much higher over 60 years of age[8] and the risk is increased if the level of injury is at high cervical spine and complete SCI. Furthermore, mortality was reported higher among patients who had underlying disease[14].

Therefore, there should be public health measures for the prevention of falls and RTA. The stakeholders should be working together in the prevention of spine trauma and spinal cord injuries. We should come up with a spine rehabilitation center to reduce the time of rehabilitation thereby preventing complications. Understanding of the epidemiological characteristic of traumatic SCI is important to generative good clinical practice guidelines.

## CONCLUSIONS

Falls have been found to be common cause of traumatic spine injuries and associated cord injuries. The majority of the patients were males and farmers and in the range of productive age group. The patients with less severe injuries (67 %) had complete recovery without any complications. They were able to continue with their normal work. Although only 37% of the study population had associated cord injuries, more than half of this (54%) had a complete catastrophic cord injury gravely compromising functional independence. Lumbar spine injuries were the commonest followed by cervical and thoracic spine injuries but the associated cord injuries were the least at lumbar spine and the most at the cervical spine level. At the thoracic spine, although the spine injuries were minimum it had a maximum number of patients with a complete SCI among the associated cord injuries. While majority of patients with spine injuries did not have associated cord injuries almost of half of the patients needed surgical procedures for the purpose of reduction, fixation and stabilization. Owing to the absence of a rehabilitation center, many patients with traumatic SCI had to stay in the acute care ward for rehabilitation.

## LIMITATIONS

The limitation of the study was the small sample size although majority of spine trauma patients are referred to JDWNRH from all parts of the country. The study did not include SCI without spine fractures that also presents with significant neurological disruption.

The study also did not use American Spinal Injury Association (ASIA) scoring system and did not make attempt

to study different prognostic characteristics of different types of SCI may reveal. Regarding the cause of trauma, the study did not make attempt to detail the etiological classifications. For instance, the study did not segregate the types of falls – fall from the tree, building, walls, towers, etc. or did not specify the motor vehicle accidents – passenger, driver, or pedestrians, etc. It was also beyond the scope of the study to have explored the rehabilitation services, social and economic variables, and other quality of life factors of patients with SCI. Therefore, future studies are recommended to explore these variables and characteristics including the employment of longitudinal studies.

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**AUTHORS CONTRIBUTION**

Following authors have made substantial contributions to the manuscript as under:

**KW:** Concept, design, data collection and analysis, manuscript writing and review.

**UT:** Concept, design, data collection and analysis, manuscript writing and review

**KP:** Concept, design, data analysis, manuscript writing and review

Author agree to be accountable for all respects of the work in ensuring that questions related to the accuracy and integrity of any part of the work are appropriately investigated and resolved.

**CONFLICT OF INTEREST**

None

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