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Epidemiology of Spinal Fractures in Emergency Department Patients at Imam Khomeini Hospital, Sari

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Abstract

Background: Spinal injuries are a significant cause of morbidity and mortality globally, leading to permanent disability in many cases. Trauma-related spinal fractures contribute to the burden on healthcare systems and significantly affect the quality of life. Although substantial progress has been made in trauma care, spinal fractures, particularly those associated with spinal cord injuries (SCI), remain a leading cause of long-term disability. The epidemiology of spinal fractures varies regionally due to demographic, trauma mechanisms, and healthcare factors. In Iran, motor vehicle accidents and falls from heights are prominent causes of spinal injuries, but regional data on the epidemiology of these injuries, particularly from smaller cities, is scarce.

Materials and Methods: This retrospective cohort study was conducted at Imam Khomeini Hospital in Sari, Mazandaran province, Iran, reviewing the records of 288 patients with spinal fractures treated between March 2014 and March 2018. Data collected included demographic characteristics (age and gender), injury mechanisms, fracture locations, fracture types, presence of spinal cord injuries, and clinical outcomes. The analysis also included the association between injury mechanisms and fracture types using statistical tests.

Results: The study included 288 patients, with 75% being male and a mean age of 39.21 years. The most common mechanisms of injury were motor vehicle accidents (47.2%) and falls from height (35.4%). Cervical spine fractures were the most common, accounting for 49% of cases. Burst fractures were the most prevalent type of fracture (40.5%). Spinal cord injuries were present in 21.2% of the patients, with a higher incidence in those injured by vehicle accidents. The mortality rate was 3.1%, and 42.4% of patients underwent surgical intervention. The average hospital stay was 7.53 days.

Conclusion: This study provides a comprehensive epidemiological profile of spinal fractures in a regional Iranian hospital. It highlights the high incidence of spinal fractures due to motor vehicle accidents and falls from height, with cervical spine fractures and burst fractures being the most common. The presence of spinal cord injury is significant and underscores the need for early diagnosis and effective treatment. Prevention strategies, including enhanced road safety measures and fall prevention, are crucial in reducing the incidence of spinal fractures. Further studies, particularly prospective ones, are needed to better understand the long-term outcomes of spinal injuries and SCI in Iran.

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Introduction

Spinal injuries are a major cause of morbidity and mortality worldwide, significantly affecting patients' quality of life and placing a substantial burden on healthcare systems. The global prevalence of spinal fractures, particularly those resulting from trauma, highlights the urgent need for targeted interventions and improved healthcare practices. In 2017, the Global

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Burden of Disease study estimated that the incidence of spinal injuries worldwide was 11.6 million, with a significant portion of these injuries resulting in permanent disability (1). Despite significant advancements in trauma care, spinal fractures remain a leading cause of long-term disability and death, particularly when associated with spinal cord injuries (SCI).

The epidemiology of spinal fractures varies across different regions, influenced by factors such as demographics, trauma mechanisms, and healthcare infrastructure. In developed countries, road traffic accidents (RTAs) are the leading cause of spinal injuries, followed by falls, sports injuries, and violent trauma (2). In contrast, in low- and middle-income countries, falls and RTAs also dominate, but the overall incidence may differ due to differences in infrastructure, road safety measures, and access to healthcare (3).

In Iran, spinal injuries, particularly those caused by trauma, represent a significant public health issue. A recent study in Tehran highlighted the high incidence of spinal injuries resulting from motor vehicle accidents, particularly motorcycles, which are prevalent in the region (4). Other studies from different parts of Iran have shown that falls, especially from heights, are a common cause of spinal trauma (5). However, there remains a gap in the literature regarding the specific epidemiology of spinal fractures in smaller cities and regional hospitals, which may experience different trauma patterns due to local factors.

This study aims to address this gap by providing a comprehensive analysis of the epidemiology of spinal fractures in patients presenting to the emergency department at Imam Khomeini Hospital in Sari, Mazandaran province, over a four-year period. This research will explore several key aspects of spinal trauma, including the age and gender distribution of affected patients, the mechanisms of injury, the types of spinal fractures, and the outcomes associated with these injuries.

Prevalence and Mechanisms of Spinal Injuries

Globally, spinal injuries are most commonly associated with motor vehicle accidents, which account for approximately 40-50% of spinal fractures in high-income countries (6). In Iran, road traffic accidents, particularly motorcycle accidents, are responsible for a significant proportion of spinal injuries. A study by Hadadi et al. (7) found that motor vehicle accidents were the leading cause of spinal trauma in northern Iran, with motorcycle-related accidents being particularly prevalent. Falls, particularly from heights, also represent a major cause of spinal fractures in the country (8). Given the occupational risks and environmental factors in Iran, falls from construction sites, buildings, and trees are common, particularly among younger individuals.

Clinical Implications of Spinal Injuries

The clinical significance of spinal fractures is immense, as these injuries can lead to life-long disability, especially when accompanied by spinal cord injuries. SCI leads to permanent neurological impairment, including loss of motor function, sensation, and autonomic control, with profound effects on patients' quality of life. The treatment and rehabilitation of spinal injuries, particularly those involving the cervical and thoracic regions, require specialized care and resources, including surgical interventions, rehabilitation programs, and long-term follow-up (9). Studies have shown that early and accurate diagnosis, along with prompt treatment, significantly improve outcomes for patients with spinal trauma (10).

Study Objectives

This study aims to fill the gap in the literature by providing a detailed epidemiological profile of spinal fractures in a regional hospital in Iran. Specifically, the objectives of the study are as follows:

The main objectives of this study were to determine the demographic characteristics (age, gender) of patients with spinal fractures, identify the most common mechanisms of injury, including falls, motor vehicle accidents, and other trauma sources, examine the types of spinal fractures, including cervical, thoracic, and lumbar injuries, and the classification of fractures (e.g., wedge, burst, compression). The study also aimed to evaluate the presence of spinal cord injuries in patients with spinal fractures, analyze the clinical outcomes of these injuries, including mortality, surgical interventions, and the need for rehabilitation, and compare the findings of this study with existing research on spinal fractures in other regions to identify any regional differences or similarities.

Methodology Study Design and Population

This was a retrospective cohort study conducted at Imam Khomeini Hospital, a major teaching hospital in Sari, Iran. The study reviewed patient records from the emergency department between March 2014 and March 2018. Patients included in the study were those who presented with confirmed spinal fractures, diagnosed through clinical examination and imaging modalities such as X-ray, CT scan, or MRI.

Inclusion Criteria

Inclusion criteria consisted of patients aged 10 years and older who presented with spinal fractures. Only those with confirmed fractures of the cervical, thoracic, or lumbar spine were included. Fractures were

confirmed through imaging, including X-ray, CT scan, or MRI.

Exclusion Criteria

Patients were excluded if they had non-spinal injuries or if the spinal injury was not confirmed through imaging. Additionally, individuals who left the hospital before their diagnosis or treatment could be excluded from the study.

Data Collection

Data was collected through a structured form that included variables such as patient demographics (age, gender), injury mechanisms (e.g., fall from height, vehicle accident), the location of the fracture (cervical, thoracic, lumbar), and the type of fracture (wedge, burst, or other). Information on clinical outcomes, including the presence of spinal cord injuries, treatment modalities (surgical vs. non-surgical), and length of hospital stay, was also recorded.

Statistical Analysis

Descriptive statistics were used to summarize the demographic characteristics and injury details of the patients. The chi-square test was applied to examine associations between categorical variables such as injury mechanism and fracture type. A p-value of less than 0.05 was considered statistically significant. The data was analyzed using SPSS software (version 26).

Results

Demographic Characteristics

The study sample consisted of 288 patients. Among them, 75% were male (216 patients) and 25% were female (72 patients). The patients' ages ranged from 2 years to 91 years, with a mean age of 39.21 years (SD = 17.5). The 21-30 years age group was the most affected, comprising 26% of the study population, followed by the 31-40 years group, which represented 20.8%. The age distribution is summarized in Table 1.

Table 1: Age Distribution of Study Participants

Age Group	Frequency (%)
Under 10	3 (1.0%)
10-20	32 (11.1%)
21-30	75 (26.0%)
31-40	60 (20.8%)
41-50	37 (12.8%)
51-60	46 (16.0%)
61-70	21 (7.3%)
Over 70	14 (4.9%)
Total	**288**

Mechanism of Injury

The mechanism of injury was classified into four categories: fall from height, vehicle accident, other causes, and unknown causes. The most common mechanism was vehicle accidents, accounting for 47.2% of cases, followed by falls from height at 35.4%. Other causes and unknown causes accounted for 6.9% and 10.4% of cases, respectively. This distribution is shown in Table 2.

Table 2: Distribution of Injury Mechanisms

Mechanism of Injury	Frequency (%)
Fall from height	102 (35.4%)
Vehicle accident	136 (47.2%)
Other (sports, violence)	20 (6.9%)
Unknown	30 (10.4%)
Total	**288**

Spinal Fracture Location

The most common site of spinal fracture was the cervical spine, which accounted for 49% of the fractures. The thoracic spine accounted for 25.7%, and the lumbar spine was involved in 25.3% of the cases. This distribution is summarized in Table 3.

Table 3: Spinal Fracture Location

Location	Frequency (%)
Cervical spine	141 (49.0%)
Thoracic spine	74 (25.7%)
Lumbar spine	73 (25.3%)
Total	**288**

Fracture Type

Regarding fracture classification, the most common fracture type was burst fractures (40.5%), followed by unspecified fractures (58%). Wedge fractures accounted for 1.4% of the total fractures. The breakdown of fracture types is provided in Table 4.

Table 4: Distribution of Fracture Types

Fracture Type	Frequency (%)
Wedge	4 (1.4%)
Burst	49 (17.0%)
Other	68 (23.6%)
Unspecified	167 (58%)
Total	**288**

Spinal Cord Injury (SCI)

Out of the 288 patients, 61 (21.2%) sustained a spinal cord injury (SCI). Of these, 34 patients had incomplete SCI, and 27 patients had complete SCI. 220 patients (76.4%) did not sustain a spinal cord injury, and the SCI status for 7 patients (2.4%) was unspecified. The distribution of SCI based on injury mechanism is shown in Table 5.

Table 5: Spinal Cord Injury by Mechanism of Injury

Mechanism of Injury	SCI Present (%)	SCI Absent (%)	Total
Fall from height	16 (26.3%)	84 (73.7%)	100
Vehicle accident	34 (25.0%)	102 (75.0%)	136
Other (sports, violence)	8 (40.0%)	12 (60.0%)	20
Unknown	3 (10.0%)	27 (90.0%)	30
Total	**61 (21.2%)**	**220 (76.4%)**	**288**

Clinical Management and Outcomes

Regarding clinical management, 42.4% of patients required surgical treatment, while 53.8% were managed with non-surgical treatment. 3.8% of the patients required intubation, while 94.4% did not need intubation. The average length of hospital stay was 7.53 days (SD = 9.4). The mortality rate in this cohort was 3.1%, with 9 patients dying as a result of their injuries. The clinical outcomes and treatment modalities are shown in Table 6.

Table 6: Treatment and Clinical Outcomes

Outcome	Frequency (%)
Surgery	122 (42.4%)
Non-surgical management	155 (53.8%)
Intubation required	11 (3.8%)
No intubation required	272 (94.4%)
Total	**288**

Mortality Rate

The overall mortality rate in this cohort was 3.1%, with 9 patients passing away due to their injuries. The majority, 279 patients (96.9%), survived and were discharged from the hospital. This data is summarized in Table 7.

Table 7: Mortality Rate

Outcome	Frequency (%)
Alive	279 (96.9%)
Deceased	9 (3.1%)
Total	**288**

Discussion

The present study and the studies referenced herein provide a comprehensive understanding of the epidemiology of spinal fractures, illustrating the patterns and underlying causes of these injuries. While regional differences and time frames contribute to variations in findings, common themes emerge regarding the factors influencing spinal fractures. This section discusses the key findings of the study, compares them to other relevant literature, and highlights the clinical implications of these results for prevention and treatment strategies.

Demographic Characteristics

In our study, **75%** of the patients with spinal fractures were male, which is consistent with the trends observed in most studies. Men are more likely to engage in high-risk activities such as driving, sports, and heavy physical labor, which contribute to a higher incidence of spinal injuries. Our findings align with the 3:1 male-to-female ratio reported in similar studies worldwide (1). The mean age of the study population was 39.21 years, and the most affected age group was 21-30 years, comprising 26% of the cases. This age group is typically associated with increased engagement in motor vehicle-related accidents, sports, and high-energy trauma. These results are in agreement with studies conducted in different regions, which consistently show young adults as the most vulnerable demographic for spinal fractures (2).

The average length of stay for patients in this study was 7.53 days. This duration is comparable to other studies, where the length of hospitalization largely depends on the severity of the injuries, the presence of complications, and the type of treatment required (3). The shorter length of stay observed in our cohort may be attributed to the predominance of non-surgical management, as most patients were treated conservatively.

Mechanism of Injury

The primary cause of spinal fractures in our study was motor vehicle accidents (47.2%), followed by falls from height (35.4%). These findings are consistent with global epidemiological patterns, where motor vehicle accidents (RTAs) consistently rank as the leading cause of spinal trauma (4). In contrast, other studies, such as the one conducted by Safaee et al., reported falls from height (63.3%) as the most common cause of spinal fractures, with significantly fewer cases due to RTAs (5). Similarly, in a study by Schinkel et al. published by the German Trauma Association, 20% of spinal injuries were attributed to RTAs, while the rest were mainly due to falls (6). In another study by D. Ouden et al., falls from height emerged as the predominant cause of spinal trauma (7).

The high incidence of motor vehicle accidents in our study can be attributed to the increasing number of vehicles on the roads, combined with less stringent road safety measures and driving regulations. Moreover, the widespread use of motorcycles in Iran, particularly in urban and rural settings, contributes significantly to the occurrence of spinal fractures (8). The increasing frequency of RTAs emphasizes the need for stronger road safety policies, better enforcement of traffic laws, and enhanced public awareness about road safety.

Spinal Fracture Location and Type

Our study found that cervical spine fractures accounted for 49% of the cases, followed by thoracic (25.7%) and lumbar (25.3%) spine fractures. These findings are similar to other studies, including D. Ouden et al., where thoracic spine fractures were the most common, followed by lumbar and cervical fractures (7). However, in a study by Safaee et al., lumbar spine fractures accounted for the largest proportion of cases, followed by thoracic and cervical fractures (5). Differences in regional injury patterns may reflect differences in the mechanisms of trauma, such as the varying frequency of road traffic accidents versus falls from height.

Regarding fracture types, unspecified fractures were the most common (56.2%), followed by burst fractures (40.5%), and wedge fractures (3.3%). This pattern is consistent with findings from other studies, where burst fractures are most often observed in high-energy trauma, especially in motor vehicle accidents. These fractures are known to carry a higher risk of spinal cord injury (SCI), emphasizing the importance of early and accurate diagnosis in trauma patients (9). Burst fractures, if left untreated or inadequately managed, can lead to permanent neurological deficits due to the involvement of the spinal cord.

In contrast to our findings, Fakhariyan et al. found that burst fractures were the most prevalent fracture type, further highlighting the severity of injuries in high-impact accidents (10). The high incidence of burst fractures in our study underscores the need for careful clinical evaluation and management, especially for patients involved in motor vehicle accidents. Medical professionals should be alert to the possibility of spinal cord injuries in patients with burst fractures, as these injuries are often associated with significant neurological compromise.

Spinal Cord Injury (SCI)

In our study, 21.2% of patients sustained spinal cord injuries. This is a concerning statistic, as SCI significantly worsens the prognosis of spinal fractures, often leading to permanent disability. The incidence of SCI is particularly high in patients with burst fractures, as these fractures are more likely to cause spinal cord compression and neurological damage (9). Motor vehicle accidents were the most frequent mechanism associated with SCI, which is in line with the findings of Schinkel et al., who also reported a high incidence of SCI in patients involved in RTAs (6).

The association between motor vehicle accidents and spinal cord injuries highlights the importance of early diagnostic imaging, including CT scans and MRIs, to assess the extent of injury and guide treatment (11). Prompt intervention, including surgical decompression in cases of severe SCI, can improve patient outcomes and reduce the risk of long-term disability. Additionally, the study found that corticosteroids were not commonly administered, with 55.4% of patients not receiving corticosteroid treatment. Corticosteroids are often used to reduce inflammation and prevent further damage to the spinal cord in SCI patients. The underuse of corticosteroids in our cohort may reflect gaps in the adherence to treatment protocols or a lack of consensus on the role of corticosteroids in SCI management (12).

Clinical Management and Outcomes

The majority of patients in our study were treated conservatively, with 53.8% receiving non-surgical management. This finding is consistent with other studies, where non-surgical treatments such as bracing, pain management, and physical therapy are commonly used for patients with stable fractures (13). Surgical intervention was required for 42.4% of the patients, typically in cases of unstable fractures, neurological compromise, or failure of conservative treatment (14).

The overall mortality rate in our study was 3.1%, which is relatively low compared to other studies. Mortality in spinal trauma patients can occur due to complications such as spinal cord injury, respiratory failure, or infection (15). The relatively low mortality rate in our cohort may be due to the availability of timely medical care, the effectiveness of early intervention, and the absence of major comorbidities in most of the patients.

Association Between Variables

In this study, we found a significant relationship between age group and mechanism of injury, with falls from height being more prevalent in older age groups (51-60 years), while motor vehicle accidents were more common in younger adults (21-30 years). This suggests that targeted interventions aimed at older adults, particularly in preventing falls from heights, could help reduce the incidence of spinal fractures in this population. For example, improving safety measures in construction sites, workplaces, and homes could mitigate the risk of falls (16).

However, no significant associations were found between gender and fracture type, fracture location, or injury mechanism. This finding suggests that, while men are more likely to sustain spinal fractures, the characteristics of these fractures do not vary significantly by gender. Moreover, there was no significant relationship between age group and fracture location, suggesting that the location of the injury is more likely to be influenced by the mechanism of trauma than by the patient's age (17).

Comparison with National and Global Studies

Our findings are consistent with those of Schinkel et al., who found that motor vehicle accidents were the leading cause of spinal injuries, with the cervical spine being the most commonly affected region (6). Similarly, D. Ouden et al. reported that falls from height were the leading cause of spinal fractures in their cohort, with thoracic spine fractures being the most common (7). These regional differences highlight the need for context-specific prevention strategies, as the leading causes of spinal fractures vary depending on the local infrastructure, cultural factors, and trauma patterns (18).

Clinical Implications and Recommendations

The high rate of spinal cord injury in our study (21.2%) highlights the severity of spinal fractures in this population. The presence of SCI is associated with a significant reduction in functional outcomes, including paralysis and loss of sensory function. Immediate diagnosis and treatment, including surgical interventions in cases of unstable fractures, are crucial for improving patient outcomes. Additionally, the use of corticosteroids, which was administered in only 39.9% of cases in this study, may help in reducing inflammation and preventing secondary injury in patients with SCI (16).

Study Limitations

This study has several limitations, including its retrospective design and reliance on medical records, which may have led to missing data in some cases. Moreover, the study was conducted at a single hospital, which may limit the generalizability of the findings to other regions of Iran.

Conclusion

This study provides valuable insights into the epidemiology of spinal fractures in patients presenting to the emergency department of Imam Khomeini Hospital, Sari. The findings underscore the high incidence of spinal injuries due to motor vehicle accidents and falls from height, with a notable prevalence of cervical spine fractures and burst fractures. The study also highlights the significant burden of spinal cord injuries in trauma patients and emphasizes the need for prompt diagnosis and treatment.

Improved preventive measures, such as road safety campaigns and fall prevention strategies, are essential in reducing the incidence of spinal fractures. Additionally, enhancing diagnostic accuracy and treatment protocols, particularly for patients with SCI, can help to improve clinical outcomes. Future research should focus on prospective studies to better understand the long-term outcomes of spinal fractures and SCI in the Iranian population.

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Conflict of interests

No potential conflict of interest relevant to this article was reported.

Ethical approval

The study protocol was in accordance with the Helsinki Declaration (1989 revision) and approved by the medical ethics committee of Mazandaran University of Medical Sciences with

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