

An analysis of the length of stay in traumatic and non-traumatic spinal cord injured patients

A rehabilitation unit experience in Saudi Arabia

Maher S. Al-Jadid, JBPM&R, FAFRM (H), Asirvatham A. Robert, MSc, MPhil.

ABSTRACT

الأهداف: تحديد وتحليل تأثير العمر، والجنس، ونوع الإصابة، والانتماء العرقي على مدة الإقامة (LoS) بالوحدة الداخلية لإعادة التأهيل بعد الاعتلال الإصابي (TSCI)، وغير الإصابي للحبل الشوكي (NTSCI).

الطريقة: أجريت دراسة استرجاعية على جميع المرضى الذين أكملوا برنامج إعادة تأهيل اعتلال الحبل الشوكي الإصابي (TSCI)، وغير الإصابي المنشأ (NTSCI) بمدينة سلطان بن عبد العزيز للخدمات الإنسانية - الرياض - المملكة العربية السعودية خلال الفترة من يناير 2005م إلى أكتوبر 2008م واختيروا لهذا الدراسة. ثم التعرف على سجلات تنويم 495 مريض يعانون من اعتلال الحبل النخاعي الشوكي بسبب الإصابة (404 ذكر - 91 أنثى)، و 126 مريض يعانون من اعتلال الحبل الشوكي بدون التعرض لإصابة (81 ذكر - 45 أنثى)، وكان متوسط العمر للمرضى الذين شملتهم الدراسة 34.3 ± 0.68 و 45 ± 1.56 عام. استبعد المرضى الذين كانت أعمارهم أقل من 10 أو مساوية وأكثر من 81 عام أو مساوية بسبب صغر نسبتهم. قمنا بتحليل تأثير العمر، والجنس، ونوع الإصابة، والاختلافات العرقية على طول مدة الإقامة.

النتائج: مقارنة بالمرضى الذين يعانون من اعتلال الحبل الشوكي نتيجة الإصابة، كان لدى المرضى المصابين باعتلال الحبل الشوكي دون التعرض لإصابة NTSCI مدة إقامة LoS أقل وبدلالة إحصائية $p=0.035$ و $58.8 \pm 1.68, 46.2 \pm 2.1$. كان تكرار التنويم للمرضى الذين يعانون من اعتلال الحبل الشوكي نتيجة إصابة أعلى لدى المجموعات العمرية من 21-30 عام، وأقل في المجموعات العمرية 71-80 عام. مقارنة بمجموعة المرضى الذين يعانون من اعتلال الحبل الشوكي نتيجة الإصابة TSCI، كان تكرار تنويم المرضى المصابين باعتلال الحبل الشوكي دون التعرض لإصابة NTSCI أقل في جميع المجموعات العمرية. كانت مدة إقامة LoS الذكور أطول، من الإناث في جميع المجموعات العمرية لحالات اعتلال العمود الفقري نتيجة الإصابة، وحالات الغير إصابية المنشأ NTSCI. كانت مدة الإقامة LoS للمرضى السعوديين أعلى في برنامج إعادة التأهيل لحالات اعتلال الحبل الشوكي الناتجة من إصابة TSCI ($p=0.021$) أو الغير إصابية المنشأ NTSCI مقارنة بغير السعوديين.

خاتمة: تشير نتائج الدراسة على أن الجنس، ونوع الإصابة، و الاختلافات العرقية كانت عوامل مؤثرة على مدة إقامة المرضى LoS الذين يعانون من اعتلال الحبل الشوكي الإصابي وغير الإصابي المنشأ.

Objectives: To determine and analyze the influence of age, gender, type of injury, and ethnicity in the length of stay (LoS) of in-patient rehabilitation unit patients after traumatic spinal cord injury (TSCI) and non-traumatic spinal cord injury (NTSCI).

Methods: We conducted a retrospective study of all patients who completed the TSCI and NTSCI rehabilitation program at Sultan Bin Abdulaziz Humanitarian City, Riyadh, Saudi Arabia from January 2005 to October 2008. Admission records of 495 traumatic spinal cord injured (male 404, female 91; mean age 34.3 ± 0.68 years) and 126 non-traumatic spinal cord injured patients (male 81, female 45; mean age 45 ± 1.56 years) were identified. We excluded patients aged ≤ 10 and ≥ 81 years due to the small proportion. The influence of age, gender, type of injury, and ethnic differences in the LoS were analyzed.

Results: Compared with TSCI, patients with NTSCI had a significantly ($p=0.035$) shorter LoS ($58.8 \pm 1.68, 46.2 \pm 2.1$). The frequency of the TSCI was higher in the 21-30 age groups and lower in the 71-80 age group. Compared with TSCI, the frequency of NTSCI was less in all age groups. The LoS of male was longer than the female in all age groups. The LoS of Saudi patients were higher in TSCI ($p=0.021$) and NTSCI rehabilitation program compared with the non-Saudis.

Conclusion: The results of the study suggest that the gender, types of injury, and ethnicity differences were influencing factors of LoS of traumatic and non traumatic spinal cord injured patients.

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From the Rehabilitation Medicine Division, Department of Neurosciences (Al-Jadid), Riyadh Military Hospital, and Research Center (Robert), Sultan Bin Abdulaziz Humanitarian City, Riyadh, Kingdom of Saudi Arabia.

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Address correspondence and reprint request to: Dr. Maher Al-Jadid, Riyadh Military Hospital, PO Box 14126, Riyadh 11424, Kingdom of Saudi Arabia. Tel. +966 (1) 4777714 Ext. 25301. Fax. +966 (1) 4722400. E-mail: maljadid@rmb.med.sa

Spinal cord injury (SCI) is an acute devastating neurological disorder that has profound influences on modern society from physical, psychosocial, and socioeconomic perspectives.¹ It is a most important reason of permanent disability in young adults, resulting in incomplete or complete loss of motor and sensory functions below the lesion site.² Literature on SCI has largely focused on people with traumatic SCI (TSCI), with minimal research on non-traumatic spinal cord injury (NTSCI) population.^{3,4} Conversely, NTSCI accounts for approximately one-third of all SCI cases admitted to in-patient rehabilitation;^{3,4} however, with the rising incidence of cancer-related SCI and aging population, others suggest that NTSCI represents at least 50% of all in-patient rehabilitation SCI cases.³ The demographic characteristics and pattern of neurological injury in patients with NTSCI are different from those with TSCI. Non-traumatic spinal cord injury tends to affect older adults and results in a pattern of injury that is usually incomplete and is more likely to cause paraplegia than tetraplegia.^{5,6} Traumatic SCI causes death of neurons, disruption of motor and sensory nerve fiber (axon) pathways and disruption of communication with the brain.⁷ The extent of these impairments is dependent upon the severity of the injury, level at which the injury has occurred,^{1,8} and associated medical condition.^{9,10} The life expectancy of persons with SCI has increased in recent decades, although it is still lower than the life expectancy of the general population.¹¹ However, most people suffering from SCI can now be expected to live for many years. In addition, studies reported that prolonged hospital stay is associated with nosocomial infections, immobility, pressure sores, deep vein thrombosis and deconditioning.¹² As the search for solutions to rising health care costs has intensified over the past few years in the public and private sectors, the implications of age, gender, and ethnic variations in LoS have assumed greater importance for SCI patients. The duration of hospital stay depends on not only clinical factors, but also social and economic factors.¹³ Therefore, the assessment of various factors such as age, gender, type of injury, and ethnic is necessary to shorten the duration of LoS. The aim of the present study was to determine and analyze the influence of age, gender, type of injury, and ethnicity in LoS of inpatient rehabilitation unit patients after SCI.

Methods. We conducted a retrospective study of all patients who completed the TSCI and NTSCI rehabilitation program at Sultan Bin Abdulaziz Humanitarian City, Riyadh, Saudi Arabia from January 2005 to October 2008. Admission records of 495 TSCI (male 404, female 91) and 126 NTSCI (male 81, female

45) patients were identified with a mean age 34.3 ± 0.68 ; 41.8 ± 1.91 years were included in this study.

The patients were divided into 7 groups based on their age 11-20, 21-30, 31-40, 41-50, 51-60, 61-70, and 71-80 years. Patient's aged ≤ 10 and ≥ 81 years were excluded due to the small proportion. The study was approved by the Research & Ethical Committee of Sultan Bin Abdulaziz Humanitarian City, Riyadh, Saudi Arabia.

Data analysis was carried out using Microsoft Excel 2002 (Microsoft Corporation, Seattle, WA) and GraphPad InStat Version 3 (GraphPad Software, Sand Diego, USA). Data presented as mean \pm SEM. The LoS was analyzed by one-way analysis of variance (ANOVA). Tukey-Kramer multiple comparisons test, and Student's t-test was used for analyzing the age, gender, type of injury, and ethnicity differences of LoS. *P*-value of < 0.05 was considered statistically significant.

Results. Age, gender, and ethnicity wise distribution of the patients included in the study is shown in Table 1. The mean age of traumatic spinal cord injured patients was 34.3 ± 0.68 years and the median of 30 years. The mean age of non-traumatic spinal cord injured patients was 45 ± 1.56 years and the median of 46 years. There were 495 traumatic (male 404, female 91) and 126 non-traumatic spinal cord injured (male 81, female 45) patients. There were 443 (89.5%) Saudi patients and 52 (10.5%) non-Saudi patients in TSCI and 113 (89.7%) Saudi patients and 13 (10.3%) non-Saudi patients in NTSCI rehabilitation program. Figure 1 shows the age wise frequencies of the SCI in the study population. The frequency of the TSCI was higher in the 21-30 (40%) and 31-40 (19.7%) age groups and lower in the 71-80 (2.2%) age group. The frequency of the NTSCI was higher in the 21-30 (20.6%) and lower in the 31-40 (8.7%) age group. Compared with TSCI the frequency of NTSCI was less in all age groups except 71-80 age group.

The influence of age in LoS of the study population is demonstrated in Figure 2. There were no significant changes found in the LoS of different age groups of TSCI and NTSCI rehabilitation program. Conversely, the study found that the LoS of TSCI were higher than the NTSCI patients in all age groups of the study population and the statistically significant results were observed in NTSCI patients age group 41-50 ($p=0.042$) and 51-60 ($p=0.034$). The overall results indicate that when compared with TSCI, patients with NTSCI had a significantly ($p=0.035$) shorter rehabilitation length of stay (58.8 ± 1.68 , 46.2 ± 2.1). Changes of LoS within the gender are shown in Figures 3a & 3b. The results showed that the LoS of male were longer than female in all age groups of traumatic and non-traumatic spinal

Table 1 - Age and gender distribution of the patients.

Age groups (years)	Injury type	Age (mean ± SEM)	Gender (number)		Nationality (number)	
			Male	Female	Saudi	Non-Saudi
11 – 20	TSCI	18.0 ± 0.2	41	14	53	2
	NTSCI	15.5 ± 0.6	13	5	17	1
21 – 30	TSCI	25.0 ± 0.1	167	31	183	15
	NTSCI	25.6 ± 0.5	18	8	21	5
31 – 40	TSCI	34.5 ± 0.2	74	24	89	9
	NTSCI	35.6 ± 0.9	6	5	9	2
41 – 50	TSCI	44.7 ± 0.3	51	9	48	12
	NTSCI	45.9 ± 0.6	10	4	13	1
51 – 60	TSCI	55.6 ± 0.5	24	7	27	4
	NTSCI	55.5 ± 0.6	12	15	26	1
61 – 70	TSCI	65.8 ± 0.4	39	3	34	8
	NTSCI	65.5 ± 0.7	11	5	14	2
71 – 80	TSCI	75.2 ± 1.5	8	3	9	2
	NTSCI	74.1 ± 0.7	11	3	13	1
Total			485	136	556	65

TSCI - traumatic spinal cord injury, NTSCI - non-traumatic spinal cord injury

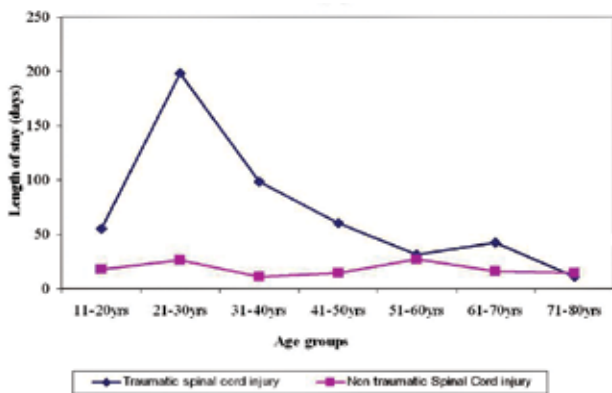


Figure 1 - The frequency of traumatic and non-traumatic spinal cord injury.

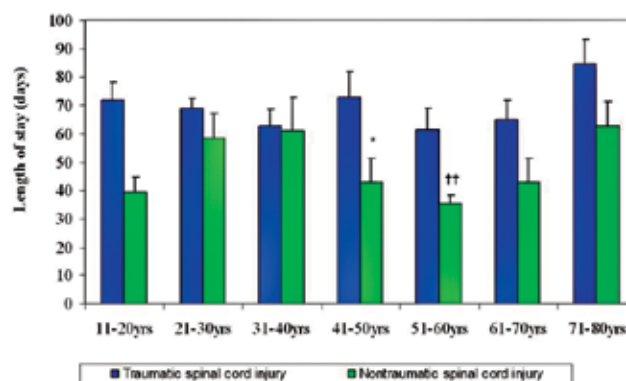


Figure 2 - The role of age in length of stay in traumatic and non-traumatic spinal cord injured patients. Values versus baseline - Tukey-Kramer multiple comparison test. TSCI versus NTSCI - t-test, * $p=0.042$, † $p=0.034$

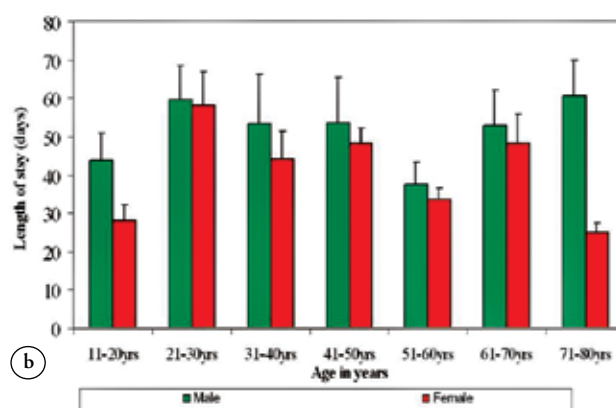
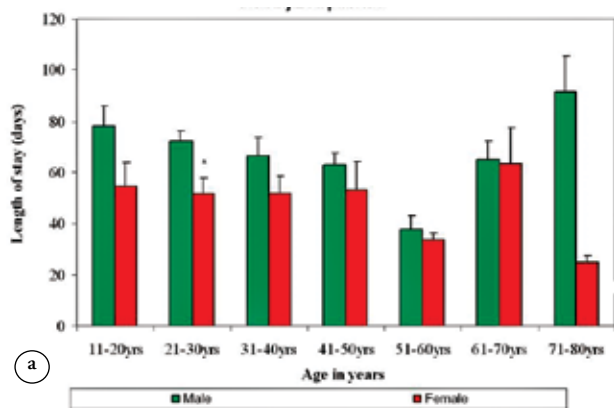


Figure 3 - The role of gender in length of stay of a) traumatic and b) non-traumatic spinal cord injured patients. Values versus baseline - Tukey-Kramer multiple comparison test. TSCI versus NTSCI - t-test, * $p=0.026$

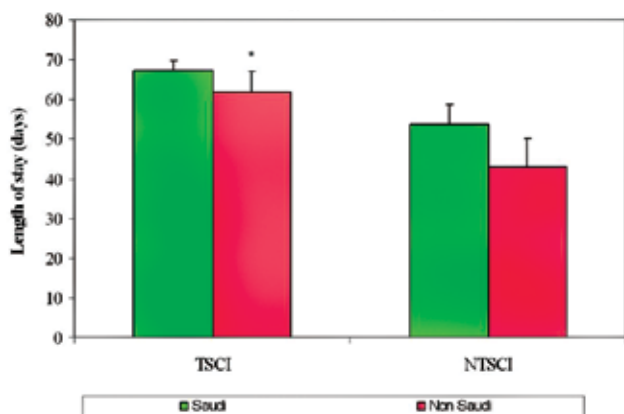


Figure 4 - The role of ethnicity in length of stay of traumatic and non-traumatic spinal cord injured patients. *P value TSCI versus NTSCI - t-test, $p=0.021$.

cord injured patients. Statistically significant result was observed in the male age group 21-30 ($p=0.026$) of traumatic spinal cord injured patients. The difference in the LoS in ethnicity is demonstrated in Figure 4. The results showed that there were notable differences observed in traumatic and non-traumatic spinal cord injured patients of Saudi population as compared to the non-Saudi's. Furthermore, significant results were observed in Saudi traumatic spinal cord injured patients as compared to non-Saudi patients ($p=0.021$).

Discussion. Studies reported that the demographic characteristics and pattern of neurological injury in patients with NTSCI are different from those with TSCI. Non-traumatic SCI tends to affect older adults.^{14,15} In this study, we observed that 40% of TSCI patients were in the age range between 21-30 years. This is in accordance with the previous study that most of the individuals with spinal cord injuries are young adults, primarily males.¹⁶ In Saudi Arabia, with its rapid expansion of road construction and increase in the number of vehicles, road traffic accidents are becoming a serious public health problem. Road traffic accidents (RTA) are the second major health problem after infectious diseases. The road traffic spinal cord injuries are, and will remain the leading cause of SCI, with high proportion of complete injury at rehabilitation onset, especially in car drivers of young adults.^{17,18} A hospital based study from Saudi Arabia showed that 79.2% of patients admitted for spinal injuries has sustained their injuries as a result of a motor vehicle accident.¹⁸ However, the causes of injuries vary between regions of the country and between urban and rural locations.¹⁹

In this study, we observed that when compared to NTSCI, patients with TSCI the LoS was higher in all age groups. It demonstrates that the type of SCI was an important influencing factor for the LoS. The

findings supported by a previous study that patients with NTSCI can achieve rates of functional gains and shorter rehabilitation LoS and lower rehabilitation charge compared with TSCI.²⁰ On the other hand, a study result showed that despite more impairment in persons with traumatic spinal cord lesion; however, no statistically significant difference was observed in the LoS.²¹ Conversely, the overall results of our study indicate that when compared with TSCI, patients with NTSCI had a significantly ($p=0.035$) shorter rehabilitation LoS (58.8 ± 1.68 , 46.2 ± 2.1). However, the LoS differed in reports from various countries.²² The mean values were found 20-74 days in the USA,²³ 56-61 in Australia,⁴ 91-143 in Italy,⁵ 154-240 in the Netherlands,^{24,25} 198-222 in Spain,²⁶ and 267 in Japan.²⁷ The LoS of Saudi Arabia is comparable with the USA and Australia reports. There are conflicting results in the literature concerning the influence of age on SCI rehabilitation.¹⁴ A study of traumatic and NTSCI that matched 130 patients for etiology, time from onset, and injury characteristics reported that older patients tend to have a shorter LoS.¹⁵ In contrast to the above, other studies have found that age was not a predictor of LoS after traumatic and NTSCI.¹⁴ In our study, the TSCI and NTSCI, patients' age was not found to influence the rehabilitation LoS.

Several studies have been published conflicting results on the effect of gender in LoS of SCI patients.²⁸⁻³⁰ However, the present study results showed that the LoS of male were longer than female in all age groups of traumatic and non-traumatic spinal cord injured patients. It has been reported that female patients may have more natural neurological recovery than male patients and males appear to be more vulnerable to infections, injury, and stress;^{30,31} however, for a given level and degree of neurologic injury, males tend to do better functionally than females at time of discharge from rehabilitation.³⁰ On the other hand, studies have reported no gender differences in the LOS of SCI patients.²⁸⁻³⁰

The previous studies reported that ethnicity is a major influencing factor for LoS of SCI patients.^{4,5,20,23,24} The present study results also observed notable differences between traumatic and non-traumatic spinal cord injured patients of Saudi and non-Saudis population. It should be noted that LoS in hospitals is a major contributor of direct SCI care cost. In efforts to contain health care costs, providers have attempted to decrease patients' average LoS in the hospital. The assumption has been that reducing LoS yields large cost savings.^{32,33} A study reported that reducing LoS by as much as one full day reduces the total cost of care on average by $\leq 3\%$.³²

The major limitation of this study was the limited number of risk factors examined. Further research is needed to address the limitations indicated in the study. Despite the limitation, the study provides valuable data for LoS of traumatic and non-traumatic spinal cord injured patients. In addition, this type of study among SCI patients in Saudi Arabia might provide new information and understanding among the Saudi population.

In conclusion, the results of this study indicate that the gender, types of injury, and ethnicity are the significant factors which influence the LoS in spinal cord injured patients. However, further studies are required in different clinical settings to provide a more comprehensive picture of LoS in SCI patients.

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