Demographic Profile of Spinal Cord Injury (SCI): A Hospital-based Prospective study in Bangladesh

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ABSTRACT

Purpose: *To provide an overview of demographic characteristics of spinal cord injury (SCI) in Bangladesh.*

Methods: *The study was conducted between 1st January and 31st December 2012 at 5 hospitals: Centre for the Rehabilitation of the Paralysed (CRP) in Savar, National Institute of Traumatology & Orthopaedic Rehabilitation (NITOR), Bangabandhu Sheikh Mujib Medical University (BSMMU), Rangpur Medical College Hospital, and Chittagong Medical College Hospital. 600 SCI cases from these tertiary hospitals were enrolled, and data was collected from those who met the study criteria, using a structured questionnaire developed on the basis of SCI core data set. Data was processed and analysed by SPSS version 16.*

Results: *The male/female ratio was 4.5:1. Mean age at injury was 34.53 years (16–83 years). The cause of SCI was falls for 34.8% and RTA for 25.5% of the clients. 83.5% of SCI was traumatic and 16.5% was non-traumatic in origin. Only 9.5% of the clients were directly admitted to tertiary hospitals while 90.5% had intermediate admission before that. One-third (33.2%) of the clients used ambulance for intra-hospital transfer. 70.5% of the injury resulted in paraplegia and 29.5% in tetraplegia. Thoraco-lumbar junction (T11-L2) was the region most commonly involved, accounting for 38.7% of all cases. Overall 58.7% SCI cases were found with complete injury (ASIA-A) and 41.3% with incomplete injury during admission. 20.8% of the clients were admitted with pressure ulcer. The study found 27.2% of cases were operated on. The in-hospital mortality rate was 3.3%.*

Limitation: *The pre-hospital fatalities were not included in the study. During data collection, extent of SCI was found in only 507 cases instead of all 600 enrolled.*

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Conclusions: This study could contribute to the establishment of an effective prevention programme and comprehensive SCI management in Bangladesh.

Key words: *Paraplegia, ASIA scale, demography, spinal cord injury, Bangladesh, developing countries*

INTRODUCTION

Spinal cord injury (SCI) can result in a change, either temporary or permanent, in normal motor, sensory, or autonomic function of the spinal cord (Segun, 2011).

If SCI does not result in death, it can take a toll in terms of profound psychological, physical and financial affliction on affected families as well as on society. As a permanent cure for SCI is yet just in imagination (Donovan, 2007), prevention is seen as the only effective way to address the problem. Investigating the epidemiological pattern of SCI is the first step in planning for preventive strategies (McCammon and Ethans, 2011). These strategies provide baseline data to monitor the effectiveness of interventions (Segun, 2011). They help in prioritisation for resource allocation and thus should be especially helpful for developing countries, which have limited trained manpower, facilities and resources (Wyandaele and Wyandaele, 2006).

Various studies have been conducted globally on SCI incidence and prevalence (Ackery et al, 2004; Wyandaele and Wyandaele, 2006; Burns and O'Connell, 2012). Bangladesh is a densely populated developing country which has poor occupational safety measures, poor roads and mixed traffic, with vehicle users reluctant to use seat-belts. This makes the population vulnerable to SCI. However, little is known about the incidence, prevalence and epidemiology of SCI in the country as only four published articles were to be found (Hoque et al, 1999; Razzak et al, 2011; Islam et al, 2012; Razzak, 2013) on the characteristics of spinal cord injury (SCI). These were retrospective studies based on single centres and with a small sample size. Therefore, the current study has been conducted in multi-centres, to explore the demographic profile with a larger sample size.

METHOD

Setting

This hospital-based prospective study was conducted between 1st January and 31st December 2012, in 5 different tertiary hospitals of Bangladesh. Three of the

hospitals are situated in Dhaka, the capital city, and the other two cover two districts of Bangladesh. In each of the hospitals, the concerned neuro/orthopaedic surgeon conducted this study. Ethical clearance from the respective hospital authority was taken before data collection.

Study Sample

Majority of the SCI clients from all over the country are treated at these tertiary hospitals, as per data of the annual scientific conference (Bangladesh Spine Society, 2012). Clients with spinal injuries admitted in orthopaedic, neurosurgery or spine units of these hospitals during the study period were included as the sample population. Those who died before reaching hospital and a case of re-admission during the study period were not included.

Data Collection

Using a structured questionnaire, trained personnel of the respective hospital recorded the socio-demographic data, mode of injury, type of injury, skeletal level, neurological level and completeness of injury of suspected SCI clients at admission. Final clinico-radiological examination was performed by the spinal/ neurosurgeon of the concerned hospital to ascertain the presence of any spinal injury. After this evaluation, only SCI cases were recorded and preserved for data entry, while the others were taken off the list.

The level and extent of SCI was defined according to the International Neurological Classification of Spinal Injury using the American Spinal Injury Association Impairment (ASIA) scale (Maynard et al, 1997).

Statistical Analysis

Data was collected in a pre-tested structured questionnaire developed on the basis of the core data set of SCI (De Vivo et al, 2006). Descriptive data was presented as n (%), mean, median and standard deviation (SD). Differences in proportions were measured between selected variables by Fisher's exact test. Statistical mean differences were determined by independent Student's t-test. Statistical significance was set at $P<0.05$. All statistical analyses were performed using the SPSS software (Statistical Package for the Social Sciences, v. 16.0, Chicago, IL, USA).

RESULTS

Gender and Age Distribution

A total of 600 SCI cases were enrolled in this study. Males were 81.8% (N: 491) and females 18.2% (N: 109). Male/Female ratio was 4.5:1.Mean age at injury was 34.5 years (16–83 years) with standard deviation ±13.5. The median age was 32 years and mode 40 years. The age distribution had a peak at 16-30 year group, accounting for 45.7% (N=274).

Figure 1: Age Distribution of SCI Clients
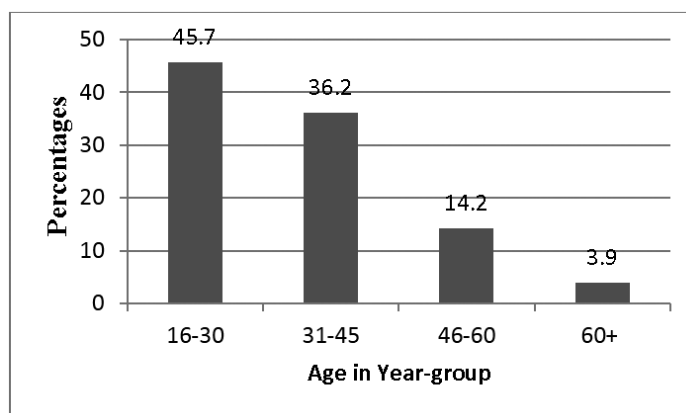
Socio-economic Characteristics of Clients

Two-thirds (72.8%) of the clients were from rural areas, with nil or minimum education. 71% of them were married. 62.7% of the families were of the nuclear type and mean family members were 6.04 (Table 1). The mean monthly income of the clients or their families was only 9196.3 taka and expenditure was 7960.0 taka (1 $=80 Taka).

### Table 1: Socio-economic Characteristics of the Clients (N=600)

Characteristics	N	%
Residence of Client:		
Rural	437	72.8
Urban	112	18.7
Semi-urban	51	8.5

| Marital Status:		
Married	426	71.0
Unmarried/single	142	23.7
Divorced/separated/widow	13	2.2
Not applicable	19	3.2
Religion of Client:		
Islam	545	90.8
Hinduism	42	7.0
Others	13	2.2
Education of Clients:		
No education	156	26.0
Primary	146	24.3
Junior school	146	24.3
SSC	85	14.2
HSC	44	7.3
Graduate and above	23	3.8
Family Type:		
Nuclear	376	62.7
Joint	224	37.3

Occupation before Injury

One-third (36.30%) of the clients were farmers or day labourers at the time of their injury (Figure 2) and 55.7% were involved in various kinds of work. Most of them (89.2%) were unaware of occupational safety.

## Figure 2: Occupation of Clients before Injury
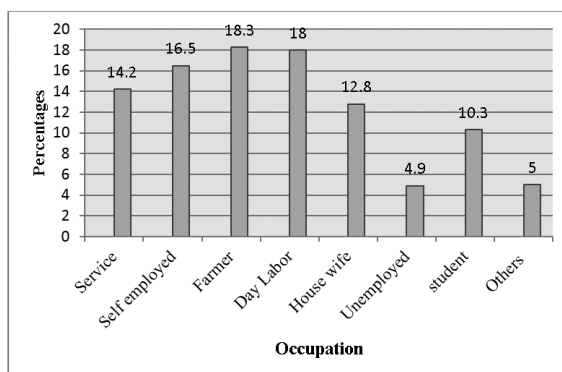
Causes of Injury

Figure 3: Causes of Spinal Injury
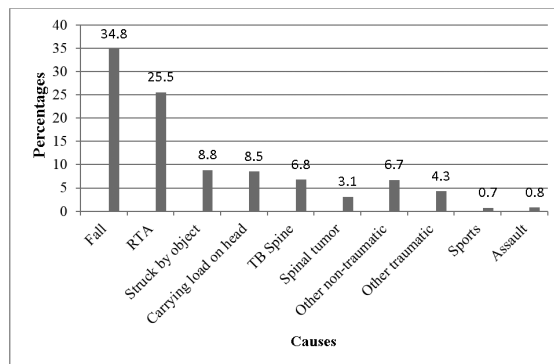
It was found that 83.5% of the SCI was traumatic (TSCI) and 16.5% was non-traumatic in origin (Figure 3). Falls were the most common cause of SCI, accounting for 34.8%. This included low falls (<1 metre) for 9.5% of the clients, high falls (1-5 metres) for 7.6% and high-energy falls (>5 metres such as falling from a tree, construction site, electric pole, etc.) for 82.9% (Figure 4). However, most of the falls led to paraplegia (80.0%) and the rest developed into tetraplegia (20%). For age-specific causes of injury, it was found that most of the falls (80.86%), RTA (86.9%) and being struck by object (90.56%) occurred in the 16-45 year age groups. TB spine found the highest prevalence (6.8%) in the non-traumatic group. It was prevalent among clients over 31 years of age (70.73%) and among females (51.21%). Majority of the TB spine cases (92.6%) led to paraplegia.

Figure 4: Mode of High-Energy Fall
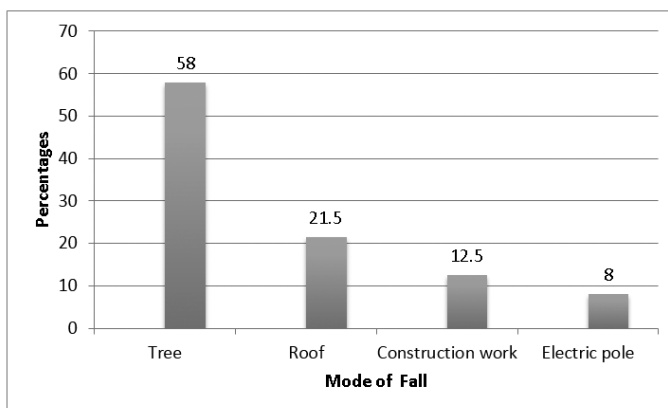
Road traffic accident (RTA) was the second most common cause of SCI, accounting for 25.5% of clients. It affects all the age groups, but most often those between 31-45 years of age (43.7%) and males. RTA caused 66.0% paraplegia and 34% tetraplegia, of which 56.16% was complete and 41.8% incomplete injury (Table 2).

**Table 2: Age Groups (years), extent of SCI related to major causes of injury (N=507)**

Cause Age group	N	Paraplegia Complete	Incomplete	Tetraplegia Complete	Incomplete
Fall					
16-30	98	50	35	8	5
31-45	71	31	22	10	8
45+	40	10	14	8	8
RTA					
16-30	66	26	19	12	9
31-45	67	30	14	11	12
45+	20	6	6	4	4
Load carrying on head					
16-30	24	6	2	12	4
31-45	15	2	1	7	5
45+	12	2	4	2	4
Stuck by object					
16-30	28	13	10	2	3
31-45	20	10	5	4	1
45+	5	2	0	2	1
TB spine					
16-30	12	6	5	0	1
31-45	16	7	7	1	1
45+	13	5	7	1	0

Intermediate Admission and Transport

It was found that 9.5% of clients were admitted directly in a tertiary hospital. One-third (31.5%) of them had single intermediate admission, 34% had double and 25% had triple or more intermediate admissions before being admitted in a tertiary hospital. Only one-third (33.2%) of the clients were transferred by

ambulance from one hospital to another; the rest used different conventional modes of transport (Figure 5).

Figure 5: Transport used in Intra-hospital SCI Client Transfer
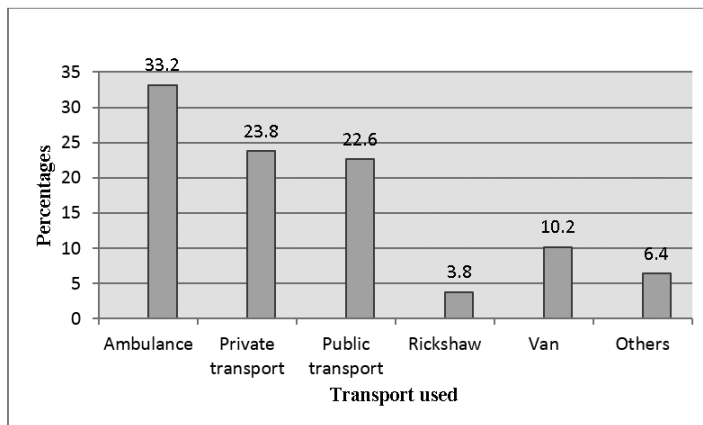
Neurological Level and Severity of Injury

Thoraco-lumbar junction (T11-L2) was the most common neurological level of injury, which accounted for 31.67% of all cases and 38.7% of thoraco-lumbar cases. The most common cervical spine injuries involved C4 and C5 segments, accounting for 81.81% of cervical SCI cases and 15% of total cases. The neurological level and injury severity of SCI in this study is presented in Table 3.

Table 3: Neurological Level (N. level) and ASIA Impairment Scale during admission

ASIA Impairment scale (AIS) at admission (N=600)										
N. Level	**ASIA-A**		**ASIA-B**		**ASIA-C**		**ASIA-D**		**Total**	
	N	**(%)**	**N**	**(%)**	**N**	**(%)**	**N**	**(%)**	**N**	**(%)**
C1-C4	79	(13.2)	30	(5.0)	5	(0.8)	8	(1.3)	122	(20.3)
C5-C8	25	(4.2)	16	(2.7)	3	(0.5)	11	(1.8)	55	(9.2)
T1-S5	248	(41.3)	77	(12.8)	39	(6.5)	59	(9.8)	423	(70.5)
Total	**352**	**(58.7)**	**123**	**(20.5)**	**47**	**(7.8)**	**78**	**(13.0)**	**600**	**(100.0)**

According to the American Spinal Injury Association (ASIA) Impairment Scale (AIS), overall 58.7% of SCI was found to be complete (ASIA-A) and the rest (41.3%) were various grades of incomplete injury during admission. Thoracic/lumbar

(paraplegia) injury accounted for 70.5%, of which 41.3% was complete and 29.2 % was incomplete injury. Cervical injury (tetraplegia) was 29.5%, of which 17.3% was complete and 12.2% was incomplete injury. Majority of the carrying load on head (60.8%) and struck by object (62.3%) causes produced complete injury.

Associated Conditions and Surgery

41.5% of the SCI cases were associated with other conditions at admission. The most frequent associated condition was pressure ulcer (20.8%). Only 2.7% of spinal injury cases had non-contiguous vertebral injury (Table 4).

Table 4: Showing Associated Conditions (N=600)

Associated Condition	N	%
Fractures	51	8.5
Pressure ulcer	125	20.8
Head injury	38	6.3
Cut injury	9	1.5
Non-contiguous vertebral lesions	16	2.7
Others	10	1.7
Total	**249**	**41.5**

Spinal surgery - This study found that 27.2% of the cases were operated on. The most commonly performed surgery was pedicle screw fixation (20.0%) for thoraco-lumbar injuries. Other types of surgical procedures were anterior decompression and fusion (ACDF) for cervical injury (2.2%), lateral mass fusion (0.5%), laminectomy (1.2%) and others (3.2%).

In-hospital mortality - Totally 20 clients (3.3% of admissions) died during treatment at hospital. Of these, 16 had traumatic cervical injury and died because of respiratory failure or severe electrolyte imbalance. The remaining 4 clients had thoraco-lumbar injury with severe sepsis and anemia due to severe pressure ulcer.

DISCUSSION

SCI clients are predominantly male, though the ratio varies considerably within developed and developing countries. The male/female ratio ranges from 2.5:1 -

4.3:1 among developed countries, and 2.34:1 - 9:1 among developing countries (Ackery et al, 2004; Wyandaele and Wyandaele, 2006; Alshahri et al, 2012; Burns and O'Connell, 2012; Vasiliadis, 2012). The current study found male/female ratio was 4.5:1 among the SCI clients though there was almost equal gender composition in the populations of Bangladesh (World Bank, 2015). However, different published articles showed that this male/female ratio in Bangladesh has been reducing over time: 7.5:1 in 1999 (Hoque et al, 1999), 4.95:1 in 2011 (Islam et al, 2011) and 4.5:1 in the current study. This decreasing trend in the male/female ratio suggests that nowadays the number of women with SCI is on the rise in Bangladesh. As the sex ratio reflects the socioeconomic and cultural status of a society (Khun et al, 1983), a few possible factors for this change in ratio may be: more women are being involved in economic activities (Bangladesh Bureau of Statistics, 2011) as women's education has increased during the last two decades (UNICEF, 2011), national progress in various macroeconomic and social development occurs (Helal and Hossain, 2013), changing concept in health seeking disparity between male-female, increased identification of non-traumatic SCI with improved medical equipment (women suffer more in nTSCI). This scenario was also observed in various studies (Kuhn et al, 1983; DeVivo, 2012; Shin et al, 2013; WHO, 2013) though the reasons may differ in different countries or regions.

In the current study, the mean age at injury was 34.5 years. This matches with studies from Bangladesh - Hoque et al (2012), Islam et al (2011) and Razzak (2013); regional studies - Kuptniratsaikul (2003) and Agarwal et al (2007); and studies from other places - Ackery et al (2004) and Rahimi-Movaghar et al (2013). The mean age of SCI clients seems to be higher in developed countries (Ackery et al, 2004; Ning et al, 2011; Tee et al, 2013), possibly due to their longer life expectancies, a higher mean age of population and better medical care system (Ackery et al, 2004). However, it is a universal fact that SCI affects the most active and productive age group of society. In most cases these victims are the only wage earners of their family, so when they become unproductive the affected family is in a precarious position. In Bangladesh, social security is less or nonexistent and victims experience tremendous suffering.

SCI is broadly classified as either traumatic or non-traumatic in nature. This study found 83.4% traumatic SCI (TSCI) cases and 16.6% non-traumatic SCI (nTSCI) cases, which was in consonance with the study of Agarwal et al (2014) and the WHO report on SCI (2013). Falls and RTA comprise two major causes of SCI

(60.3%) in the present study. However, falls were found to be the most common cause of SCI in Bangladesh (34.8%), in keeping with findings of other studies in the country (Hoque et al, 1999; Islam et al, 2011; Razzak et al, 2011), studies from some Asian countries such as Nepal (68.2% according to Lakhey et al, 2005) and Pakistan (63% according to Cripps et al, 2014), as well as studies from Finland (64.9% according to Koskinen et al, 2014).

The mode and reasons for falls as a cause of TSCI vary all over the world. For uniformity and to compare data, falls were subdivided into low, high and high-energy falls. High and high-energy falls were more common (82.9%) than low falls (17.1%) in the current study. Falls from a significant height were also noted in many low and lower-middle income countries like India (Chhabra and Arora, 2012), Nepal (Lakhey et al, 2005), Pakistan (Rathore et al, 2008), and Nigeria (Nwankwo and Uche, 2013). Contrarily, low falls occurred more in middle and high-income countries where elderly people (>65 years) are a growing concern: China (Cheng et al, 2008), Australia (Tee et al, 2013), Finland (Koskinen et al, 2014), and Japan (Katoh et al, 2014).

Most falls in Bangladesh occur while working, either at home while doing housework/house maintenance, or at the workplace while plucking fruit, collecting firewood from trees, electric work, construction work, etc (Chhabra and Arora,2012; Hoque et al, 2012; Cripps et al, 2014). Some other modes of falling were also observed: fall while carrying load over shoulder/ back/ head; fall from overloaded bus/train/tractor; fall due to women's neck-scarf getting entangled in the wheels of two or three-wheeled running vehicles; and, fall while running to catch a pet animal. This signifies lack of awareness and occupational safety in the country.

The current study found RTA was the second most common cause (25.5%) of SCI in Bangladesh, whereas it ranked third (18%) in 1999 (Hoque et al, 1999). Similar increased trends of SCI caused by RTA have also been noticed recently in Jammu (Manjeet et al, 2009) and other places in India (Chhabra and Arora, 2012). A few factors that could be responsible for the increase in transport accidents in recent years are: increased urbanisation and the number of motorised vehicles, less public awareness, insufficient number of roads and highways, and poor road infrastructure, unskilled drivers, incompetent traffic systems, weak legislation, rise in number of faulty and non-standard vehicles on the road in Bangladesh (Weerts, 2009; Biswas et al, 2012; WHO, 2004).

It is interesting that the number of transport-related injuries is stable or decreasing in developed countries (Cripps et al, 2014) due to prevention strategies, whereas fall-related injuries are increasing (van den Berg et al, 2010; Noe, 2015) over time due mainly to ageing problems.

The WHO report on SCI (World Health Organization, 2013) stated that spinal cord injury is preventable. Since falls and RTA are the two major causes of SCI, preventive measures should be employed not only in Bangladesh but also in many developing countries. The government and the concerned international non-government organizations should initiate such preventive programmes immediately.

The current study revealed that 16.6% of SCI was non-traumatic in origin. This was consistent with other studies in the region (Agarwal et al, 2007; Shin et al, 2013). TB spine was found to be the most prevalent in the non-traumatic group (6.8% overall and 41% in nTSCI) in this study, which is in consonance with the findings of Hoque et al (1999) in Bangladesh and Razdan et al (1994) in Kashmir, India. Like many other Asian countries, tuberculosis is an endemic disease in Bangladesh. The spine is the skeletal site most often affected, because of its favourable environment, followed by the hip and knee. Spinal tuberculosis accounts for almost 50% of cases of skeletal tuberculosis (Gautam et al, 2005). For that reason TB spine is more common in developing countries whereas degeneration of spine, neoplasm, inflammatory conditions etc., are reported as the frequent causes of nTSCI in developed countries (Scivoletto et al, 2011; New et al, 2013). Hence early detection and prompt treatment of pulmonary tuberculosis can reduce the incidence of spinal tuberculosis in Bangladesh.

With respect to the neurological level of injury, this study found that 70.49% resulted in paraplegia and 29.51% in tetraplegia. These findings are consistent with various studies on Asian countries: in Bangladesh, Razzak et al (2011) found 79.75% paraplegic vs 20.25 % tetraplegic; in India, Chhabra and Arora (2012) reported 66.67% vs 33.33 %; and in Malaysia, Ibrahim et al(2013) found 63% vs 37 %. Contrarily, more tetraplegia than paraplegia was found in Japan, with Shingu et al (1995) reporting 62.4% tetraplegia vs 36.3% paraplegia. This is similar to China, where Ning et al (2012) found 71.5% tetraplegia vs 28.5% paraplegia. For most middle to high-income countries it is fact that tetraplegia is reported more than paraplegia (Hagen et al, 2010; Knutsdottir et al , 2012; Najendijk et al, 2014).

Some of the reasons for fewer tetraplegic cases in Bangladesh may be: different mode of injury, high pre-hospital mortality, non-existence of pre-hospital trauma care in the country, and lack of ICUs as well as competent and trained medical personnel. Moreover, the caregivers are unwilling to take tetraplegic clients to hospital because of high treatment cost for cervical spine injuries, no national health insurance, poor prognosis of such clients, and unavailability of nearby treatment facilities for cervical injury cases. Hence fewer cases of tetraplegia are found in Bangladesh, as compared to paraplegia.

Using the American Spinal Injury Association (ASIA) Impairment Scale (AIS), the current study found that during admission overall 58.7% of SCI cases were complete (ASIA-A) and the rest or 41.3% were various grades of incomplete injury (ASIA-B to D). Complete SCI has also been reported in India (71.18%) by Chhabra and Arora (2012), in Bangladesh (78%) by Islam et al (2011), and in Afghanistan (67%) by Michael and Roth (2012). The high rate of complete SCI in Bangladesh that the current study found could be due to the different causes and mechanism of injury, improper acute management, delay to initiate definitive treatment and lower number of tetraplegic cases. However, in resource-rich countries more incomplete injury than complete injury was observed: in Italy 68% vs 32% (Scivoletto et al, 2011), in China 74.8% vs 25.2% (Ning et al, 2011), and in Iceland 61% vs 39% (Knu´tsdottir et al, 2012). New and improved acute treatment modalities, trends in age and etiology are some factors (O'Connor, 2005; DeVivo, 2012) responsible for more incomplete injuries in these countries.

CONCLUSION

This is the first multi-centered prospective study on SCI in Bangladesh, focusing on a larger sample size. It found that young and active people from low-income society were most affected by SCI. Majority of them were victims of falls from a height and road traffic accidents. The primitive conditions of pre-hospital trauma care and lack of occupational safety increase their suffering. Therefore the priority should be to establish and strengthen preventive measures in Bangladesh so as to reduce the frequency of spinal cord injuries. Moreover, the public should be made aware of SCI, and provision of occupational safety measures need to be initiated and adhered to. To ensure better rehabilitation of SCI clients, the authors recommend that comprehensive SCI management be launched as soon as possible across the country.

Implications

This study indicates the need for intensive public awareness and increased government support for the prevention of SCI. Measures include: environmental modification, legislation for change in people's behaviour, and education about occupational safety of persons at risk for injury.

Limitations

The study has several limitations. All pre-hospital fatalities were excluded, which makes it difficult to draw comparisons with international data. During data collection, the extent of SCI was found in only 507 cases instead of in the entire sample of 600. Moreover, since there was no follow-up work done after the study, the final outcome for the study participants is not known.

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REFERENCES

Ackery A, Tator CH, Krassioukov A (2004). A global perspective on spinal cord injury epidemiology. J Neurotrauma; 21: 1355–1370. https://doi.org/10.1089/neu.2004.21.1355. PMid:15672627

Agarwal P, Upadhyay P, Raja K (2007). A demographic profile of traumatic and non-traumatic spinal injury cases: a hospital-based study from India. Spinal Cord; 45: 597–602. https://doi.org/10.1038/sj.sc.3102005. PMid:17179974

Aito S, Tucci L, Zidarich V, Werhagen L (2014). Traumatic spinal cord injuries. Evidence from 30 years in a single centre. Spinal Cord; 52: 264-267. https://doi.org/10.1038/sc.2014.52. https://doi.org/10.1038/sc.2014.2. PMid:24492638

Alshahri SS, Cripps RA, Lee BB, Al-Jadid MS (2012). Traumatic spinal cord injury in Saudi Arabia: An epidemiological estimate from Riyadh. Spinal Cord; 50: 882–884. https://doi.org/10.1038/sc.2012.65. PMid:22777491

Bangladesh Bureau of Statistics (BBS) Statistics and Informatics Division (SID) (2011). Population and housing census 2011. Socio-economic and demographic report national series, Volume 4.

Bangladesh Spine Society (2012). Management of thoracolumbar spinal injury at a specialized centre in Bangladesh. Annual National Conference & Scientific Eeminar of Bangladesh Spine Society, Dhaka.

Biswas SK (2012). Road traffic injuries: an emerging problem in Bangladesh. Faridpur Med. Coll. J; 7(1): 05.

Burns AS, O'Connell C (2012). The challenge of spinal cord injury care in the developing world. The Journal of Spinal Cord Medicine; 35(1): 3-8. https://doi.org/10.1016/B978-0-444-52137-8.00003-6 PMid:23098705

Cheng LM, Zeng ZL, Yang ZY, Zhou JQ, Yuan F, Zhang SM (2008). Epidemiologic features and effect of surgical treatment of spinal injuries treated in one medical centre. Chin J Orthop Trauma; 3: 245-248.

Chhabra HS, Arora M (2012). Demographic profile of traumatic spinal cord injuries admitted at Indian Spinal Injuries Centre with special emphasis on mode of injury: A retrospective study. Spinal Cord; 50: 745–754. https://doi.org/10.1038/sc.2012.45. PMid:22584285

Cripps RA, Lee BB, Fitzharris M, Wing PC (2014). The global map for traumatic spinal cord injury epidemiology: Update 2011, global incidence rate. Spinal Cord; 52: 110–116. https://doi.org/10.1038/sc.2012.158. PMid:23439068

DeVivo MJ (2012). Epidemiology of traumatic spinal cord injury: trends and future implications. Spinal Cord; 50: 365–372. https://doi.org/10.1038/sc.2011.178. PMid:22270188

DeVivo M, Biering-Sorensen F, Charlifue S, Noonan V, Post M, Stripling T, Wing P (2006). Executive Committee for the International SCI Data Sets Committees. International Spinal Cord Injury Core Data Set. Spinal Cord; 44: 535–540. https://doi.org/10.1038/sj.sc.3101958. PMid:16955073

Donovan WH (2007). Spinal Cord Injury—Past, Present, and Future. J Spinal Cord Med.; 30(2): 85-100. https://doi.org/10.1080/10790268.2007.11753918 PMid:17591221 PMCid:PMC2031949

Gautam MP, Karki P, Rijal S, Singh R (2005). Pott's spine and Pott's paraplegia. J Nep Med Assoc; 44(159): 106–15.

Hagen EM, Eide GE, Rekand T, Gilhus NE, Gronning M (2010). A 50-year follow-up of the incidence of traumatic spinal cord injuries in Western Norway Spinal Cord; 48: 313–318.

Helal M, Hossain MA (2013). Four decades of economic development of Bangladesh: An assessment. Journal of the Asiatic Society of Bangladesh (Hum.); 58(2): 335-362.

Hoque MF, Christoph G, Kylie (1999). Spinal cord lesions in Bangladesh: An epidemiological study. Spinal Cord; 37: 858-861. http://dx.doi.org/10.1038/sj.sc.3100938. PMid: 10602529

Hoque MF, Hasan Z, Razzak ATMA, Helal SU (2012). Cervical spinal cord injury due to fall while carrying heavy load on head: a problem in Bangladesh. Spinal Cord; 50: 275–277. https://doi.org/10.1038/sc.2011.153. PMid:22143680

Ibrahim A, Lee KY, Kanoo LL, Tan CH, Hamid MA, Hamedon NM, Haniff J (2013). Epidemiology of spinal cord injury in Hospital Kuala Lumpur. Spine (Phila Pa 1976) Mar 1; 38(5): 419-24.

Islam MS, Hafez MA, Akter M (2011). Characterisation of spinal cord lesion in patients attending a specialised rehabilitation centre in Bangladesh. Spinal Cord; 49: 783–786. https://doi.org/10.1038/sc.2011.36. PMid:21502957

Katoh S, Enishi T, Sato N, Sairyo K (2014). High incidence of acute traumatic spinal cord injury in a rural population in Japan. Spinal Cord; 52: 264-267. https://doi.org/10.1038/sc.2014.13. PMid:24513725

Knutsdottir S, Thorisdottir H, Sigvaldason K, Jonsson H Jr., Bjornsson A, Ingvarsson P (2012). Epidemiology of traumatic spinal cord injuries in Iceland from 1975 to 2009. Spinal Cord; 50: 123 –126. https://doi.org/10.1038/sc.2011.105. PMid:21946442

Koskinen EA, Alen A, Väärälä EM, Rellman J, Kallinen M, Vainionpää A (2014). Centralised spinal cord injury in Finland: Unveiling the hidden incidence of traumatic injuries. Spinal Cord; 52: 779-784. https://doi.org/10.1038/sc.2013.163, https://doi.org/10.1038/sc.2014.131. PMid:25112968

Kuhn W, Zach GA, Kochlin P, Urwyler A (1983). Comparison of spinal cord injury in females and in males, 1979 ± 1981 Basle. Paraplegia; 21: 154 ± 160.

Kuptniratsaikul V (2003). Epidemiology of spinal cord injuries: A study in the Spinal Unit, Siriraj Hospital, Thailand, 1997-2000. J Med Assoc Tahi; 86(12): 1116-21. PMid:14971518

Lakhey S, Jha N, Shrestha BP, Niraula S (2005). Aetioepidemiological profile of spinal injury patients in Eastern Nepal. Tropical Doctor; 35: 231-233. https://doi.org/10.1258/004947505774938756. PMid:16354480

Manjeet S, Siddhartha S, Iftikhar WH, Agnivesh T, Farid MH, Nirdosh M, Dara S(2009). Spine injuries in a tertiary health care hospital in Jammu: A clinico-epidemiological study. Internet J Neurosurg; 5: 2.

Maynard FM, Bracken MB, Creasy G, Ditunno Jr JF, Donowan WH, Ducker TB, Garber SL, Marino RJ, Stover SL, Tator CH, Waters RL, Wilberger JE, Young W (1997). International standards for neurological and functional classification of spinal cord injury. Spinal Cord; 35.

McCammon JR, Ethans K (2011). Spinal cord injury in Manitoba; a provincial epidemiological study. J Spinal Cord Med; 34: 6-10.

Michael M, Roth K (2012). Against all odds: A qualitative study of rehabilitation of persons with spinal cord injury in Afghanistan. Spinal Cord; 50: 864-868. https://doi.org/10.1038/sc.2012.113. PMid:23032605

Najendijk JHB, Post MWM, Asbeck van FWA (2014). Epidemiology of traumatic spinal cord injuries in the Netherlands in 2010. Spinal Cord; 52: 258-263. https://doi.org/10.1038/sc.2013.180. PMid:24445971

New PW, Cripps RA, Lee BB (2013). Global non-traumatic SCI epidemiology. Spinal Cord; 1–13.

Ning G-Z, Yu T-Q, Feng S-Q, Zhou X-Z, Ban D-X, Liu Y, Jiao X-X (2011). Epidemiology of traumatic spinal cord injury in Tianjin, China. Spinal Cord; 49: 386–390. https://doi.org/10.1038/sc.2010.130. PMid:20921958

Ning G-Z, Wu Q, Li Y-L, Feng S-Q (2012).Epidemiology of traumatic spinal cord injury in Asia: A systematic review. The Journal of Spinal Cord Medicine; 35(4). https://doi.org/10.1179/2045772312Y.0000000021. PMid:22925749 PMCid:PMC3425879

Noe BB, Mikkelsen EM, Hansen RM, Thygesen M, Hagen EM. Incidence of traumatic spinal cord injury in Denmark, 1990–2012: A hospital-based study. Spinal Cord (2015); 53: 436–440. https://doi.org/10.1038/sc.2014.181. PMid:25366529

Nwankwo OE, Uche EO (2013). Epidemiological and treatment profiles of spinal cord injury in southeast Nigeria. Spinal Cord; 51: 448–452. https://doi.org/10.1038/sc.2013.10. PMid:23478671

O'Connor PJ (2005). Forecasting of spinal cord injury annual case numbers in Australia. Arch Phys Med Rehabil; 86(1): 48–51. https://doi.org/10.1016/j.apmr.2004.07.346. PMid:15640988

Rahimi-Movaghar V, Sayyah MK, Akbari H, Khorramirouz R, Rasouli MR, Moradi-Lakeh M, Shokraneh F, Vaccaro AR (2013). Epidemiology of traumatic spinal cord injury in developing countries: A systematic review. Neuroepidemiology; 41: 65–85. https://doi.org/10.1159/000350710 PMid:23774577

Rathore MF, Hanif S, Farooq F, Ahmad N, Mansoor SN (2008). Traumatic spinal cord injuries at a tertiary care rehabilitation institute in Pakistan. J Pak Med Assoc; 58(2): 53–7. PMid:18333519

Razdan S, Kaul RL, Motta A, Kaul S, Bhatt RK (1994). Prevalence and pattern of major neurological disorders in rural Kashmir (India) in 1986. Neuroepidemiology; 13:113–119. https://doi.org/10.1159/000110368. PMid:8015664

Razzak A, Helal SU, Nuri RP (2011). Life expectancy after Spinal Cord Injury in a developing country – A retrospective study at CRP, Bangladesh. Disability, CBR & Inclusive Development; 22(2): 114-123. https://doi.org/10.5463/dcid.v22i2.34

Razzak ATMA (2013). Early Care following Traumatic Spinal Cord Injury (TSCI) in a Rehabilitation Centre in Bangladesh - An Analysis. Disability, CBR and Inclusive Development (DCID); 24(2): 64-78. https://doi.org/10.5463/dcid.v24i2.211

Scivoletto G, Farchi S, Laurenzal L, Molinari M (2011). Traumatic and non-traumatic spinal cord lesions: an Italian comparison of neurological and functional outcomes. Spinal Cord; 49: 391–396. https://doi.org/10.1038/sc.2011.6. https://doi.org/10.1038/sc.2011.31, https://doi.org/10.1038/sc.2010.180, https://doi.org/10.1038/sc.2010.85. PMid:20603629

Segun TD (2011). Spinal cord injury definition, epidemiology and pathophysiology view. Available from: http://emedicine.medscape.com/article/322480-overview#a30. [Accessed on 12 Jul 2011].

Shin CJ, Kim DH, Yu SJ, Yang HE, Yoon SY (2013). Epidemiologic change of patients with spinal cord injury; Ann Rehabil Med; 37(1): 50-56. https://doi.org/10.5535/arm.2013.37.1.50 PMid:23525183 PMCid:PMC3604234

Shingu H, Ohama M, Ikata T, Katoh S, Akatsu T (1995). A nationwide epidemiological survey of spinal cord injuries in Japan from January 1990 to December 1992. Paraplegia; 33: 183–188. https://doi.org/10.1038/sc.1995.42, PMid:7609973

Tee JW, Chan CHP, Fitzgerald MCB, Liew SM, Rosenfeld JV (2013). Epidemiological trends of spine trauma: An Australian Level 1 Trauma Centre Study. Global Spine J; 3: 75–84. https://doi.org/10.1055/s-0033-1337124. PMid:24436855 PMCid:PMC3854579

UNICEF (2011). Annual report. Available from: http://www.unicef.org/bangladesh/education_460.htm

Vasiliadis AV (2012). Epidemiology map of traumatic spinal cord injuries: A global overview. International Journal of Caring Sciences; 5(3): 335-347.

van den Berg MEL, Castellote JM, Mahillo-Fernandez I, de Pedro-Cuesta J (2010). Incidence of spinal cord injury worldwide: A systemic review. Neuroepidemiology; 34: 184-192. https://doi.org/10.1159/000279335. PMid:20130419

Weerts E (2009). Final reporting of project outcomes. Spinal Cord Injury care and Orthopaedic workshop. Handicap International, Hanoi, Vietnam. PMCid:PMC2682635

World Bank Data (2015). World population indicators. Available from: http://databank.worldbank.org/data/reports.aspx?source=2&series=SP.POP.TOTL&country=

World Health Organisation (2004). World report on road traffic injury prevention. Geneva Switzerland: WHO Publications.

World Health Organization (2013). International perspectives on spinal cord injury. Available from: http://www.who.int/disabilities/policies/spinal_cord_injury/en/

Wyndaele M, Wyndaele JJ (2006). Incidence, prevalence and epidemiology of spinal cord injury: What learns a worldwide literature survey? Spinal Cord; 44: 523–529. https://doi.org/10.1038/sj.sc.3101893. PMid:16389270