

### A comparative analysis of length of stay of traumatic and non-traumatic brain injured patients in Saudi Arabia

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Brain injury (BI) is the leading cause of mortality and disability among young persons, and globally the prevalence of BI is rising significantly due to increasing motor-vehicle use in low and middle-income countries.<sup>1</sup> It is an acquired injury to the brain that results in partial or total impairment in one or more areas of function such as cognition, memory, attention, problem solving, information processing, speech and language, fatigue, psychosocial behavior, sensory and physical functioning. Compared to non-traumatic brain injury (NTBI), the frequent category with the greatest number of injuries is traumatic brain injury (TBI). Lack of awareness of deficits is a common problem after TBI, and is associated with poorer functional outcome, and poor compliance with rehabilitation.<sup>2</sup> Studies reported that rehabilitation is an important part of the management of brain injured patients and the age of the patient, severity of TBI and medical complications were found to be strong predictors of rehabilitation length of stay (LoS).<sup>3</sup> The duration of hospital stay depends on not only clinical factors, but also social and economic factors.<sup>4</sup> In addition, prolonged hospital stay is associated with nosocomial infections, immobility, pressure sores, deep vein thrombosis, and deconditioning.<sup>4</sup> 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, type of injury, and ethnic variations in LoS have assumed greater importance for BI patients. 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 TBI and NTBI.

We conducted a retrospective study of all patients who completed the TBI and NTBI rehabilitation program at Sultan Bin Abdulaziz Humanitarian City, Riyadh, Kingdom of Saudi Arabia from January 2005 to October 2008. Admission records of 475 TBI (male 410, female 65) and 105 NTBI (male 61, female 44) patients were identified with a mean age of  $26.9 \pm 0.56$  and  $31.3 \pm 1.8$  years were included in this study (Table 1). There were 435 (91.5%) Saudi patients and 40 (8.5%) non-Saudi patients in the TBI, and 98 (93.4%) Saudi patients and 7 (6.6%) non-Saudi patients in the NTBI rehabilitation program. The patients were divided into 7 groups based on their age 1-10, 11-20, 21-30, 31-40, 41-50, 51-60, and 61-70 years. Patient's aged  $\geq 71$  years were excluded due to the small

proportion. The study was approved by the Research and Ethics Committee of Sultan Bin Abdulaziz Humanitarian City, Riyadh, Kingdom of Saudi Arabia. The data analysis of this study was carried out using Microsoft Excel 2002 (Microsoft Corporation, Seattle, WA, USA) and GraphPad InStat Version 3 (GraphPad Software, San Diego, USA). 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. A  $p$ -value of  $<0.05$  was considered statistically significant.

Studies have shown that the incidence of TBI is increasing globally, largely due to an increase in motor vehicle use in low- and middle-income countries particularly in this adult age range.<sup>2</sup> In this present study, we found that the frequency of TBI was higher in the 11-20 (22.5%) and 21-30 (45%) age groups, and lower in the 61-70 (1.9%) age group. The frequency of NTBI was higher in the 21-30 (21.9%) and lower in the 61-70 (6.6%) age group. Compared with TBI, the frequency of NTBI was less in all age groups (Table 1).

Studies reported that the age of the patients found to be strong predictors of LoS.<sup>3</sup> Compared to younger TBI patients the aged patients stay longer duration in the hospitals due to their injury.<sup>5</sup> In our study, we also found that age was a significant influencing factor for LoS of TBI and NTBI patients. The LoS of TBI and NTBI increases with age up to the 51-60 age group. However, a slight decrease was found in the 61-70 age group compared with the 51-60 age group. In addition, the study found that the LoS of TBI were higher than the NTBI patients in all age groups of the study population (Table 1). The overall results indicate that when compared with TBI, patients with NTBI had a significantly ( $p=0.0027$ ) shorter rehabilitation LoS ( $58.2 \pm 2.6$ ,  $43.5 \pm 2.9$ ). It demonstrates that the type of injury was an important influencing factor for the LoS of BI patients. It should be noted here that the urinary tract infections, pulmonary complications, and derangement in electrolytes, and liver function are common in 60-70% of acute TBI cases and may prolong acute hospital stay.<sup>5</sup>

In this study, we found that the LoS of TBI and NTBI were higher in males as compared with the females. A recent study reported that the male and female nervous systems respond differently to TBI, and in vivo research relates this difference to neuroprotection from female sex hormones.<sup>6</sup> Female gender is independently associated with reduced mortality and decreased complications after TBI than the male population. The female hormone estrogen unlikely confers neuroprotection in women after TBI.<sup>6</sup> The results of the study showed that the LoS of the Saudi TBI patient was 61.9 days, and the non Saudi patient was 77.2 days. The LoS of the Saudi NTBI patient was 47.7 days, and non Saudi was 56.6 days. Compared with Saudi patients, the LoS of non-Saudis was higher in the TBI ( $p=0.031$ )

**Table 1** - Frequency and the influence of age and gender wise LoS of TBI and NTBI patients.

Age, years	Frequency of BI (n)		Age wise LoS (days $\pm$ SEM)		Gender wise LoS (days $\pm$ SEM) of TBI patients		Gender wise LoS (days $\pm$ SEM) of NTBI patients	
	NTBI	TBI	NTBI	TBI	Male	Female	Male	Female
1-10	16	29	37.2 $\pm$ 3.3	49 $\pm$ 3.2	43.4 $\pm$ 3.6	35.1 $\pm$ 3.2	40.1 $\pm$ 4.1	27.2 $\pm$ 5.8
11-20	11	107	41 $\pm$ 3.9	63.1 $\pm$ 3.8*	56 $\pm$ 4.1	38.4 $\pm$ 4.3 <sup>‡</sup>	44.5 $\pm$ 3.1	35.4 $\pm$ 5.3
21-30	23	214	45.3 $\pm$ 4.7	66.2 $\pm$ 3.5 <sup>†</sup>	59.5 $\pm$ 3.5	49 $\pm$ 6	48.5 $\pm$ 6.3	38.4 $\pm$ 6.3
31-40	21	78	48 $\pm$ 4.9	66 $\pm$ 5.1	63.4 $\pm$ 6	54 $\pm$ 6.4	52.9 $\pm$ 6.5	41.2 $\pm$ 5.9
41-50	18	27	56 $\pm$ 6.3	66.7 $\pm$ 6.2	67.4 $\pm$ 6.32	59 $\pm$ 5.4	64 $\pm$ 8.5	44.7 $\pm$ 5.8
51-60	9	11	63 $\pm$ 6.4	73.1 $\pm$ 6.5	76.1 $\pm$ 6.5	61 $\pm$ 6.3	68.3 $\pm$ 7.5	58.5 $\pm$ 4.8
61-70	7	9	57 $\pm$ 4.3	68 $\pm$ 5.9	65 $\pm$ 6.7	54 $\pm$ 7.4	72 $\pm$ 7.2	47.8 $\pm$ 7.3

BI - brain injury, TBI - traumatic brain injury, NTBI - non-traumatic brain injury, LoS - length of stay, SEM - standard error of mean. NTBI versus TBI: student's t-test, \* $p=0.032$ , <sup>†</sup> $p=0.041$ . Male versus female: student's t-test, <sup>‡</sup> $p=0.014$ .

and NTBI rehabilitation programs. Studies have found that racial and ethnic differences are a major influencing factor for LoS of BI patients.<sup>7</sup>

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 TBI and NTBI patients. In addition, this type of study among BI patients in Saudi Arabia might provide new information and understanding among the Saudi population. In conclusion, the results of this study indicate that the age, gender, types of injury, and ethnicity are the significant factors influencing the LoS in BI patients. However, further studies are required in different clinical settings to provide a more comprehensive picture of LoS in BI patients.

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