Epidemiological Characteristics of Traumatic Spinal Cord Injuries in Multi-Center Retrospective Study in Northwest China, 2017-2020.

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Abstract

Introduction: Traumatic spinal cord injuries (TSCI) are worldwide public health problems. There has been a lack of extensive multi-center study of TSCI epidemiology in Northwest China in pre- and post-pandemic period of COVID-19.

Materials and Methods: A multi-center retrospective study of 14 hospitals of Northwest China was conducted on patients with TSCI between 2017 and 2020. Variables assessed included patient demographics, etiology, segmental distribution, treatment, waiting time for treatment and outcomes.

Results: The number of patients with TSCI showed an increasing trend from 2017 to 2019 while there were fewer patients in 2020 than in 2019. The male-to-female ratio was 3.67:1 and the mean age was 48 ± 14.9 . The major cause of TSCI was high fall (38.8%), low fall (27.7%), traffic accidents (23.9%), sports (2.6%) and others (7.0%). The segmental distribution showed a bimodal pattern, peak segments were C6 and T11, L1(14.7%) was the most frequently injured segments. Incomplete injury (72.8%) occurred more often than complete injury (27.2%). ASIA scale of most patients did not change before and after treatment both in operational or conservative group. 975 patients from urban and 1646 patients from rural areas were conducted, most urban residents could rush to get treatment after injured immediately (<1 h), whereas most rural patients get treatment spend several hours since injured. The rough annual incidence from 2017-2020 are 112.4, 143.4, 152.2 and 132.6 per million people calculated by the population-coverage-rate.

Conclusion: The incidence of TSCI in Northwest China is high and growing. However, under the pandemic policy reasons, it has decreased in 2020. The promotion of online work may be an effective primary prevention measures for trauma. Also, due to the distance from the hospitals with proper conditions, rural patients need to spend long time to there, the timely treatment of them should be paid attention.

Introduction

Traumatic spinal cord injuries (TSCI) can cause significant morbidity and mortality. [1] These injuries often caused by heavy injuries, traffic accidents, falling accidents, etc., and are centred occur in the range of the labor age population and elderly population. [2, 3] Despite the economic differences between countries or regions, this traumatic disease has caused a large loss of working population, imposing a serious economic burden to patients and families, and which lead to high health expenditure and economic losses.[4, 5] Unfortunately, there is currently no effective treatment for patients with TSCI – severe damage to the spinal cord usually means permanent impairment. [4, 6, 7] Therefore, attention should be paid to primary prevention. The understanding of injury risk factors, incidence and demographic characteristics can better guide the promotion of preventive measures and the allocation of medical resources. [8, 9]

The overall global incidence of TSCI was 10.5 cases per 100,000 persons, but the incidence of TSCI varies across countries and regions. [1] China is a country with rapid industrial development and frequent

traffic flow, this brings more injury-causing factors, and the spinal trauma caused by it also increases year by year. [10] Therefore, it is necessary to update Chinese TSCI incidence data in real time. However, most of the existing studies have focused on East China, while there has been a lack of extensive multi-center review of TSCI epidemiology in Northwest China in recent years. [6, 11–14] The level of economic development in Northwest China is far behind that in East and Mid-China region, and their characteristics of injury factors should be different, so its epidemiological data cannot fully refer to the data in East&Mid region.

In this study, we aimed to discuss the epidemiological characteristics and risk factors of TSCI in Northwest China. We used multi-center retrospective data from 2017-2020 to optimize previous studies by taking into account the impact of COVID-19 on society. [15]

Materials And Methods

Location and participants

Northwest China comprises five provinces or autonomous regions: Shaanxi, Gansu, Ningxia, Qinghai and Xinjiang, with a total population of 102.8 million. We chose Shaanxi and Qinghai, two provinces with representative development levels, as shown in figure 1a. Shaanxi Province (SN) is a traditional industrial and agricultural region, with a population of 38.8 million, Qinghai Province (QH) is an animal husbandry region rich in mineral resources, located in the northern part of the Qinghai-Tibet Plateau, with a population of 6.1 million. In order to better distribute the research work, Shaanxi is further divided into northern, central and southern parts (SN-N, SN-C, SN-S) according to climate and physiognomy. We dispatched investigators to the four regions separately and selected 3-4 hospitals with different administrative levels (provincial, municipal, county) in each region, a total of 14 hospitals, as shown in figure 1b. The patients' information was gathered from the medical records in these 14 hospitals during January 2017 and December 2020.

Study setting

Eligible patients are screened by International Classification of Diseases, Version 10 (ICD-10) and its diagnostic code of TSCI. The final diagnosis is based on the patient's diagnosis at discharge/death. Four researchers retrospectively reviewed the medical records of 2621 patients with TSCI admitted to the 14 hospitals in these two representative provinces. between 1st January 2017 and 31st December 2020. The acquired information from patients' medical records included the patients' name, age, gender, occupation, marital status, time of injury, cause of injury, level of injury, severity of injury, acceptance of surgical treatment, operative mode/approach, damaged segments, preoperative and postoperative scores, rehabilitation therapy, hospital duration, medical costs, and so on.

Executive Organization and Ethics Statement

This project is jointly undertaken by China Center for Disease Control (China CDC) and Honghui Hospital of Xi'an Jiaotong University. This study was approved by the ethics committee of Honghui Hospital of Xi'an Jiaotong University. The institutional review boards of the sampled hospitals approved the review process and waived the requirement to obtain patients' written informed consent. We confirm that all methods were performed in accordance with the Declaration of Helsinki.

Statistical Analysis

All numerical data conforming to normal distribution were expressed as the mean $\pm$ standard deviation (SD). The analysis of variance (ANOVA) and χ^2 tests were used to analyze continuous and categorical data, Wilcoxon rank-sum tests were applied to examine the differences between the non-normally distributed continuous variables, and frequency analysis was used for examining data and calculating percentages. The experimental data was used to analyzed by SPSS 22.0 (SPSS Inc, Chicago). The figures were made by GraphPad Prism7 (GraphPad Software, CA). $P < 0.05$ were considered as significant difference.

Results

General demographic characteristics of patients with TSCI from 2017-2020

A total of 2621 patients from 14 hospitals with TSCI were identified in this study (figure. 1b and figure. 2). As shown in Table 1, out of these patients with TSCI, 2060 were male (78.6%) and 561 were female (21.4%), the male-to-female ratio is close to 3.67:1. The patients' ages ranged from 6 to 92 years, with an average age of 48 (± 14.9) years and a median age of 49 [interquartile range (IQR:38)] years. Among them, 48.0 $\pm$ 14.9 years for men and 49.4 $\pm$ 14.9 years for women. According to the age distribution, it was found that young adults aged 21 to 40 make up half of the TSCI population (49.9%). Regarding the occupation, farmers and herdsmen from rural or pastoral areas account for more than half of the total patients (58.1%), and the patients from urban areas are mainly workers (11.8%), students (5.5%) and retirees (5.6%). The other occupational groups included government-officer (1.0%), technician (1.1%), Enterprise-managers (1.1%), Serviceman (0.2%) and others consisting of freelancers, unemployed individuals and self-employed individuals who together accounted for 6.9% of the total patients. In addition, 8.7% of patients were unwilling to inform their occupational information or for other reasons. Significantly, from 2017 to 2019, there were more patients each year than the previous year, while in 2020 there was a decrease of 12.9% compared with the number of patients in 2019 (figure. 2).

Table 1
Demographic and etiologic characteristics of patients with TSCI from 2017-2020

Characters	Years				
	2017	2018	2019	2020	Total
Total	546(20.8%)	694(26.5%)	738(28.1%)	643(24.5%)	2621(100%)
Age (Years)					
≤20	18(3.3%)	21(3.0%)	34(4.6%)	40(6.2%)	113(4.3%)
21-40	273(50.0%)	322(46.4%)	432(58.5%)	282(43.8%)	1309(49.9%)
41-60	105(19.2%)	185(26.7%)	140(19.0%)	117(18.3%)	547(20.9%)
≥61	150(27.5%)	166(23.9%)	132(17.9%)	204(31.7%)	652(24.9%)
Gender					
Male	460(84.2%)	538(77.5%)	585(79.3%)	477(74.2%)	2060(78.6%)
Female	86(15.8%)	156(22.5%)	153(20.7%)	166(25.8%)	561(21.4%)
Occupation					
Government-officer	17(3.1%)	4(0.6%)	0(0.0%)	5(0.8%)	26(1.0%)
Technician	1(0.2%)	9(1.3%)	18(2.4%)	0(0.0%)	28(1.1%)
Enterprise-manager	3(0.5%)	1(0.1%)	9(1.2%)	15(2.3%)	28(1.1%)
White-collar worker	22(4.0%)	4(0.6%)	1 (0.1%)	1(0.2%)	28(1.1%)
Blue-collar worker	51(9.3%)	73(10.5%)	98(13.3%)	59(9.2%)	281(10.7%)
Farmer and Nomad	310(56.8%)	421(60.7%)	413(56.0%)	378(58.8%)	1522(58.1%)
Student	42(7.7%)	17(2.4%)	30(4.1%)	54(8.4%)	143(5.5%)
Serviceman	2(0.4%)	0(0.0%)	4(0.5%)	0(0.0%)	6(0.2%)
Freelancer	0(0.0%)	16(2.3%)	11(1.5%)	0(0.0%)	27(1.0%)
Self-employed	10(1.8%)	3(0.4%)	34(4.6%)	46(7.2%)	93(3.5%)
Unemployed	0(0.0%)	6(0.9%)	21(2.8%)	37(5.8%)	64(2.4%)
Retired	43(7.9%)	32(4.6%)	31(4.2%)	40(6.2%)	146(5.6%)
Others	45(8.2%)	108(15.6%)	68(9.2%)	8(1.2%)	209(8.7%)

TSCI: Traumatic Spinal Cord Injuries.

Other* included patients who do not want to disclose information or whose information is not clearly documented

Characters	Years				
	2017	2018	2019	2020	Total
Etiology					
Traffic accidents	120(22.0%)	158(22.8%)	237(32.1%)	111(17.3%)	626(23.9%)
Sports and leisure	28(5.1%)	7(1.0%)	31(4.2%)	3(0.5%)	69(2.6%)
Slip fall and low fall	159(29.1%)	185(26.7%)	161(21.8%)	222(34.5%)	727(27.7%)
High fall	223(40.8%)	289(41.6%)	228(30.9%)	276(42.9%)	1016(38.8%)
Other Violence	16(2.9%)	55(7.9%)	81(11.0%)	31(4.8%)	183(7.0%)
TSCI: Traumatic Spinal Cord Injuries.					
Other* included patients who do not want to disclose information or whose information is not clearly documented					

Etiology of the patients with TSCI

Analysis of the acquired etiological data showed that High fall was the leading cause of TSCI, indicating 38.8% of total patients ($P < 0.05$). followed by slip fall & low fall (27.7%), traffic accidents (23.9%), sports (2.6%). Other violences include falling objects, violent fights and other collisions, they account for 7.0%. Table 2 shows the etiological composition ratio of TSCI in different age groups, in which there is no significant difference in etiological composition ratio between ≤ 20 years old, 21-40 years old and 61-40 years old groups ($P > 0.05$). However, the proportion of low energy injury factors (i.e. Slip fall or Low fall) was significantly higher in patients ≥ 61 years old than in other age groups ($P < 0.01$), nearly half (45.9%) of patients with TSCI over 60 years old are caused by this factor. Table 3 describes the etiological composition of patients of genders. High fall (43.6%) is the most common cause of male patients with TSCI, while slip fall / low fall (37.6%) is the most common cause female patients with TSCI.

Table 2
The etiological composition ratio of TSCI in different age groups

Age group	Etiology					Total
	Traffic accidents	Sports	Slip fall / Low fall	High fall	Other Violence	
≤20	30 (26.5%)	16 (14.2%)	33 (29.2%)	27 (23.9%)	7 (6.2%)	113 (100%)
21-40	326 (24.9%)	24 (1.8%)	239 (18.3%)	592 (45.2%)	128 (9.8%)	1309 (100%)
41-60	138 (25.2%)	15 (2.7%)	156 (28.5%)	203 (37.1%)	35 (6.4%)	547 (100%)
≥61	132 (20.2%)	14 (2.1%)	299 (45.9%)	194 (29.8%)	13 (2.0%)	652 (100%)
Total	626 (23.9%)	69 (2.6%)	727 (27.7%)	1016 (38.8%)	183 (7.0%)	2621 (100%)

Table 3
The etiological composition ratio of TSCI in male and female

Gender	Etiology					Total
	Traffic accidents	Sports	Slip fall / Low fall	High fall	Other Violence	
Male	439 (21.3%)	53 (2.6%)	516 (25.0%)	898 (43.6%)	154 (7.5%)	2060 (100%)
Female	187 (33.3%)	16 (2.9%)	211 (37.6%)	118 (21.0%)	29 (5.2%)	561 (100%)
Total	626 (23.9%)	69 (2.6%)	727 (27.7%)	1016 (38.8%)	183 (7.0%)	2621 (100%)

Injury Level

As can be seen from the statistics in Figure 3, TSCI occurred at the cervical, thoracic, lumbosacral levels, and the proportions in these levels were 33.0%, 36.8% and 30.2%, respectively. Count the number of cases per injury vertebral segment, there were 79.0 patients with single-level spinal fractures and 20.1% patients with multi-level (≥2 levels) spinal fractures. Figure 3 showed that the distribution of segmental injury cases showed a "bimodal" pattern, analysis of this data indicates that the two peak injury levels of TSCI

were C6 and T11 vertebra, Overall, L1, T12 and C6 were the most frequently injured segments, accounting for 14.7%, 12.2% and 8.2% of the total cases, respectively. Further, the injury types of each vertebral segment are divided into fracture-dislocation, distractive flexion fracture (Chance fracture), burst fracture and compression fracture. Roughly analysis, the majority fracture type of TSCI patients due to cervical injury is fracture-dislocation, which type accounts for 59.1% of cervical injuries; Compression fractures are more common in TSCI patients due to thoracic injury (exclude T12), which type accounts for 48.3% of thoracic injuries (exclude T12); the majority fracture type of TSCI patients due to lumbosacral injury (include T12) is burst fracture, which type accounts for 55.9% of thoracic injuries (include T12).

Severity of TSCI

The severity of patients with TSCI were divided into complete quadriplegia (CQ), incomplete quadriplegia (IQ), complete paraplegia (CP) and incomplete paraplegia (IP) according to the degree of injury as shown in figure 4a., The patients presenting with IQ accounted for most of all patients with TSCI, accounting for 39.53%. The next is IP, accounting for 33.27%. Patients suffered from complete injury included CQ and CP, they accounted for 21.10% and 6.10%, respectively. Admission assessment results using the ASIA scale system is shown in figure 4b. From the pie chart of patients with TSCI patients, 26.82% suffered from complete motor and sensory dysfunction (ASIA A), 11.22% patients detected as complete motor dysfunction and some part of the sensory function is retained (ASIA B), 24.23% patients have inefficient motor functions (myodynamia of most of key muscles < 3, ASIA C) and 37.73% patients remain useful motor functions (myodynamia of key muscles > 3, ASIA D).

The period between injury and admission

We recorded the patient's waiting time from injury to admission. According to the data characteristics, we counted the 975 patients from urban and 1646 patients from rural areas with TSCI separately in figure 5. It was observed that most urban residents (88% of 1646 patients) were able to rush to hospital for medical treatment within 1 hour of injury. When most patients (55.4% of 1646) with TSCI from rural areas arrived at regional hospitals which is qualified for treatment, 4-7 h had passed since the time of injury.

The annual count of TSCI patients form urban and rural

We divided the annual patient count into two groups: those from urban and those from rural areas. From 2017 to 2020, the annual number of urban patients was 185, 288, 323 and 172, which showed an increasing trend in the first three years, and decreased significantly in 2020 compared with 2019. From 2017 to 2020, the number of rural patients was 361, 406, 415 and 471, and the number of cases had been rising for four consecutive years.

Treatment of TSCI and status on discharge

In terms of the treatment that TSCI patients received, 2002 cases received operative treatment, 619 cases received conservative treatment. We regard the outcomes of the patients treated with operative treatment or conservative treatment as a whole. We can figure out the change in patients' condition after receiving one of the treatments from Table 4. Regardless of the treatment, about three-quarters of patients had no change in their ASIA scales before and after treatment, among them, in the patients who received surgical treatment accounted for 71.6%, in the patients who received conservative treatment accounted for 80%. If ASIA scale was improved than on admission but still at incomplete level (B/C/D), it would be regarded as improvement, with an improvement rate of 22.4% for those treated surgically, and the improvement rate for those treated conservatively was only 11.6%, about half of the former. Patients with ASIA scale of Grade E at discharge were considered cured, the cure rate of both methods was unsatisfactory, with 4.8% for operative treatment and 7.1% for conservative treatment. In addition, there are a few cases of deterioration or death.

Table 4
Treatment of TSCI and functional changes in discharge and admission

Treatment of TSCI	Status on discharge					
	Cure* ¹	Improvement* ²	Unchanged* ³	Deterioration* ⁴	Death	Total
Operative Treatment	97 (4.8%)	448 (22.4%)	1433 (71.6%)	11 (0.5%)	13 (0.6%)	2002 (100.0%)
Conservative Treatment	44 (7.1%)	72 (11.6%)	499 (80.6%)	0 (0.0%)	4 (0.6%)	619 (100.0%)
Total	141 (5.4%)	520 (19.8%)	1932 (73.7%)	11 (0.4%)	17 (0.6%)	2621 (100.0%)
* ¹ At discharge, ASIA scale reached E;						
* ² ASIA scale was improved than on admission but still at incomplete level (B/C/D);						
* ³ ASIA scale on admission and discharge were the same;						
* ⁴ ASIA scale was worse than on admission						

Estimation of TSCI incidence in Northwest China

We can only infer the whole from the approximate relationship between the number of beds in our sampling hospital and the regional population covered by them. By referring to the China Statistical Yearbook (<https://www.yearbookchina.com/>) from 2017 to 2020, we combined the bed data of the five

provinces in Northwest China and concluded that the average annual bed in Northwest China during the four years was 6.194 beds per thousand people. The total number of beds in the 14 sampled hospitals was about 30,000, so it is estimated that the hospitals could cover a population of $30,000/6.194 \times 10^{-3} = 4,843,397$. The four-year incidence rate of TSCI can be estimated as the ratio of TSCI patients number admitted by the hospital to the total population covered by the hospital. These hospitals treated 2,621 patients with TSCI in the four years from 2017 to 2020. If we use these samples to estimate the population, the four-year incidence rate of TSCI (per million people) was calculated to be 541.15 cases in the population covered by these hospitals. According to the survey data (Figure 2), the annual incidence rates from 2017 to 2020 are 112.4, 143.4, 152.2 and 132.6 per million people respectively.

Discussion

Northwest China is an economically backward region in China with low coverage of health insurance and educational level, but it is still developing rapidly. A large number of people are engaged in traditional manual labor or industrial production. Traffic factors and falls are both important injury factors for TSCI in labor force (industry, agriculture and husbandry). In the past, we have conducted single-center studies [15] However, despite its under-development with low population density, the total area of five provinces in northwest China is nearly 3.08 million square kilometers, which is a vast area covers about 1/3 land area of China. In order to get timely treatment, local patients usually choose a nearby medical center. Therefore, multi-center study in multiple regions can better represent the whole region than single-center research. We collected the data of patients with TSCI admitted to 14 hospitals located in QH, SN-N, SN-C, SN-S to understand the changes in the incidence of spinal cord injury patients before and after the emergence of COVID-19 (2017-2020). It can optimize the allocation of medical resources then provide timely healthcare to the population of more areas.

Annual count result demonstrated an increasing trend in TSCI patient count from 2017 to 2019, This trend is consistent with previous research findings.[6, 15, 16] Unusually, the patient count in 2020 was significantly lower than the previous year, there were 12.8% fewer patients in 2020 than in 2019. We speculate that this is due to the shutdown and some "work-at-home" proposals implemented by the Chinese government in the first two quarters of 2020 to prevent the COVID-19 epidemic. Recent studies of other traumatic diseases have reached similar conclusions.[17–19] In addition, from the perspective of patients from urban or rural areas, the impact of these policies on urban population is far greater than that of rural population, the number of patients in urban population in 2020 is only 53.3% of the last year, while the number of patients in rural areas in 2020 is still increasing compared with the previous year. We consider this to be related to the feasibility of shutdown policies and "work-at-home" proposals. In cities, where there are more office workers and students, it is easier to work or study online, which largely shields them from the exposure of many outdoor injury factors, while agricultural or livestock production is hard to move online. Another indication is that the proportion of patients aged over 60 in 2020 shows a significant increase. Due to bone degenerative changes and hypofunction of sensory and motor, non-traffic and low-energy injury factors are more likely to cause TSCI in elderly people Compared with young

and middle-aged people. [20, 21] Combined with the epidemic policy mentioned earlier, this evidence is consistent with our conclusions. Although the COVID-19 pandemic brings immeasurable economic losses and damages human health, it also facilitates the development of online work and learning, which makes it possible for many jobs to be performed online at home for a long time. From our conclusion, promoting online office work and learning will make a lot of sense to reduce the incidence of traumatic diseases among people at labor age, especially for urban resident.

In our investigation, the male to female ratio in patients with TSCI was 3.67:1, it is similar to the rate reported in other regions. [6, 14, 22] This indicates that most of the patients with TSCI are male. This can be attributed to the fact that most workers in dangerous, physically demanding jobs are male, and that a greater proportion of drivers are male, too.

Most of the injuries were in the 21-40 age group (49.9%, 1309 cases), followed by the ≥ 61 age group (24.9%, 652 cases) and 41-60 age group (20.9%, 547 cases). There are two age groups with high incidence. Such a "bimodal" trend seems to be different from the conclusions of previous studies. Most of the previous literatures described a "unimodal" trend with the highest age group around 40 ± 10 years old. [6, 23, 24] This may be due to the difference in group spacing and the increased incidence of the elderly under the 2020 epidemic policy. The mean age of patients in our data was 48 (± 14.9), which was higher than the domestic average age and global average age given by previous literatures. [10, 25] We estimate that this result may be influenced by the aging of society and the policy of delaying retirement time.

Our study also revealed the etiology of the patients with TSCI in Northwest China, included high falls (41.0%), traffic (23.9%), sports (2.6%), low fall (27.7%), high fall (38.8%) and other violence (7.0%). Groups were observed according to age firstly, we find that high energy injury factors, such as high fall, were the most common cause of TSCI in 21-40 and 41-60 age groups, accounting for 45.2% and 37.1%, respectively and for people over 60 years old, low energy factors, such as low falls or slips, accounted for 45.9% of the total cases. This is consistent with the conclusion of the study in Guangdong province. [6] Then groups were observed according to gender, result indicated that male group was more likely to have high energy factors causing TSCI.

Integrate the above etiological results, the age of high incidence of TSCI is still dominated by the labor age, especially male. So the labor security agencies of governments and the employers of workers should also strengthen labor safety measures and enhance safety education for employees. [13] In addition, the specialization and mechanization of agricultural and animal husbandry workers should be promoted so that dangerous and strenuous manual labour can be left to machines as far as possible.

Spinal cord injury is usually associated with spinal cord injury, and the levels of injury are corresponding. We counted the segments of the patient's vertebra and the types of fractures, it is the same as the previous literature, the proportions of injuries in cervical, thoracic and lumbar vertebra were similar, and the high incidence of spinal fracture caused by TSCI in each part was C5-C6, T11-T12, and L1-L2. The distribution of injury segments showed a "bimodal" distribution with C6 and L1 as the centers, with 1-2

adjacent segments. [23, 26] On the whole, the T11-L3 segment had the highest proportion of injuries, with a total of 1397 cases, accounting for 42.6% of all injured cases. The main fractural types of cervical, thoracic and lumbar vertebrae are also different, which is related to their anatomical structure and mechanical characteristics.

From the severity of the injury and the outcome of treatment, our results reveal a less optimistic condition after treatment. As a result of consensus, incomplete injury (72.8%) occurred more often than complete injury (27.2%). Given the large number of patients with incomplete TSCI, this issue should be the focus of basic research related to neural regeneration, such as "how to promote the compensation of surviving neurons in the injured area" or "how to achieve differentiation of uninjured stem cells into neurons in the incomplete injured segment". [27] ASIA scale of most patients did not change before and after treatment both in operational group (71.6%) or conservative group (80.6%). This illustrates the importance of prevention in improving tertiary prevention measures and rehabilitation techniques as an important guarantee of improved treatment outcomes. Moreover, the patients who were treated operationally had a higher improvement rate (22.4%) and deterioration rate (0.5%) than the patients who were treated conservatively (improvement rate is 11.6%, deterioration rate is 0.0%). Therefore, improving surgical methods on the basis of reducing postoperative complications is also a strategy to improve the efficacy of TSCI.

Our study also focused on urban-rural differences that had not previously been noticed by investigators. The annual difference in the number of cases was mentioned earlier, and we also compared the length of time between the onset and the treatment of patients in urban and rural areas. From our results, we can see that almost all urban residents can rush to the hospital for emergency treatment after get injured immediately (<1 h), whereas by the time most patients from rural areas arrive at the hospital for treatment, it has been 4 to 7 hours since they were injured. This reflects the delay in the treatment of patients caused by poor transport conditions in rural areas. In fact, some hospitals in developed areas are already using helicopter emergency medical service (HEMS) to save treatment time for patients in remote areas. [28] This kind of traffic measure is not restricted by the topography and is of great significance for patients with various acute diseases in rural areas such as the Loess Plateau and the Qinghai-Tibet Plateau in Northwest China. The problem is the high cost of HEMS, which also requires better allocation of resources and funding by the public health system.

Finally, we estimated the incidence of TSCI in Northwest China based on the hospital coverage population from 2017 – 2020, the incidence ranged from 112.2 to 152.4 cases per million people. That is higher than 23.7 per million people in Tianjin and 60.6 per million people in Beijing. [29, 30] The incidence of TSCI is difficult to calculate due to the unpredictability of the occurrence of trauma. Sampling methods, inclusion criteria, regional demographic differences and other factors will affect the results. Our estimated results only provide a reference for the incidence of TSCI in northwest China, and more scientific design and observational studies are needed to accurately obtain its incidence.

However, as a retrospective study, there are irreparable misrecords or incomplete information in the data we obtained, which may lead to deviation between our results and the actual situation. Furthermore, we ignore the data of treatment cost and medicare coverage, which can well reflect the economic pressure of patients and the development level of the region. Therefore, there is insufficient evidence in some descriptions of the severity of TSCI in Northwest China.

Conclusions

In general, we used multicenter sampling, which made our data more reflective of the overall situation in Northwest China, and we discussed the impact of COVID-19 disease control policies and rural-urban differences on TSCI incidence. In addition to the conclusions similar to other studies, we also have some findings worth exploring. Due to the implementation of COVID-19 prevention and control measures, the incidence of TSCI among urban residents has decreased to a certain extent. Therefore, we suggest that the promotion of online office and learning is the effective primary prevention measures for traumatic diseases. Besides, due to the differences between urban and rural areas, rural patients need to spend more time to get to the good conditional hospital for treatment, and the problem of emergency transfer service still needs to be addressed.

Abrasives

TSCI: Traumatic spinal cord injuries; COVID-19: Corona Virus Disease 2019; ASIA scale: American Spinal Injury Association impairment scale; ICD-10: International Classification of Diseases, Version 10; China CDC: China Center for Disease Control; HEMS: helicopter emergency medical service.

Declarations

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Figures

Figure 1

A total of 2621 patients from 14 hospitals in two provinces with TSCI were identified in this study (A) Sampling Provinces; (B) Sampling Regions for Multi-center Epidemiological Investigation.

Figure 2

The annual count of TSCI patients during 2017–2020.

Figure 3

Distribution of fracture level for TSCI patients by the type of fracture. (n=2621)

Figure 4

The severity of patients with TSCI: (A) The degree of injury; (B) Their spinal function after injury evaluated by ASIA impairment scale.

Figure 5

Urban and rural differences in patient treatment: (A) The patient's waiting time from injury to admission; (B) The annual count of TSCI patients form urban and rural.