FACTORs AFFECTING LENGTH OF STAY IN HOSPITAL OF PATIENTS WITH TRAUMATIC SPINAL CORD INJURY IN CHINA

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Objective: To investigate factors associated with length of stay in hospital of patients with traumatic spinal cord injury in China, based on recent data spanning a period of 10 years.

Methods: The study was conducted in the China Rehabilitation Research Center, Beijing, which is the largest rehabilitation hospital in China. Associated variables were statistically analysed, including sex, age, marital status, patient’s home address, and payment method as demographic variables, and cause of injury, severity of injury, level of injury, spasticity, osteoporosis, neurogenic bladder, and complications as clinical variables. Univariate analysis and multiple linear regression analysis were used to determine the association between length of stay and these variables.

Results: A total of 2,110 participants were included in this study. Median length of stay in hospital was 113.5 days. Longer length of stay correlated significantly with higher age, single status, being struck by an object, motor vehicle collision, complete injury, and complications. Patients whose injury resulted from a fall from a low height, those with neurogenic bladder, and/or patients of older age had shorter lengths of stay.

Conclusion: Analysis of data for patients with traumatic spinal cord injury, spanning a recent period of 10 years in China, shows that close attention should be paid to those patients with osteoporosis, spasticity, complete injury, injury caused by object striking or motor vehicle collision, patients with single status, or who are in the age range 15–29 years. Active measures should be taken to reduce length of stay in patients with complications, such as urinary tract infection, respiratory infection, or neuropathic pain.

Key words: trauma; spinal cord injury; length of stay; China; rehabilitation.

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This study investigated factors associated with length of stay in hospital of patients with traumatic spinal cord injury in China, based on recent data spanning period of 10 years. Associated variables were statistically analysed, including sex, age, single status, patient’s home address, and payment method as demographic variables, and cause, severity, level of injury, spasticity, osteoporosis, neurogenic bladder, and complications as clinical variables. Univariate analysis and multiple linear regression analysis were used to detect the association between length of stay and these variables. A total of 2,110 participants were included in the study. Median length of stay in hospital was 113.5 days. Longer length of stay was significantly correlated with being older, single status, being struck by an object, motor vehicle collision, complete injury, and complications. Patients whose injury resulted from fall from a low height, those with neurogenic bladder, and/or patients of older age had shorter lengths of stay. Close attention should be paid to those patients with osteoporosis, spasticity, complete injury, injury caused by being struck by an object or motor vehicle collision, patients with single status, or who are in the age range 15–29 years. Active measures should be taken to reduce length of stay in patients with complications, such as urinary tract infection, respiratory infection, or neuropathic pain.

METHODS

This study was conducted in the China Rehabilitation Research Center (CRRC), which is the first and largest national rehabilita-
tion centre in China, and is the only Grade 3A general hospital and rehabilitation hospital in China. In the past 30 years, more than 10,000 patients with SCI from all over China have been admitted to the CRRC. Patients with TSCI who were admitted from 1 January 2010 to 31 December 2019 were retrospectively reviewed and analysed. Cases resulting from non-traumatic injury were excluded.

Measures and definition

The LOS included the length of time a patient stayed in the rehabilitation centre, from the first date of admission to the date of final discharge. After undergoing surgery or treatment in the emergency ward, patients would be transferred to the rehabilitation ward for rehabilitation training. Data were extracted from the centre’s database and examined. Associated variables were statistically analysed, including sex, patient’s home address, marital status, and payment method as demographic variables, and cause of injury, severity of injury, level of injury, spasticity, osteoporosis, neurogenic bladder, and complications as clinical variables. All variables were obtained from the database of SCI in the CRRC. Categorical variables included demographic variables and clinical variables, while continuous variables were age and LOS.

Patients were grouped according to age: 0–14, 15–29, 30–44, 45–59, and 60 years or older. The causes of SCI included high fall (from a height ≥ 1 m), low fall (from < 1 m), motor vehicle collision (MVC), being struck by an object and other injuries. The severity of injury was divided into complete and incomplete injury, according to the American Spinal Injury Association (4) Impairment Scale (5) (AIS grade A for complete SCI, AIS grade B, C and D for incomplete SCI). Based on dual energy X-ray absorptiometry, bone mass > 2.5 standard deviations (SD) below the young mean value would be diagnosed as osteoporosis (6).

Complications closely correlated with TSCI included intestinal dysfunction, urinary tract infection, neuropathic pain, respiratory infection, deep venous thrombosis (DVT), pressure ulcers, and orthostatic hypotension. Neuropathic pain is caused by a lesion or disease of the somatosensory system, which, here, refers to SCI (7). Orthostatic hypotension is a decrease in systolic blood pressure of 20 mmHg or more, or a reduction in diastolic blood pressure of 10 mmHg or more, on changing body position from a supine position to an upright posture, regardless of the presence of symptoms (8). After consultation with the specialist department, the doctors made the diagnosis and the more senior doctors reviewed it according to the above definitions.

The payment method was divided into “patients’ own expense” and “others”. “Patients’ own expense” means that they had to pay all of the medical expenses. “Others” means that patients had Basic Medical Insurance for Urban Residents and Urban Employees, New Rural Cooperative Medical Insurance, or other commercial medical insurance, or are entitled to a free medical service (9).

Statistical analyses

All statistical analyses were performed by Statistical Product and Service Solutions (version 25.0 Inc., Chicago, IL, USA). The LOS was log-transformed to make it conform to normal distribution according to Kolmogorov–Smirnov’s test, then used as outcome variable. One-way analysis of variance and t-test of 2 independent samples were performed to find significant differences between subgroups.

Multiple linear regression analysis was used to explore the association between LOS and these associated factors. Associated variables for the univariate analysis with p-value ≤ 0.1 were subject to a regression test. Stepwise selection methods were used to extract the significant independent variables contributing to LOS for patients with TSCI. p-values < 0.05 were used as the criteria for inclusion in the linear regression equation.

A total of 2,110 patients were included in this study. The median age of patients was 38 years (interquartile range (IQR) 26.75–49 years; men 39.2 years, women 31.7 years, p < 0.001), with a range of 2–85 years, 61.2% of subjects were aged between 30 and 59 years. The ratio of males to females was approximately 3.55: 1.00, with males as 78.0% and females as 22.0%. The median LOS in the rehabilitation unit was 113.5 days (IQR 53–235 days). The characteristics of the patients with TSCI are summarized in Table 1.

LOS for the subgroups, and the factors associated with prolonged hospitalization in the univariate analysis are summarized in Table 1. LOS was significantly correlated with older age, single status, cause of injury, severity of injury, spasticity, osteoporosis, neurogenic bladder, and complications (intestinal dysfunction, urinary tract infection, neuropathic pain, respiratory infection, DVT, pressure ulcers, and orthostatic hypotension) (p < 0.05).

The results of association between LOS and independent variables from the multivariable analysis are shown in Table II. Patients with osteoporosis, urinary tract infection, respiratory infection, neuropathic pain, spasticity, complete injury, caused by object striking or MVC, single, age 15–29 years, had significantly longer LOS (p < 0.05), compared with patients without those factors. Patients with neurogenic bladder, older age, and low falls, had a shorter LOS, compared with those without these factors (p < 0.01). Other complications, sex, regions, level of injury, and payment method were excluded from the regression equation.

DISCUSSION

TSCI leads to motor and sensory dysfunction and a range of autonomous deficits (10). China, the largest developing country in the world, has experienced both rapid economic development and increased population growth in recent years. This study presents data for cases from the CRRC, the largest SCI institute in China, which admits cases from across the country. Except for one study from a local hospital in Tianjin with only 631 cases, no such study has reported LOS in China previously (11). An investigation in the Netherlands found
Factors affecting LOS of patients with traumatic SCI

Table I. Logarithm analysis of original data of the factors for length of stay (LOS)

<table>
<thead>
<tr>
<th>Variables</th>
<th>n (%)</th>
<th>Mean (SD)</th>
<th>EXP (Mean Median (IQR)</th>
<th>Statistic* p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1,646 (78.0)</td>
<td>4.70 (1.27)</td>
<td>110.2 (116 (53–243.5)</td>
<td>t = 0.543 0.587</td>
</tr>
<tr>
<td>Female</td>
<td>464 (22.0)</td>
<td>4.67 (1.16)</td>
<td>106.3 (105 (53–217)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–14 years</td>
<td>137 (6.5)</td>
<td>4.56 (1.29)</td>
<td>95.9 (106 (45–223.5)</td>
<td>F = 10.480 &lt; 0.001</td>
</tr>
<tr>
<td>15–29 years</td>
<td>544 (25.8)</td>
<td>4.90 (1.23)</td>
<td>134.0 (137 (64–284.5)</td>
<td></td>
</tr>
<tr>
<td>30–44 years</td>
<td>691 (32.7)</td>
<td>4.73 (1.26)</td>
<td>113.6 (118 (57–245)</td>
<td></td>
</tr>
<tr>
<td>45–59 years</td>
<td>600 (28.4)</td>
<td>4.61 (1.25)</td>
<td>100.5 (100.5 (48–217.75)</td>
<td></td>
</tr>
<tr>
<td>≥ 60 years</td>
<td>138 (6.5)</td>
<td>4.20 (1.06)</td>
<td>66.4 (67 (30–138)</td>
<td></td>
</tr>
<tr>
<td>Single status</td>
<td>541 (25.6)</td>
<td>4.86 (1.27)</td>
<td>128.9 (130 (60.5–261)</td>
<td>t = 3.564 &lt; 0.001</td>
</tr>
<tr>
<td>No</td>
<td>1,569 (74.4)</td>
<td>4.64 (1.24)</td>
<td>103.3 (104 (50–223)</td>
<td></td>
</tr>
<tr>
<td>Patient’s home address</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North China</td>
<td>977 (46.3)</td>
<td>4.69 (1.24)</td>
<td>108.9 (112 (53.5–228)</td>
<td></td>
</tr>
<tr>
<td>East China</td>
<td>439 (20.8)</td>
<td>4.77 (1.17)</td>
<td>117.9 (124 (57–240)</td>
<td></td>
</tr>
<tr>
<td>Central China</td>
<td>258 (12.2)</td>
<td>4.77 (1.31)</td>
<td>117.8 (125 (61–262)</td>
<td></td>
</tr>
<tr>
<td>Northeastern China</td>
<td>193 (9.1)</td>
<td>4.55 (1.37)</td>
<td>94.9 (102 (38–222.5)</td>
<td></td>
</tr>
<tr>
<td>Northwestern China</td>
<td>145 (6.9)</td>
<td>4.56 (1.29)</td>
<td>95.1 (96 (41.5–249.5)</td>
<td></td>
</tr>
<tr>
<td>Southwest China</td>
<td>79 (3.7)</td>
<td>4.72 (1.12)</td>
<td>112.3 (102 (58–224)</td>
<td></td>
</tr>
<tr>
<td>South China</td>
<td>19 (0.9)</td>
<td>4.49 (1.53)</td>
<td>88.9 (115 (75–240)</td>
<td></td>
</tr>
<tr>
<td>Cause of injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MVC</td>
<td>661 (31.3)</td>
<td>4.81 (1.33)</td>
<td>123.1 (126 (58–264)</td>
<td></td>
</tr>
<tr>
<td>Low fall</td>
<td>248 (11.8)</td>
<td>4.27 (1.10)</td>
<td>71.6 (75 (31–150.5)</td>
<td></td>
</tr>
<tr>
<td>High fall</td>
<td>638 (30.2)</td>
<td>4.66 (1.13)</td>
<td>105.3 (112 (57–214.25)</td>
<td></td>
</tr>
<tr>
<td>Being struck by an object</td>
<td>293 (13.9)</td>
<td>5.01 (1.29)</td>
<td>150.5 (168 (77.5–338)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>270 (12.8)</td>
<td>4.53 (1.27)</td>
<td>92.9 (96 (43–191)</td>
<td></td>
</tr>
<tr>
<td>Severity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete</td>
<td>1,029 (48.8)</td>
<td>4.84 (1.21)</td>
<td>126.7 (132 (64–265.5)</td>
<td>t = 5.335 &lt; 0.001</td>
</tr>
<tr>
<td>Incomplete</td>
<td>1,081 (51.2)</td>
<td>4.55 (1.27)</td>
<td>95.0 (97 (43.5–202.5)</td>
<td></td>
</tr>
<tr>
<td>Level of injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tetraplegia</td>
<td>843 (40.0)</td>
<td>4.66 (1.3)</td>
<td>105.3 (104 (49–217.5)</td>
<td></td>
</tr>
<tr>
<td>Paraplegia</td>
<td>1,267 (60.0)</td>
<td>4.72 (1.21)</td>
<td>112.0 (118 (57–246)</td>
<td></td>
</tr>
<tr>
<td>Spasticity</td>
<td>376 (17.8)</td>
<td>4.99 (1.29)</td>
<td>147.6 (137.5 (66.3–309.25)</td>
<td>t &lt; 0.05</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>369 (17.5)</td>
<td>5.35 (1.25)</td>
<td>209.8 (214 (96–475)</td>
<td></td>
</tr>
<tr>
<td>Neurogenic bladder</td>
<td>1,075 (50.9)</td>
<td>4.81 (1.19)</td>
<td>122.8 (123 (61–259)</td>
<td></td>
</tr>
<tr>
<td>Complications</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intestinal dysfunction</td>
<td>833 (39.5)</td>
<td>4.89 (1.18)</td>
<td>132.5 (132 (64–257)</td>
<td>t = 5.753 &lt; 0.001</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>739 (35.0)</td>
<td>5.09 (1.19)</td>
<td>162.5 (160 (77–335)</td>
<td>t = 11.008 &lt; 0.001</td>
</tr>
<tr>
<td>Neuropathic pain</td>
<td>625 (29.6)</td>
<td>4.98 (1.22)</td>
<td>146.0 (141 (69.5–326.5)</td>
<td>t &lt; 0.05</td>
</tr>
<tr>
<td>Respiratory infection</td>
<td>301 (14.3)</td>
<td>5.19 (1.15)</td>
<td>180.3 (177.5 (86–396.5)</td>
<td>t = 7.605 &lt; 0.001</td>
</tr>
<tr>
<td>DVT</td>
<td>227 (10.8)</td>
<td>4.85 (1.13)</td>
<td>127.7 (121 (69–228)</td>
<td>t = 2.174 0.031</td>
</tr>
<tr>
<td>Pressure ulcers</td>
<td>213 (10.1)</td>
<td>4.89 (1.08)</td>
<td>133.6 (132 (67–226)</td>
<td>t = 2.442 0.015</td>
</tr>
<tr>
<td>Orthostatic hypotension</td>
<td>113 (5.4)</td>
<td>5.19 (1.21)</td>
<td>180.1 (159 (84.5–372.5)</td>
<td>t = 4.387 &lt; 0.001</td>
</tr>
<tr>
<td>Hypoaesthesia</td>
<td>59 (2.8)</td>
<td>4.89 (1.08)</td>
<td>133.6 (132 (67–226)</td>
<td>t = 1.250 0.211</td>
</tr>
</tbody>
</table>

*Independent samples t-test (t) or one-way analysis of variance (F) (performed on log-transformed LOS). A Bonferroni post hoc test revealed significant differences between age 0–14 and 15–29, 15–29 and ≥60 45–59, 15–29 and ≥60, 30–44 and ≥60, 45–59 and ≥60 years (p < 0.05). All other subgroups were not significantly different from each other. A Bonferroni post hoc test revealed significant difference between high fall and low fall, high fall and being struck by an object, low fall and MVC, low fall and being struck by an object (p < 0.05). All other subgroups were not significantly different from each other. On admission. EXP: expected value; IQR: interquartile range; MVC: motor vehicle collision; SD: standard deviation; DVT: deep venous thrombosis.

Table II. Multiple regression analysis of the factors for length of stay (LOS)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unstandardized coefficients (B)</th>
<th>Standardized coefficients (β)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteoporosis</td>
<td>0.571</td>
<td>0.174</td>
<td>No = 0, Yes = 1</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>0.415</td>
<td>0.158</td>
<td>No = 0, Yes = 1</td>
</tr>
<tr>
<td>Respiratory infection</td>
<td>0.346</td>
<td>0.097</td>
<td>No = 0, Yes = 1</td>
</tr>
<tr>
<td>Being struck by an object</td>
<td>0.331</td>
<td>0.092</td>
<td>No = 0, Yes = 1</td>
</tr>
<tr>
<td>Neurogenic bladder</td>
<td>0.229</td>
<td>0.084</td>
<td>No = 0, Yes = 1</td>
</tr>
<tr>
<td>Motor vehicle collision</td>
<td>0.207</td>
<td>0.077</td>
<td>No = 0, Yes = 1</td>
</tr>
<tr>
<td>Severity of the injury</td>
<td>0.171</td>
<td>0.068</td>
<td>Incomplete = 0, Complete = 1</td>
</tr>
<tr>
<td>Single status</td>
<td>0.180</td>
<td>0.063</td>
<td>No = 0, Yes = 1</td>
</tr>
<tr>
<td>Spasticity</td>
<td>0.164</td>
<td>0.050</td>
<td>No = 0, Yes = 1</td>
</tr>
<tr>
<td>Age 15–29 years</td>
<td>0.135</td>
<td>0.047</td>
<td>No = 0, Yes = 1</td>
</tr>
<tr>
<td>Neurogenic bladder</td>
<td>−0.175</td>
<td>−0.070</td>
<td>No = 0, Yes = 1</td>
</tr>
<tr>
<td>Age 60 years and over</td>
<td>−0.342</td>
<td>−0.068</td>
<td>No = 0, Yes = 1</td>
</tr>
<tr>
<td>Low fall</td>
<td>−0.185</td>
<td>−0.048</td>
<td>No = 0, Yes = 1</td>
</tr>
</tbody>
</table>

Dependent variable: ln LOS; t = 2.304, p = 0.021.
that median LOS was 240 days (IQR 164–322 days),
which was longer than the LOS in CRRC (12). Another
multi-centre investigation in Australia found that
the median rehabilitation LOS of SCI cases was 138 days
(IQR 88–212 days) (13). After the initial rehabilitation
treatment in CRRC, some patients were transferred to
local primary hospitals or nearby community hospitals
to continue rehabilitation training. However, data regarding
patient transfer were not available.

Univariate and multivariate analyses showed that
patients in the age range 15–29 years had longer LOS,
while those aged 60 years and over had shorter LOS,
which might relate to the cause of injury and severity
of injury in patients in different age groups (14). In the
current study cohort, injury in 44.9% of patients aged
60 years and over was caused by low fall, while 35.1%
of patients in the age range 15–29 years were injured
by high fall, and 37.1% by MVC. As for severity of
injury, 16.7% of patients aged 60 years or over had
complete injury, while 55.7% of patients in the age
range 15–29 years had complete injury.

It has been reported that being single significantly
increases the risk of pressure ulcers in patients with
TSCI. TSCI is a huge obstacle to the future employment
of patients, and it also decreases the likelihood
of getting married (15). Patients who receive intensive
care from their spouse may improve quickly in activities
of daily living (ADL) and have reduced LOS.

In both univariate and multivariate analysis, payment
method showed little correlation with LOS. However,
because China’s medical insurance system is different
from that of countries in the western world, it is difficult
to make comparisons between them. This result can
therefore serve only as an understanding and reference
for China’s national conditions. However, it can be con-
cluded that China must invest more in the rehabilitation
of patients with SCI (16), because 52.9% of patients bear
all rehabilitation costs themselves. A national unified
programme of social security for SCI rehabilitation
should be put forward as soon as possible.

The results of this study support that patients with
complete TSCI at the time of admission had longer LOS,
in both univariate analysis and multiple linear
regression analysis. A study in Canada also supported
this conclusion (17). Patients with complete TSCI had
higher risks of complications than those with incom-
plete injuries, which may lead to longer LOS (18).

The cause of injury may have a greater impact on pa-
tients’ LOS. Combining the results of one-way analysis
of variance (ANOVA) and multiple linear regression,
it can be inferred that patients with injuries resulting
from a low fall may have shorter LOS, while patients
with injuries resulted from a MVC or being struck by
an object tend to have longer LOS. The latter was more
likely to be a high-energy trauma, and it is also more
likely to cause more serious injuries, such as motor
complete TSCI, leading to longer LOS (19). Among
patients with TSCI caused by high falls and MVCs,
53.3% and 50.1% of patients had complete injuries,
respectively. However, the proportion of patients with
injuries resulting from a low fall was only 23.8% in the
study cohort. Thus, patients with more severe injuries
resulting from high falls and MVCs could explain the
longer LOS of patients with the 2 causes.

Spasticity is a consequence of TSCI, and oste-
porosis may coexist with TSCI. Among the included
participants, 6.5% were elderly, and they were more
likely to have osteoporosis (20). After TSCI, patients
were confined to wheelchairs with little movement, and
were at high risk of osteoporosis. Even a minor injury,
such as a low fall, may cause spinal fracture and SCI
in patients with osteoporosis (17). Both spasticity and
osteoporosis prolonged LOS in hospital.

Patients with TSCI often have complications, whether
they are hospitalized in the acute or rehabilitation period
or after being discharged from the hospital (21, 22). It
has been shown in previous studies that patients with
complications after TSCI may have longer LOS (11,
23). The current study demonstrates that urinary tract
infection, respiratory infection, and neuropathic pain
influenced the LOS. Therefore, future studies must focus
on these complications in order to shorten the LOS of
patients with TSCI. A meta-analysis showed that the
incidence of pressure injury in cases of SCI was 22%
in developing countries vs 27% in developed countries
from 2000 to 2009 (24). Participants with pressure
ulcers had longer LOS in univariate analysis, but in
multivariable analysis, pressure ulcers had little effect
on LOS (25). These factors may be mixed with severity
of the injury to cover up the influence of associated factors
on LOS in multiple linear regression analysis.

Study limitations

This study had several limitations. First and foremost,
it was a retrospective study and, therefore, the accuracy
and completeness of documentation in the medical
notes was assumed. Secondly, this study was conducted
in a single geographical area in China, and therefore it
may not be possible to make generalizations based on
current results about TSCI in other countries or even
the rest of China. Thirdly, the relationship between
LOS and time from traumatic event to surgery were
not interpreted in this study, although these factors
would have contributed to the recovery of injury and
the analyses of LOS. Finally, the current study only
examined the effect of the epidemiological and clinical
factors on LOS and did not identify correlation between
these factors (e.g. AIS grade, surgery, causes of injury, and complications). Further research to address the above issues is thus required.

**Conclusion**

This study examined the factors affecting the LOS of patients with TSCI, based on recent 10-year data from China. This study also provides valuable information for future prospective studies in China with regard to better understanding the factors associated with the rehabilitation LOS for inpatients after TSCI. At the same time, rehabilitation has become a key health strategy of the 21st century (26). Thus, more attention should be paid to prevent and control complications during the rehabilitation of cases of TSCI, especially for those with complete TSCI.

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The authors have no conflicts of interest to declare.

**REFERENCES**