



Comparison of Length of Hospital Stay Between Taipei City and Hualien County in Spinal Trauma Patients

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Background/Purpose: Urban and rural regions have different levels of medical resources. This study aimed to compare the length of stay (LOS) in hospital of spinal trauma patients between the city of Taipei (urban region) and Hualien County (rural region).

Methods: Demographic and clinical variables of spinal trauma patients were collected. Patients' LOS in hospital and associated factors were analyzed.

Results: There were significant differences in sex ($p=0.025$), injury season ($p=0.007$), type of neurologic deficit ($p=0.006$), and number of associated injuries ($p=0.004$) between patients in these two regions. Regression analysis indicated that with increased age, the hospitalization days and intensive care unit days increased in Taipei. The hospitalization days of patients in Hualien County increased when patients were injured during January to March.

Conclusion: Factors affecting patients' LOS in hospital were different between the two regions. Prevention strategies are necessary to be aware of different factors affecting LOS between urban and rural regions.

1. Introduction

Spinal trauma (ST) may result in spinal cord injury (SCI), causing 10–25% of cases of neurological impairment. In the United States, ST prevalence is around 4–5.3/100,000, while approximately 12,000 patients with SCI require hospitalization each year.¹ In Germany, approximately 55,000 ST patients receive hospital care every year. In addition, 20% of these patients have symptoms of SCI.² Some studies have suggested that not only prolonged inpatient care, but also acute care and rehabilitation therapy, are the main causes of hospital expenditure inflation.^{3,4}

Every year, approximately 61.6 patients per 100,000 of the population in Taiwan require hospital services due to ST, and the neurological impairment rate for these patients is 28.3% while the spinal surgery rate is 17.3%. However, neurological impairment and spinal surgery may not only result in a longer length of stay (LOS) in hospital but also more medical costs.^{5,6} Moreover, risk factors such as age, sex, and severity of injuries could also affect LOS in hospital.^{5–7}

The city of Taipei is the political and economic center of Taiwan (2,622,125 residents in 271.7997 km²), while Hualien County (341,433 residents in 4628.5714 km²) is located on the east coast of Taiwan and is mainly

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dependent on agriculture and tourism. The degree of urbanization in Taipei is substantially higher than in Hualien County and their resources of health services are also different.^{8,9} A total of seven medical centers are located in Taipei and there is only one in Hualien County. In our study, Taipei and Hualien County were used as representative Taiwanese urban and rural regions.

Previous studies in Taiwan have only focused on SCI patients in a single region, with a single cause of injury or on survival analysis and rehabilitation resource utilization.^{10–15} There have been no cross-region comparative studies on ST patients in Taiwan. To ensure efficient use of medical resources, improve the quality of medical care, and ascertain sustainable national health insurance, the LOS in hospital needs to be compared between urban and rural regions.

The hospitalization days and intensive care unit (ICU) stay were selected as dependant variables for measuring LOS in hospital. This study focused on ST patients in the two different regions, and we performed an epidemiological analysis of LOS after ST.

2. Methods

The primary criteria used for selecting subjects was the International Classification of Diseases 9th revision codes including 7674 (injury to the spine and spinal cord), 805× (fracture of the vertebral column without SCI), 806× (fracture of the vertebral column with SCI), and 952× (SCI without evidence of spinal bone injury).

Medical records of patients with acute ST in 21 hospitals in Taipei and three in Hualien County between 2004 and 2006 were reviewed. Demographic and clinical variables of each patient were extracted based on a pre-designed form, including age, sex, injury season, cause of injury, level of medical facility (medical center or non-medical center), type of neurological deficit (complete quadriplegia, complete paraplegia, incomplete quadriplegia, incomplete paraplegia or no neurological deficits), number of associated injuries (including head, chest, abdomen, face, and limb fractures), locus of injured vertebrae (single cervical, thoracic, or lumbar injury, combined injuries in 2 or 3 spinal sections), ICU days,

and hospitalization days. Inclusion criteria were ST patients whose trauma was caused by a fall or traffic accident. Exclusion criteria included patients younger than 15 years old and patients with sacral or coccygeal fractures only.

Data collected from the patients were first entered into Microsoft Excel to construct a database. SPSS version 15.0 (SPSS Inc., Chicago, IL, USA) was used for analysis. The patients were separated into Taipei and Hualien County, and comparative analysis was performed based on the abovementioned variables. To clarify the relative contributions of these independent variables to LOS in Taipei and Hualien County, multiple linear regression analysis was used. The normality of each independent variable was tested using a normal probability–probability plot prior to multiple regression analysis. With the injury status variable controlled (type of neurological deficits, associated injury, and locus of injured vertebrae), the correlation between baseline characteristics (age, sex, injury season, cause of injury, and level of treating hospital) and LOS in hospital (number of ICU days and hospitalization days) was analyzed. Multivariate analyses of significant factors associated with ST were evaluated by β coefficients and 95% confidence intervals. The level of significance was set to a p value less than 0.05.

3. Results

A total of 871 patients' charts were reviewed; there were 574 in Taipei and 107 in Hualien County. There was no significant difference in the average number of ICU days and hospitalization days between Taipei and Hualien County ($p=0.925$ and 0.730 ; Table 1).

Table 2 shows the comparison of demographic and clinical variables between Taipei and Hualien County. There were more male patients in Hualien County than in Taipei ($p=0.025$). In Hualien, the period from April to June had the highest percentage of injuries compared with the rest of the year, while it was July to September in Taipei. The difference in injury season between the two regions was statistically significant ($p=0.007$). There was also a significant difference in the percentage of neurologic deficits ($p=0.006$) and the percentage of

Table 1 Length of hospital stay of patients in Taipei (urban) and Hualien County (rural)

Variable	Minimum	Maximum	Mean	SD	p
ICU days					0.925
Taipei ($n=574$)	0	128	2.70	9.22	
Hualien County ($n=107$)	0	40	2.62	5.85	
Hospitalization days					0.730
Taipei ($n=574$)	1	148	16.51	22.07	
Hualien County ($n=107$)	1	104	17.29	18.74	

SD=standard deviation; ICU=intensive care unit.

patients with associated injuries ($p=0.004$) between the two regions (Table 2).

Probability–probability plot results showed that the relationships between LOS in hospital and every independent variable were normally distributed both in Taipei and Hualien County (Figure 1). The statistical outcome of ICU days and hospitalization days for Taipei and Hualien patients is shown in Table 3. The period of ICU stay was significantly affected by patient age in Taipei ($\beta=0.06$, $p=0.019$), but not in Hualien. The number of hospitalization days was also significantly affected by patient age in Taipei ($\beta=0.12$, $p=0.031$); however, in Hualien County, it was significantly higher when patients were injured between January and March ($\beta=10.19$, $p=0.022$).

4. Discussion

ST encompasses a broad spectrum of neurological presentations, from functionally intact to complete quadriplegia. If patients with ST experience permanent neurological deficits, this will result in serious resource utilization as well as huge personal and social losses. Many researchers have studied SCIs, including cost and

resource consumption, but few have evaluated ST.¹⁶ In Taiwan, Yang and colleagues demonstrated that male ST patients had longer hospitalization days than females (9.2 days vs. 7.8 days, $p<0.001$), and also had higher medical costs (NT\$51,326.8 vs. NT\$35,360.6, $p<0.001$).⁵ Another study found that a 1-year increase in the age of ST patients caused a 0.03-fold increase in hospitalization days.⁶ In addition, the severity of associated injuries and how they affect LOS in hospital has been investigated. For example, compared with general ST patients, patients with lower limb trauma stay in hospital for 4.3 days longer, pelvic trauma patients stay 3.6 days longer, chest trauma patients stay 3.5 days longer, abdominal trauma patients stay 2.4 days longer, and upper limb trauma patients stay 1.2 days longer.⁶

In a 2004 American study, the number of hospitalization days of SCI patients was 18.¹⁷ Lan et al also investigated 88 patients who had traffic accidents and falls causing SCI from 1987 to 1990, and found that incomplete paraplegics spent the least amount of days (average, 67 ± 26 days), while complete quadriplegics spent the most amount of days hospitalized (average, 135 ± 72 days).¹¹ Our study showed that Hualien County patients had slightly higher hospitalization days (17.29 days)

Table 2 Comparison of demographic and clinical variables between Taipei (urban) and Hualien County (rural)*

Variable	Taipei	Hualien County	<i>p</i>
Total	574 (100.0)	107 (100.0)	
Age (yr)	49.9 $\pm$ 18.6	49.6 $\pm$ 17.7	0.847
Sex			0.025
Male	374 (65.2)	82 (76.6)	
Female	199 (34.7)	25 (23.4)	
Injury season			0.007
January–March	139 (24.2)	21 (19.6)	
April–June	120 (20.9)	37 (34.6)	
July–September	164 (28.6)	19 (17.8)	
October–December	142 (24.7)	28 (26.2)	
Cause of injury			0.161
Motor vehicle accidents	305 (53.1)	63 (58.9)	
Falls	269 (46.9)	44 (41.1)	
Receiving medical facility is a medical center	458 (79.8)	79 (73.8)	0.197
Neurologic deficits			0.006
No deficits	492 (85.7)	81 (75.7)	
Complete quadriplegia	22 (3.8)	4 (3.7)	
Complete paraplegia	29 (5.1)	6 (5.6)	
Incomplete quadriplegia	19 (3.3)	12 (11.2)	
Incomplete paraplegia	12 (2.1)	4 (3.7)	
Associated injury	305 (53.1)	72 (67.3)	0.004
Location of spinal injury			0.085
One locus	486 (84.7)	100 (93.5)	
Two loci	48 (8.4)	3 (2.8)	
Three loci	3 (0.5)	0 (0.0)	

*Data are presented as *n*(%) except for age which is mean $\pm$ standard deviation.

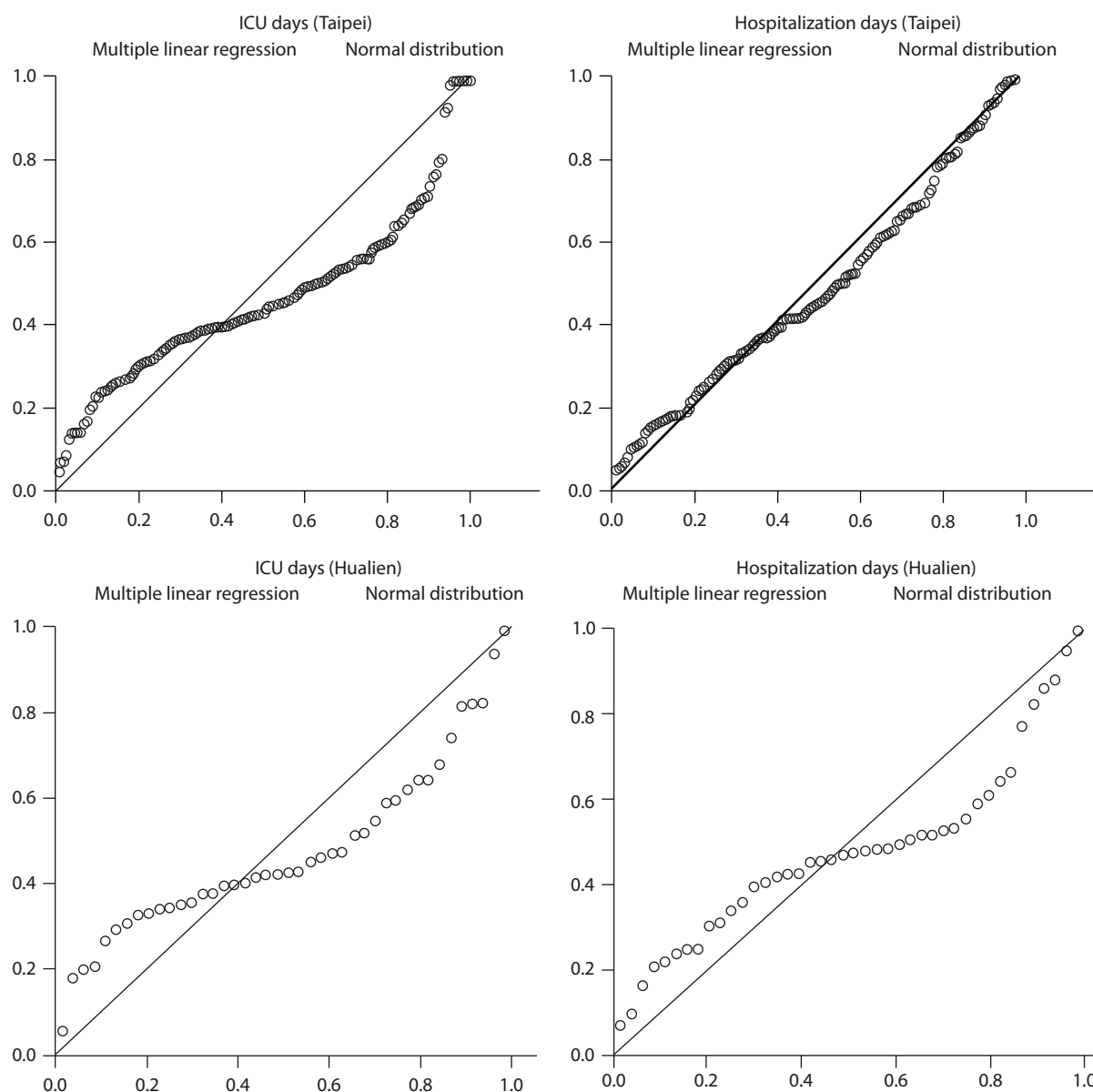


Figure 1 Normal distribution of regression analysis of intensive care unit (ICU) days and hospitalization days for patients in Taipei (urban) and Hualien County (rural).

compared with patients in Taipei (16.51 days). The time of hospitalization days in both cities was far shorter than that reported in former studies in Taiwan.^{11,13} Since the samples of our study included ST patients without neurological deficits, these data should be interpreted with caution. If prevention strategies, such as implementation of national health insurance to provide higher quality medical services and enforcement of traffic safety rules, which reduce the severity of injury, could be continuously provided in the future, hospital LOS could be gradually reduced.^{18,19}

In our study, the finding that patients in Hualien had a significantly higher percentage of associated injuries and neurological deficits than those in Taipei might have resulted in longer LOS for Hualien. However, the hospitalization days in these two regions were not statistically

different. According to a survey in Taiwan in 2006 of medical organizations and medical services, there is only one medical center in Hualien County, the Buddhist Tzu Chi General Hospital. However, the ratio is 198 people per bed in Hualien County, while in Taipei it is 197 people per bed.²⁰ Additionally, the ratios for ICU beds are similar in Hualien and Taipei (2043 vs. 2050). Each specialist (including 22 orthopedic doctors and 15 neurosurgery doctors) serves 9386 patients on average in Hualien County, but each specialist (139 orthopedic doctors and 79 neurosurgery doctors) serves 12,002 patients in Taipei. Thus, although Hualien is a rural region, there are more orthopedists and neurosurgeons per patient in that county than in Taipei. The hospital beds per patient provided in Hualien are almost the same number as in Taipei. Therefore, the finding that the hospital LOS in

Table 3 Regression analysis of intensive care unit (ICU) days and hospitalization days for patients in Taipei (urban) and Hualien County (rural)

Variable (control group)*	Taipei	Hualien County
	β value (95% CI)	β value (95% CI)
Dependent variable: ICU days		
Age	0.06 [†] (0.01 to 0.10)	−0.01 (−0.07 to 0.06)
Sex: female (male)	−1.41 (−3.00 to 0.18)	−1.20 (−4.05 to 1.64)
Injury season		
January–March (October–December)	−0.50 (−2.62 to 1.62)	−0.67 (−4.05 to 2.71)
April–June (October–December)	−0.15 (−2.35 to 2.04)	−1.52 (−4.49 to 1.46)
July–September (October–December)	−1.04 (−3.08 to 1.00)	−0.45 (−3.87 to 2.97)
Cause of injury: falls (motor vehicle accident)	−0.69 (−2.33 to 0.96)	−2.00 (−4.39 to 0.39)
Accepting hospital: medical center (non-medical center)	−0.74 (−2.64 to 1.17)	−1.33 (−4.17 to 1.50)
Dependent variable: Hospitalization days		
Age	0.12 [†] (0.02 to 0.23)	−0.05 (−0.24 to 0.14)
Sex: female (male)	−4.13 (−7.93 to −0.33)	−2.07 (−10.10 to 5.96)
Injury season		
January–March (October–December)	0.82 (−4.25 to 5.90)	10.19 [†] (0.64 to 19.73)
April–June (October–December)	0.84 (−4.41 to 6.08)	0.60 (−7.80 to 9.00)
July–September (October–December)	−1.32 (−6.19 to 3.55)	2.82 (−6.83 to 12.47)
Cause of injury: falls (motor vehicle accident)	−1.91 (−5.84 to 2.03)	3.20 (−3.55 to 9.95)
Accepting hospital: medical center (non-medical center)	0.22 (−4.32 to 4.77)	1.71 (−6.29 to 9.71)

*Three variables were controlled: (1) neurological deficits, (2) associated injury, and (3) locus of spinal injury; [†] $p < 0.05$. CI = confidence interval.

these two regions was not statistically different may be explained by an earlier study showing a negative attitude of patients in Hualien towards medical care and their inability to afford the costs decreasing their willingness for hospitalization.²¹ Patient economic status and willingness to remain hospitalized should be investigated in future studies.

With regard to sex, males comprised the majority of patients in both Taipei and Hualien County (65.2% and 76.6%, respectively), and this is consistent with previous studies.^{10,11,13} This phenomenon may be because males are more likely to operate motor vehicles than females in Taiwan, and it is not region-specific. For patients in Taipei, the period from July to September was the most common injury season, but conversely, it was the least common in Hualien. From July to September, outdoor recreation activities increase because of summer vacation. Therefore, falls or traffic accidents are more frequent, and the likelihood of ST increases. Most Taipei students go to school by bus and Mass Rapid Transit, while most Hualien students ride motorcycles to school. Li and Fu proposed that youths aged 15–24 in Hualien County had the least number of injuries in July because during summer vacation they were less likely to ride motorcycles.²² The difference in injury season between the patients in these two regions should be explored to determine if strategies can be implemented to reduce ST.

Based on the results of regression analysis, we found that neurological deficits and associated injuries significantly affected the ICU days of patients in Hualien County. Age was positively correlated with ICU days for patients in

Taipei, but not for Hualien patients. Although the average age of patients in these two regions was not different, the lower percentage of associated injuries and neurological deficits for Taipei patients compared with Hualien County patients might indicate that the factor of age had the biggest effect on the number of ICU days.

In our study, we found that elderly patients in Taipei spent more days in the hospital. Wang et al studied head trauma patients and their hospitalization days in Taipei.²³ They reported that the average age of patients injured due to traffic accidents was 39.3 years, and the average number of hospitalization days was 10.7 days. When the cause was a fall, the average age was 55.9 years and the length of hospital stay was 15.7 days. Thus, age is a risk factor in predicting medical resource utilization (LOS in hospital) in patients in Taipei and a health policy for seniors should incorporate this finding.

Our study found that more hospitalization days resulted when patients in Hualien County were injured from January to March. A study in 2003 showed that the death rate of motor vehicle accidents in the Hualien region ($46.7/10^5$) was two times the average rate in Taiwan ($23.2/10^5$).¹⁹ A 2007 study revealed that deaths due to traffic accidents are higher in winter than in fall, and December has the highest occurrence.²⁴ Furthermore, of the total population in the Hualien region, 25.58% are aboriginal people,²⁵ who have a higher risk of accidents due to drinking and driving or falls than those in Taipei.^{19,23,26} Thus, impaired concentration of surrounding hazards caused by drunkenness may lead to more severe injuries while driving or engaging in daily activities.

Compared with Taipei, Hualien is a large but sparsely populated area, and consequently, an injured person may not be discovered quickly and may require more time to be transported to the hospital.^{27,28} During the colder months of January to March, people are more prone to hypothermia. The delay in receiving treatment could worsen the patient's condition leading to increased hospital days.

This study found that after sustaining ST, patients in Taipei and Hualien County did not show a significant difference in LOS in hospital. The factor affecting LOS in Taipei was age, while the factor affecting ICU days in Hualien was the season of injury. We suggest that, in the future, the elderly population in Taipei be educated about safety at home and at work. In contrast, in Hualien County, prevention strategies are necessary to promote awareness of the season when ST injuries are most likely to occur. Lastly, whether other potential factors affect LOS should be explored. Only through a deeper understanding of the difference between urban and rural regions can better prevention strategies be implemented to reduce injuries and personal as well as social losses after ST.

Our study has a few limitations. First, the data were collected by a review of medical records. Therefore, detailed information related to socioeconomic status, patient activities at the time of injury and the location of injury that might have affected LOS could not be obtained. There may also have been personal bias during the process of data extraction. Second, the study focused on hospitalized ST patients, excluding patients who died at the accident site or in the emergency room. Therefore, our study did not consider the use of medical resources of the most severely injured patients. Third, study subjects involved only patients in Taipei and Hualien County, and they may not be representative of national data of ST. Therefore, future studies should include a countrywide survey to assist health authorities with the allocation of medical resources for ST.

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