Epidemiological Analysis of 459 Patients Hospitalized With Traumatic Spinal Cord Injury in Suzhou City, China

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Research Article

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Abstract

Study design Retrospective study.

Objective: To analyze the epidemiological characteristics of patients hospitalized with traumatic spinal cord injury (TSCI).

Setting: The First Affiliated Hospital of Soochow University

Methods: This retrospective epidemiological study included 459 patients hospitalized with TSCI.

Results: Mean age in this patient cohort was 50.7 ± 14.2 years, and 50–59 year olds were the most vulnerable age group (27.0%). Main cause of injury was fall from height in the 10-49 year-old group, traffic accident in the 50-79 year-old group, and low fall in ≥80 year-old group. Traffic accident accounted for the largest proportion of injuries (37.0%). The male-to-female ratio was 3.1:1, with more males than females accounting for all causes of injury. The difference in proportion of males to females was the greatest for fall from height and lowest for low fall. The anatomical site most vulnerable to fracture was the cervical segment (68.2%). Thoracolumbar segment (15.0%) was the anatomical site most frequently injured in fall from height, and the cervical segment was the most commonly injured site for all the remaining causes of injury. Most patients were classified with Grade D injuries using the American Spinal Injury Association (ASIA) Impairment scale. The most common complication of injuries was urinary tract infection (48.3%). Patients with bedsores had the longest hospital stay, with an average of 105 days. Patients with complications had significantly longer hospital stays than those without complications. Patients with multiple complications had longer hospital stays than those with a single complication. Patients receiving surgery accounted for 82.4%, and those receiving conservative treatment accounted for 17.6%, of our patient population. Average length of hospital stay for all patients was 51.1 ± 79.3 days. Patients that received surgery, those with ASIA Grade A, and those with injured thoracolumbar segment had prolonged hospital stays.

Conclusion: Patients with TSCI were generally of advanced age. Traffic accident was the main cause of TSCI, but causes of TSCI were different in different age groups. Elderly patients showed a high rate of low fall. The majority of TSCI occurred in male patients, and males and females had different causes of TSCI. Neck injuries were relatively common. Injury sites varied according to the different causes of injury. The prolonged hospital stays of patients with TSCI were related to numerous factors. Our study highlights the need to focus on the prevention and treatment of various complications, and selection of appropriate treatment, in patients with TSCI. TSCI should be comprehensively prevented according to its epidemiological characteristics.

Introduction

Traumatic spinal cord injury (TSCI) is increasing yearly worldwide [1], particularly in the developing countries; the annual incidence rate in China is 23.7–60.6/million [2]. TSCI, which causes functional

impairment in patients [3], also affects these patients' families, resulting in a considerable economic societal burden [1]. The epidemiology of TSCI varies in different countries and regions. Currently, there is a substantial gap in epidemiological research on TSCI in countries with high TSCI burdens and in developed countries [1]. Conducting epidemiological analysis of TSCI helps to develop targeted prevention and professional emergency first aid for high-risk groups, and provides reference for care and treatment strategies for patients with TSCI.

Suzhou City, located in the Yangtze River Delta region of China, ranks first among all the prefecture-level cities and shows the most active economic development in China. However, few epidemiological studies on TSCI have been performed in this area. Our present study conducted a retrospective epidemiological analysis in 459 patients hospitalized with TSCI in Suzhou City, Jiangsu Province, China from January 2015 to December 2019.

Information And Methods

General information

In this study, we retrieved the medical records of patients in the Departments of Rehabilitation and Orthopedics, First Affiliated Hospital (3A-grade hospital) of Soochow University, Jiangsu Province, China, from January 2015 to December 2019. Patients' medical records were examined to exclude patients with unknown diagnosis and incomplete medical history. A total of 459 patients with TSCI were included. The data collected for patients with TSCI included year of injury, age, marital status, etiology, sex, fracture segments, classification per guidelines of the American Spinal Injury Association (ASIA), complications, treatment regimens, and length of hospital stay.

Research methods

Patients with TSCI were divided into the following age groups: 10–19, 20–29, 30–39, 40–49, 50–59, 60–69, 70–79, and ≥ 80. Causes of injury were classified as follows: traffic accident, fall from height,struck by object, low fall, sports, and others. Falls or slips on level ground, and falls on a step less than 1 meter in height, were classified as low fall [4]. Anatomical sites of fracture were classified as follows: cervical segment (C1–C7), thoracic segment (T1–T9), thoracolumbar segment (T10–L2), and lumbosacral segment (below L2). Patients with multiple-site fractures of the spine were classified according to the spinal-cord segment having the most severe injury [4]. The degree of spinal-cord injury was classified according to ASIA Impairment Scale [5].

Statistical analysis

SPSS 20.0 software (IBM, Armonk, NY) was used for statistical analysis of all the data. Numeric data are presented as mean ± standard deviation, and count data are presented as percentages.

Results

General conditions

This study included 459 TSCI patients, with 81 patients admitted in 2015, 85 patients in 2016, 109 patients in 2017, 100 patients in 2018, and 84 patients in 2019. Among the 459 TSCI patients, 348 were men (75.8%) and 111 were women (24.2%). Minimum age of the patients was 11 years, and maximum age was 90 years. Mean age of the 459 patients with TSCI was 50.7 ± 14.2 years old; 433 patients were married (94.3%), 25 were unmarried (5.5%), and 1 was divorced (0.2%) (see Table 1 for details).

Table 1
Characteristics of patients hospitalized with TSCI from 2015 to 2019

Years	2015	2016	2017	2018	2019	Total
Number of cases	81	85	109	100	84	459
Age (cases, %)						
10–19	1 (1.2%)	1 (1.2%)	1 (0.9%)	1 (1.0%)	2 (2.4%)	6 (1.3%)
20–29	8 (9.9%)	6 (7.1%)	6 (5.5%)	8 (8.0%)	6 (7.1%)	34 (7.4%)
30–39	11 (13.6%)	13 (15.3%)	10 (9.2%)	13 (13.0%)	12 (14.3%)	59 (12.9%)
40–49	20 (24.7%)	25 (19.4%)	27 (24.8%)	17 (17.0%)	20 (23.8%)	109 (23.7%)
50–59	20 (24.7%)	20 (23.5%)	32 (29.4%)	28 (28.0%)	24 (28.6%)	124 (27.0%)
60–69	16 (19.8%)	15 (17.6%)	20 (18.3%)	22 (22.0%)	14 (16.7%)	87 (19.0%)
70–79	4 (4.9%)	5 (5.9%)	12 (11.0%)	7 (7.0%)	5 (6.0%)	33 (7.2%)
≥ 80	1 (1.2%)	0 (0.0%)	1 (0.9%)	4 (4.0%)	1 (1.2%)	7 (1.5%)
Disease cause (cases, %)						
Traffic accident	25 (30.9%)	35 (41.2%)	48 (44.0%)	31 (31.0%)	31 (36.9%)	170 (37.0%)
Fall from height	30 (37.0%)	22 (25.9%)	35 (32.1%)	37 (37.0%)	24 (28.6%)	148 (32.2%)
Struck by object	7 (8.6%)	5 (5.9%)	6 (5.5%)	9 (9.0%)	6 (7.1%)	33 (7.2%)
Low fall	16 (19.8%)	19 (22.4%)	18 (16.5%)	16 (16.0%)	21 (25.0%)	90 (19.6%)
Sports	2 (2.5%)	1 (1.2%)	0 (0.0%)	0 (0.0%)	1 (1.2%)	4 (0.9%)
Others	1 (1.2%)	3 (3.5%)	2 (1.8%)	7 (7.0%)	1 (1.2%)	14 (3.1%)
Gender (cases, %)						
Male	63 (77.8%)	62 (72.9%)	89 (81.7%)	69 (69.0%)	65 (77.4%)	348 (75.8%)
Female	18 (22.2%)	23 (27.1%)	20 (18.3%)	31 (31.0%)	19 (22.6%)	111 (24.2%)
Marital status (cases, %)						

Years	2015	2016	2017	2018	2019	Total
Married	76 (93.8%)	80 (94.1%)	106 (97.2%)	94 (20.5%)	77 (91.7%)	433 (94.3%)
Unmarried	5 (6.2%)	5 (5.9%)	3 (2.8%)	6 (6.0%)	6 (7.1%)	25 (5.5%)
Divorced	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.2%)	1 (0.2%)
Fracture segments (cases, %)						
Cervical	48 (59.3%)	62 (72.9%)	76 (69.7%)	67 (67.0%)	60 (71.4%)	313 (68.2%)
Thoracic	4 (4.9%)	1 (1.2%)	5 (4.6%)	6 (6.0%)	4 (4.8%)	20 (4.4%)
Thoracolumbar	23 (28.4%)	19 (22.4%)	23 (21.1%)	23 (23.0%)	18 (21.4%)	106 (23.1%)
Lumbosacral	6 (7.4%)	3 (3.5%)	5 (4.6%)	4 (4.0%)	2 (2.4%)	20 (4.4%)
ASIA classification (cases, %)						
A	13 (16.0%)	13 (15.3%)	15 (13.8%)	13 (13.0%)	9 (10.7%)	63 (13.7%)
B	2 (2.5%)	6 (7.1%)	6 (5.5%)	3 (3.0%)	1 (1.2%)	18 (3.9%)
C	12 (14.8%)	26 (30.6%)	27 (24.8%)	31 (31.0%)	25 (29.8%)	121 (26.4%)
D	45 (55.6%)	34 (40.0%)	52 (47.7%)	47 (47.0%)	42 (50.0%)	220 (47.9%)
E	9 (11.1%)	6 (7.1%)	9 (8.3%)	6 (6.0%)	7 (8.3%)	37 (8.1%)

Age of injury

Patient age

Among the TSCI patients included in our present study, those most vulnerable to TSCI were in the 50–59 year-old group (27.0%), followed by those in 40–49 year-old group (23.7%), 60–69 year-old group (19.0%), 30–39 year-old group (12.9%), 20–29 year-old group (7.4%), 70–79 year-old group (7.2%), ≥ 80 year-old group (1.5%), and 10–19 year-old group (1.3%).

Main cause of injury in different age groups

Main cause of injury was fall from height in the 10–49 year-old group, traffic accident in 50–79 year-old group, and low fall in the ≥ 80 year-old group (Fig. 1).

Cause of injury

Distribution of the cause of injury

Among all the TSCI patients, the most common cause of injury was traffic accident (37.0%), followed by fall from height (32.2%), low fall (19.6%), struck by object (7.2%), others (3.1%), and sports (0.9%) (Table 1). Among 170 TSCI patients injured in traffic accident, 61 patients (patients whose causes of accidents were clearly recorded) had been involved in traffic accident related to an electric moped (35.9%).

Cause of injuries in different sexes

More male than female TSCI patients accounted for all the causes of injury examined in this study, particularly for fall from height (124 males and 24 females). The difference in the male–female ratio was the smallest for injuries caused by low fall (56 males and 34 females). Among all the male patients with TSCI, the most common cause of injury was traffic accident (27.5%), followed by fall from height (27.0%); among female patients with TSCI, the most common cause of injury was also traffic accident (9.6%), followed by low fall (7.4%) (Fig. 2).

Fracture segments

Distribution of fracture segments

In general, the segment most vulnerable to fracture was the cervical segment (68.2%), followed by thoracolumbar segment (23.1%), thoracic segment (4.4%), and lumbosacral segment (4.4%). In terms of yearly distribution, the cervical segment was consistently the most likely to be fractured, followed by the thoracolumbar segment; the distributions of fractures for the thoracic and lumbosacral segments varied for different years (Table 1).

Different causes of injury in individual fracture segments

As shown in Fig. 3, the thoracolumbar segment (15.0%) was the site most frequently injured in fall from height, while the cervical segment was the site most commonly injured in the remaining causes of injury. The percentages of injury to the cervical segment caused by traffic accident, struck by object, low fall, sports, and others were 31.8, 3.5, 17.4, 0.9, and 2.1%, respectively.

Severity of injury

Most of the TSCI patients included in our present study were classified as ASIA Grade D (47.9%), followed by ASIA Grade C (26.4%) (see Table 1 for details).

Complications

Sixty-four patients with TSCI had complications, accounting for 13.9% of the total number of patients examined in this study. Urinary tract infection (48.3%) was the most common complication, followed by pulmonary infection (40.6%), and deep-vein thrombosis of the lower limbs (23.4%). Patients with two or

more complications accounted for 28.1% of all complications. Among the TSCI patients with one complication, patients who had bedsores had the longest hospital stay at 105 days. Patients with complications had significantly longer hospital stays than those without complications. Patients with multiple complications had longer hospital stays than those with a single complication (Table 2). Additionally, numerous patient records had missing data on complications because of incomplete documentation of these events.

Table 2
Number of patients with different complications and corresponding days of hospital stays.

Complications	n	Percentage (%)	Number of days in hospital
None	395	86.1	43.4
Deep vein thrombosis	10	2.2	64.2
Lung infection	13	2.8	85.4
Urinary tract infection	19	4.1	71.1
Bedsores	4	0.9	105.0
Deep vein thrombosis of lower limbs and lung infection	2	0.4	105.0
Deep vein thrombosis of lower limbs and urinary tract infection	2	0.4	165.0
Lung infection and urinary tract infection	5	1.1	144.0
Lung infection and bedsores	2	0.4	225.0
Lung infection and electrolyte disorders	1	0.2	60.0
Lung infection and bowel obstruction	1	0.2	90.0
Urinary tract infection and bedsores	1	0.2	240.0
Urinary tract infection and electrolyte disorders	2	0.4	202.5
Deep vein thrombosis of lower limbs, lung infection, and urinary tract infection	1	0.2	120.0
Lung infection, urinary tract infection, and electrolyte disorders	1	0.2	150.0
Total	459	100.0	51.1

Analysis of number of days in hospital and related conditions

Correlation between treatment regimens and length of hospital stays

Surgery was the main treatment used for the patients included in our cohort; among the 459 patients with TSCI included in our study, 378 patients received surgery, accounting for 82.4% of the total number of patients. Eighty-one patients received conservative treatment, accounting for 17.6% of the total number of patients. Average length of hospital stay for all the patients was 51.1 ± 79.4 days. The length of hospital stay for patients who had undergone surgical treatment (56.8 days on average) was significantly longer than that for patients who had undergone conservative treatment (24.1 days on average).

Correlation between ASIA classification and number of days in hospital

Patients with ASIA Grade A had the longest hospital stays (111.9 days), while patients with ASIA Grade E had the shortest hospital stays (21.4 days). Increased severity of TSCI correlated with increased length of hospital stays (Fig. 4).

Association between fragment segment and length of hospital stay

Patients with injuries of the thoracolumbar segment had the longest hospital stays of 73.2 days, followed by those with injuries of the thoracic segment (55.9 days), the cervical segment (44.5 days), and the lumbosacral segment (32.5 days).

Discussion

Epidemiology of traumatic spinal cord injury (TSCI) differs with respect to country, region, and time period. The mean age of TSCI occurrence in the developing countries is 32.4 years, and injury most common occurs in 20–30 year olds [6]. In recent years, the average age of patients with TSCI has been increasing, particularly in the developed countries [7]. A statistical study conducted in Norway in 2012–2016 showed that the 60–74 year-old age group was the most vulnerable to TSCI [8], while another study showed that the average age at the occurrence of TSCI was 55.5 years in the United States [9]. The aging of a national population is a serious problem worldwide. With continuous economic development and increasing life expectancy in China's population, the average age of TSCI is also increasing. The average age of TSCI patients in Beijing was 38.1 years old in 2002 and 40.2 years old in 2013–2019 [10]. Suzhou city has a large aging population that is increasing. In 2017, the average life expectancy of Suzhou residents reached 83.04 years. By the end of 2018, elderly persons over 60 years accounted for 26.0% of population in Suzhou, and even exceeded 30% in several districts and counties. The average age of TSCI patients evaluated in our present study was 50.7 years old, and 50–59 year-olds were the most vulnerable age group. In the Suzhou region, patients with TSCI showed an increasing trend in average age. Low fall was the second leading cause of TSCI among people aged 70 to 79 years, and were the leading cause of TSCI in patients over 80 years.

The following actions should be taken to address these trends. (1) First, we must increase our focus on these age groups, improve public education on TSCI, and advocate appropriate levels of calcium supplementation and exercise among the elderly. Research has shown that therapeutic exercise programs can reduce the fall rate and number of falls in the elderly [11]. Elderly patients having osteoporosis, or cervical and lumbar spine diseases, may need to avoid uneven or slippery roads during rain, snow, or

other hazardous weather. (2) Government should improve medical insurance options, especially for the elderly, and rationally allocate medical resources. (3) Because many elderly persons fall at home, safety should be considered in implementing home design for the elderly [3]. (4) Improved planning should be implemented for urban-road construction, and barrier-free road and green-transportation systems should also be improved. (5) Renovation of old and new village elevators should be promoted and emphasized, especially for patients who fall during the climbing of stairs. (6) In hospitals, specific intraoperative or rehabilitation plans should be made available to elderly patients with spinal cord injury, and corresponding manuals should be developed.

In recent years, low fall was recorded as the leading cause of TSCI in developed countries such as Japan [3], Italy [12], and New Zealand [13]. Globally, automobile accidents remain the leading cause of TSCI, especially in the developing countries [14]. The results obtained in our present study show that traffic accident was the main cause of TSCI, which was consistent with another study showing that traffic accident was the main cause of TSCI in Beijing in 2013–2019 [10]. Presently, vehicle ownership in Suzhou ranks as the fourth in China. It is necessary to increase penalties for traffic violations, such as those for driving while under the influence and running red lights. Additionally, it is vital that all drivers and passengers wear seat belts. It is also necessary to strengthen community education on safety, improve safety assessment and training in driving school, and emphasize safety awareness and observation of traffic rules for the public. Our study shows that 35.88% of automobile accidents involved electric bikes. Running red lights by non-motorized vehicles is also an important cause of traffic accidents. Illegal modification and assembly of electric bikes should be prohibited and strictly penalized, and registration of electric bikes should be required. The maximum speed of electric bikes should be restricted. Operators of non-motorized vehicles should not operate their vehicles while under the influence, and should be subject to the anti-drunk-driving laws applied to operators of motorized vehicles. All cyclists and passengers should be required to wear helmets.

The results obtained in this study show that after traffic accident, the second leading cause of TSCI was fall from height, especially in the 10–49 year-old group. This was determined as the most important cause of TSCI because urban construction, and the construction industry, in Suzhou are developing rapidly. The young and middle-aged populations are the main workers at numerous construction sites. It is, therefore, necessary to improve safety education for construction site managers and workers, including distribution of safety manuals and enforcing the wearing of safety helmets and ropes. Medical insurance options for these persons should also be improved, and safe construction should always be prioritized. Our study also shows that the thoracolumbar segment was the site most likely fractured in fall from height, which agrees with findings by Wang et al [15]. The chest and waist regions, which are usually in the lowest positions during falls from heights, receive the greatest impact force during these falls, thereby causing injuries with increased severity [15]. In addition, this segment of the population often constitutes the main labor force for families and societies; therefore, TSCI in these persons poses a heavy burden on families and societies.

A systematic review published in 2014 showed that the proportion of men with spinal-cord injury is higher than that of women [16]. A survey by Fanuel et al. showed that the ratio of male:female with cervical spinal cord trauma on Mount Kilimanjaro in Tanzania, Africa, is 6.5:1 [17], while that in Japan has remained 3:1 over the past 30 years [3]. A study by Chen et al. in China showed that the ratio of male:female with TSCI is 3.4:1 in the Guangdong Province [19]. Liu et al. reported that the ratio of male:female with TSCI is 4.73:1 in Beijing, China [19]. Our results indicate that the ratio of male:female with TSCI in Suzhou city was 3.1:1, indicating that more men than women accounted for all the causes of injury examined in this study. The difference in the proportion of men to women was the greatest for fall from height and smallest for low fall. This is mainly because men engage in more social activities, and in heavy-duty and high-risk jobs, than do women [20]. Thus, the difference between the sexes was the greatest for fall from height. While women are more prone to osteoporosis than are men, the difference in proportion of males to females was lowest for low fall.

A survey by Mitchell et al. showed that the cervical segment was the one injured most in New Zealand, accounting for 54% of the patient cohort examined that study [13]. In Beijing, the segment injured most in 2013–2019 was also the cervical segment, accounting for 44.1% of the total patient population, and showing an increase of 4.9%, compared with the percentage obtained in 2002 [10]. These results were also consistent with our findings. Due to the degeneration of cervical spine, rigidity of the vertebral joints, and ossification of the posterior longitudinal ligament, small external forces can easily cause considerable damage [21]. Moreover, the cervical spine has a large range of motion relative to that of the thoracolumbar spine, and when there are no protective measures for this anatomical region, cervical spinal cord injury is likely to occur in traffic accident [15]. Our study also shows that cervical spine was the segment most vulnerable to fracture in traffic accidents. Therefore, it is also important to wear a helmet during cycling. We should also focus on developing strategies to protect the cervical spine and performance of rehabilitation exercises.

Hao et al. reported that the proportion of patients with complete spinal cord injury (ASIA Grade A) was as high as 56.7% between April 1992 and August 2006 [4], while in this study, the proportion of patients with complete spinal cord injury was 13.7%; this discrepancy may be related to improvements in emergency first aid techniques used for individuals with spinal-cord injury, and advancements in early treatment by professional medical institutions, both of which reduce the disability caused by TSCI.

The data on complications of TSCI were often missing from the patient records reviewed in our present study. Evaluation of the complete statistical data available indicated that urinary tract infection was the most common complication, followed by lung infection and deep vein thrombosis of the lower limbs. Among patients with only one complication, the longest hospital stay was 105 days, observed in patients with bedsores. Patients with complications had longer hospital stays than those without complications. Patients with multiple complications had longer hospital stays that those with only one complication. Complications at late stages of spinal-cord injury are the main factors affecting the quality of life and life expectancy of patients with TSCI. Thus, treating complications and implementing early professional

rehabilitation are critical in reducing the mortality and improving the survival of these patients [21]. In developed countries, patients with spinal cord injury can receive continuous treatment for complications and individualized early rehabilitation, which reduces mortality, and improves self-sufficiency and quality of life, in this patient population [22]. The concept of early rehabilitation has been increasingly emphasized in China. Early postoperative rehabilitation, such as bladder-function training, joint mobility training, and cardiopulmonary training, will reduce the incidence of urinary tract infection, deep vein thrombosis in the lower limbs, and lung infections, respectively.

The results obtained in our present study indicate that average hospital stay was 51.1 days, and length of hospital stays was related to numerous factors. The ratio of surgical:conservative treatment in patients with TSCI was 4.7:1. Patients who received surgical treatment had longer hospital stays than those who received conservative treatment. Increased severity of ASIA-graded injury was related to increased length of hospitalization. In addition, patients with injuries in the thoracolumbar segment showed the longest hospital stays. The severity of spinal cord injury mainly depends on the degree of spinal cord compression at the moment of fracture generation, followed by factors such as location of the fracture and secondary spinal stenosis. Thus, the degree of spinal cord injury cannot be inferred based solely on fracture imaging data [23]. Thoracolumbar fractures result in high rates of disability. Short-term observations indicate that surgical treatment can reduce the total disability rate; however, the results obtained in patients with severe spinal cord injuries (including ASIA Grade A and ASIA Grade B cases) did not reach statistical significance [23]. Therefore, the degree and location of injury, and choice of surgical treatment, are likely closely related to the duration of hospitalization, and to the economic burden placed on families and societies.

Current options for the treatment of spinal cord injury are limited, which, in turn, limits the cure rate and highlights the importance of prevention [20]. Epidemiological analysis of TSCI can increase the public's awareness of TSCI-associated damage [24]. Previous epidemiologic studies of TSCI focused mainly on TSCI incidence and etiology, age and sex of the patients, and degree of injury to the spine [15]. In recent years, studies have identified high-risk groups, predicted TSCI-related trends, and focused on prevention of high-risk behaviors that can result in TSCI. Studies have also examined pre-hospital first aid and early postoperative rehabilitation in order to develop effective intervention measures for the prevention and treatment of TSCI, and for reasonable allocation of medical resources [22].

Conclusions

TSCI occurs most often in the elderly, and with the aging of the population, the incidence of TSCI is increasing. Our results indicate that while traffic accident was the main cause of TSCI, other causes of TSCI differed depending on the age group examined. Elderly patients showed a high rate of low fall. Male patients accounted for the majority of TSCI-related injuries, and men and women had different causes of TSCT. Neck injuries were relatively common, and injury sites varied according to the different causes of injury. Patients with TSCI showed prolonged hospital stays, which were related to numerous factors. Our

present study highlights the importance of prevention and treatment of various complications, and selection of optimal treatment modality, in patients with TSCI. Comprehensive prevention of TSCI based on its epidemiological characteristics should also implemented to reduce the burden of this condition on families and society.

Abbreviations

TSCI: Traumatic spinal cord injury; ASIA: American Spinal Injury Association

Declarations

Ethics approval and consent to participate

The study was approved by the ethical committee of First Affiliated Hospital of Soochow University. The patient data was anonymized in this study.

Availability of data and materials

The datasets generated during the current study are public at the email:738308604@qq.com.

Competing interests

The authors declare no conflict of interests.

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Authors' contributions

Weixing Yang designed this study.Shengjia Niu,Haibo Wang and Yue Liu collected the data.Dawei Zhang and Qingmei Chen analyzed the data. Shengjia Niu drafted the manuscript and Dawei Zhang revised paper content. Shengjia Niu,Weixing Yang and Dawei Zhang were responsible for conclusions.The authors read and approved the final manuscript.

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Figures

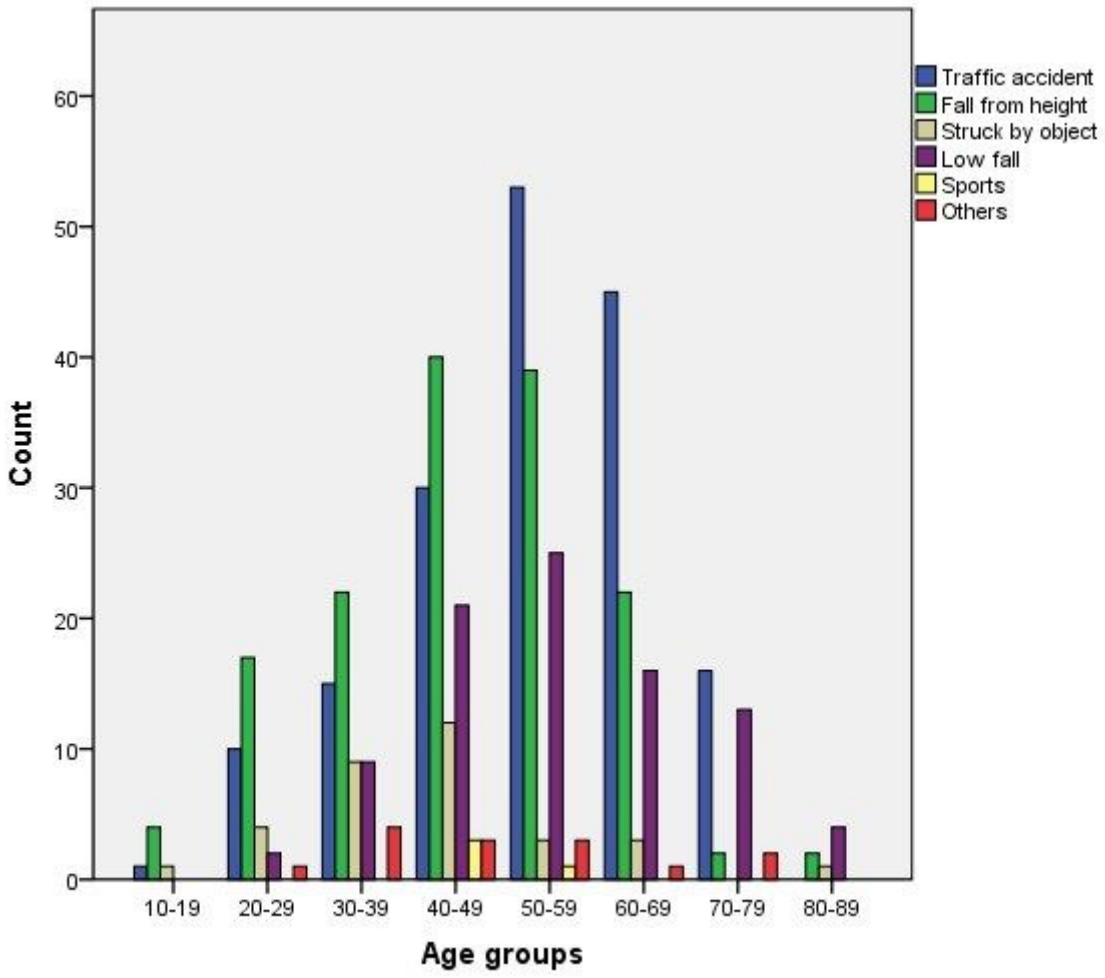

Figure 1

Distribution of causes of injury in different age groups.

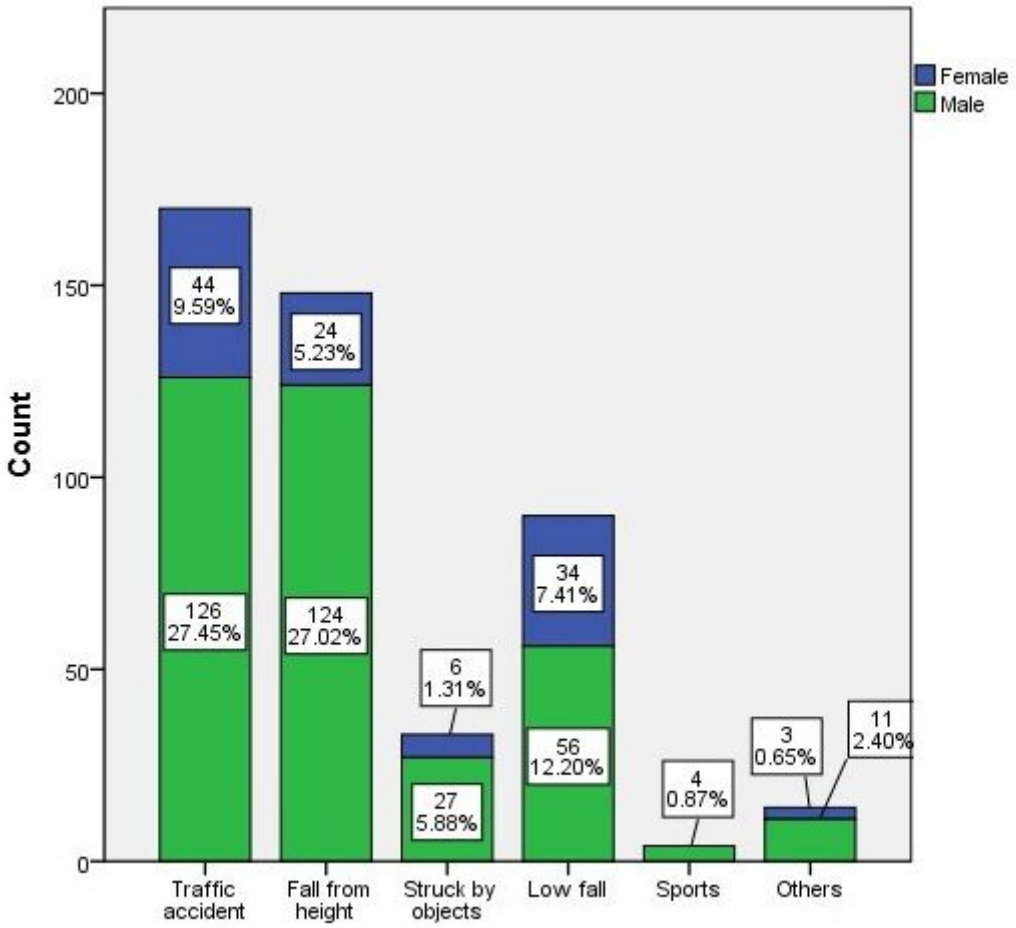

Figure 2

Distribution of causes of injury (number of cases and percentages) in different sexes.

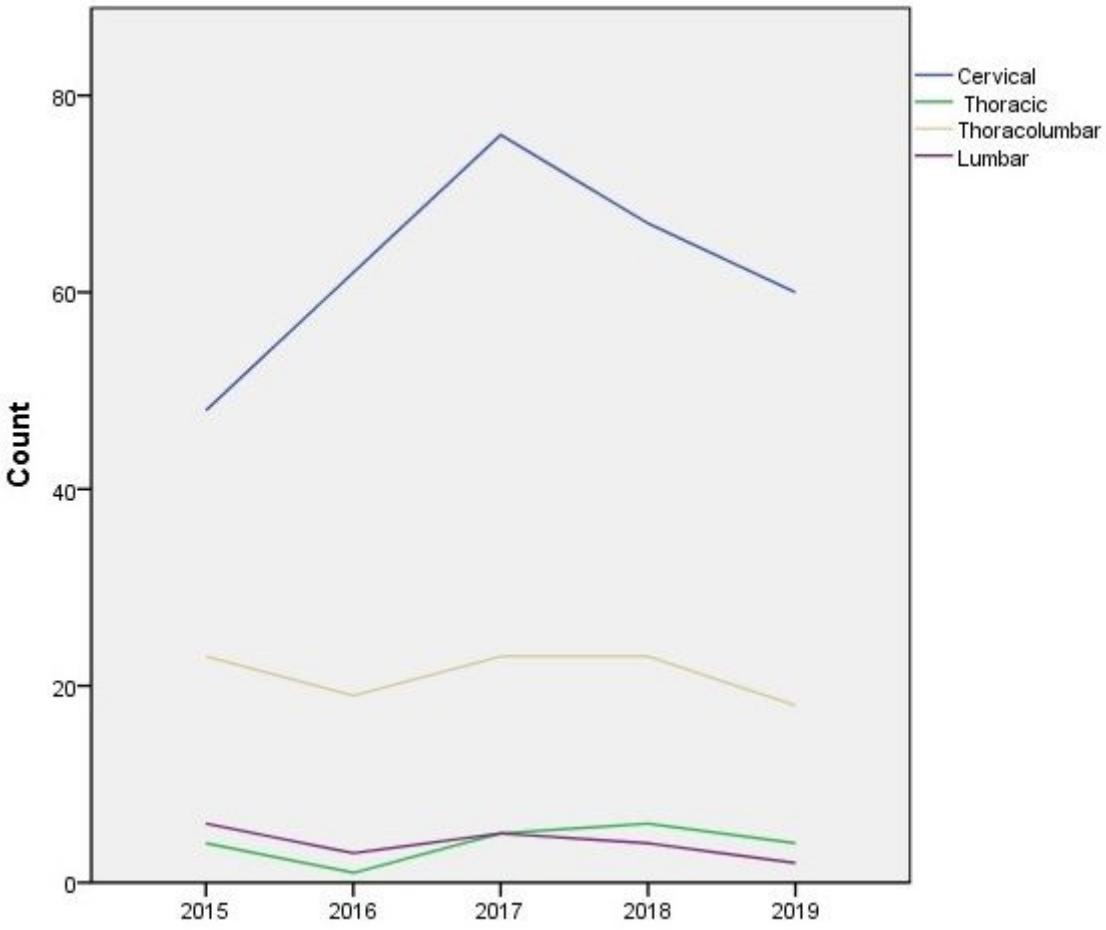

Figure 3

Distribution of causes of injury (number of cases and percentages) in different fracture segments.

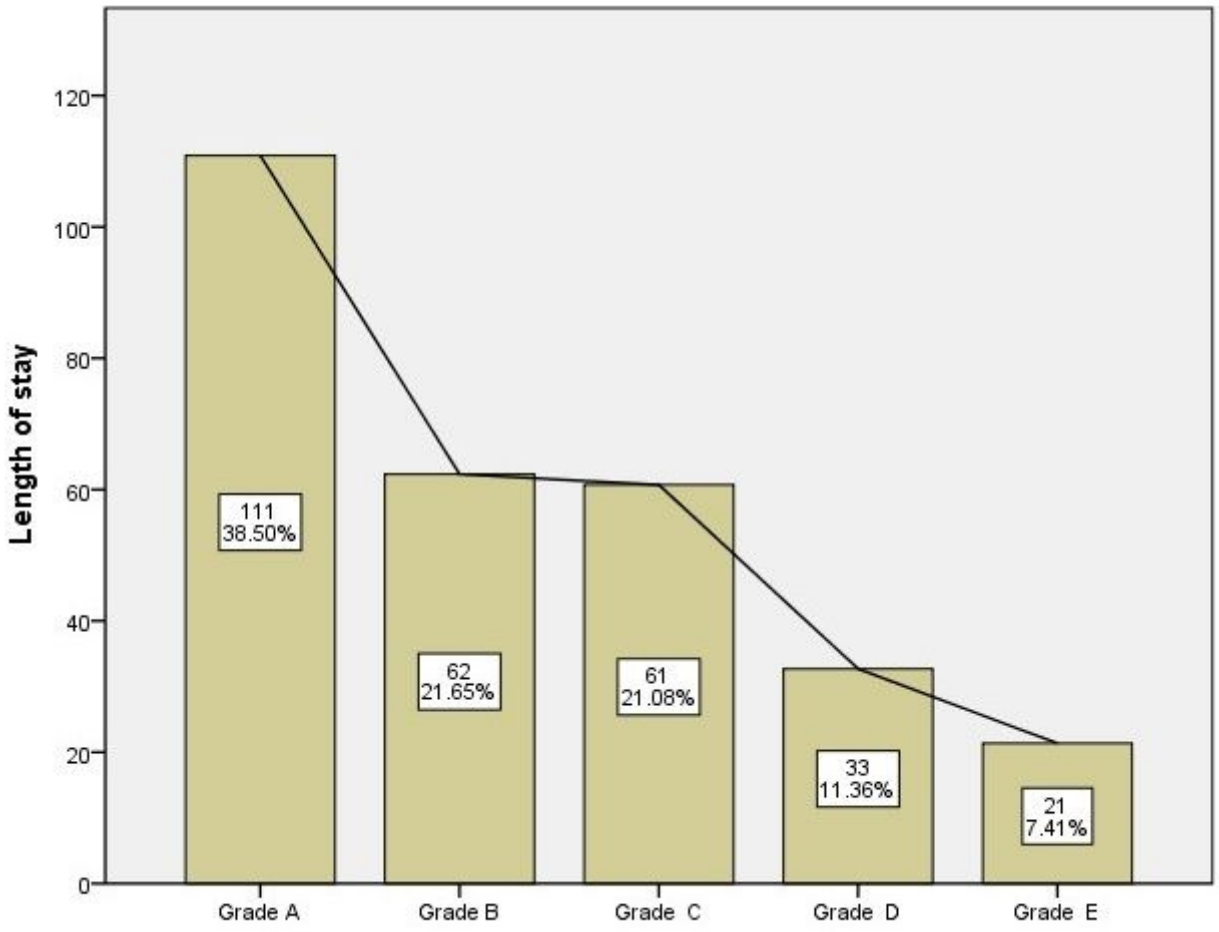

Figure 4

Relationship between hospital stays and ASIA classification.