The epidemiology of spinal fractures in a level 2 trauma center in Kuwait

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Abstract

Objectives: Spinal fractures are a public health issue with high morbidity and mortality, and significant social and economic impact. The burden of disease can be minimized through effective management and preventive strategies based on basic epidemiological figures. Therefore, this study aimed to establish the epidemiological figures for traumatic injuries of the spine, including prevalence and associated risk factors in Kuwait, one of the high-income countries in the Middle East region.

Methods: Using a retrospective design, the Orthopedic Admission Database of level II trauma center was reviewed from January 2018 to February 2020 for traumatic spinal fractures.

Results: The study included 564 patients with 788 fractures, and from this sample, 162 patients sustained vertebral fractures at 181 different vertebral anatomical areas, resulting in 28.72% prevalence rate for spinal fractures; the mean age was 37.10 (SD = 18.25) years old; 79.2% were men, and 57.8% were Kuwaitis. The most prevalent mechanism of injury was road traffic accidents at 54.5%, and the lumbar spine was the most prevalent fracture site, followed by the thoracic spine at 47.5% and 31.5%, respectively. The mortality rate associated with spinal fractures is 42.10% from trauma cases admitted to the intensive care unit. Patients' sex, nationality, fracture anatomical site, and the mechanism of injury were identified as risk factors (p < 0.05).

Conclusion: The established epidemiological figures for spinal fractures can be used to direct management and preventive strategies and assist health care planning and delivery.

Level of Evidence: III

Keywords

Fractures, prevalence, spine

Highlights

- The epidemiology of spinal fractures has been studied in the Middle East region in a middle-income countries.
- The current study has established essential epidemiological figures for spine fractures in the Middle East region in a high-income country.
- The established epidemiological figures for spine fractures can effectively direct future management and preventive plans and strategies.

Introduction

Spinal fractures are considered a major public health issue due to their high morbidity and mortality rates, with significant socioeconomic burden.[1–4] More than 10% of the trauma patients that sustained spinal injuries was as a result of road traffic accidents (RTAs) among the younger population, and from low-impact falls in the older population.[5] The global incidence of traumatic spinal fractures is 10.5 cases per 100,000 persons, with an estimated 768,473 new cases annually worldwide.[6] The 1-year cost for spinal accidents has been estimated to be EUR 22 million, mainly resulting from medical and related costs of productivity loss due to death or disability.[7–11] The complexity of spinal fractures is related to their significant association with neurological injuries, osteoporosis, and aging, resulting in poor functional outcomes and significant quality of life impairment.[3,4] It has been

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reported that 49% of patients with spinal fractures require operative intervention, which could significantly impact the well-being of the patient, both socially and financially.[6,12–14]

The multidimensional burden of spinal fractures can be controlled by optimizing the strategic planning of management and prevention. For example, the outcome of traumatic injuries can be improved by advancing trauma systems through developing specialized trauma centers.[7,15] However, health care planning requires epidemiological studies that explore prevalence rates and associated risk factors to formulate the figures and direct future plans. Despite the significant complexity and consequences of spinal fractures, few epidemiological studies are available, and the burden of traumatic spinal injuries is poorly understood.[6] Moreover, basing health care planning on epidemiological studies is significantly related to the context of various populations and their unique social, cultural, economic, legal, and institutional characteristics.[16] Such factors make decision making in some countries more difficult for policy makers and stakeholders, especially where population-based studies are not available. The most recent systematic review and meta-analysis exploring the worldwide epidemiological figures for traumatic spinal injuries has highlighted the need for local and regional explorations to determine their incidence and etiological factors.[6] In addition, the epidemiological figures can change over time, depending on the changes in population demographics, traffic safety, and medical management.[17]

The Middle East presents a unique context, and it is described by the World Health Organization as a distinct region in the world. However, the literature is limited in epidemiological studies of traumatic injuries of the spine in the Middle East region. Yet such epidemiological figures are important to assess the burden of spinal fractures in the Middle East region in order to develop national and international preventive polices and create an effective health care workforce and systems. Only two studies are available that have explored the epidemiology of spinal fractures in the region, and both were conducted in Iran, therefore representing middle-income countries.[18,19] Based on the available literature, a recent meta-analysis has estimated the incidence rate of traumatic spinal injuries in the Middle East region to be 5.2 per 100,100 persons.[6] However, this figure reflects middle-income countries only. More importantly, the mechanism of injury varies between countries, as RTAs are more prevalent in developed countries, while falling incidents are more prevalent in developing countries.[6] Therefore, epidemiological figures for spinal fractures need to be established for the Middle East region that reflect its high-income countries.

Kuwait can be taken as an example to reflect the epidemiological characteristics of higher income countries in the Middle East region. More importantly, RTAs and falling from height are the most prevalent causes of death in Kuwait, at 64.6% and 13.1%, respectively.[20] These high epidemic figures for accidents, and the fast-growing population in the Middle East in general, requires regional epidemiological studies to determine and understand the burden of spinal fractures and direct health care planning strategies. Therefore, the objective of this study is to establish the epidemiological figures for spinal fractures in Kuwait as one of the high-income countries in the Middle East region. The study aims to explore the prevalence rate, mortality, and associated risk factors of spinal fractures. Ultimately, this will support establishing benchmarks to direct national management and preventive strategies and assist health care planning and delivery.

Materials and methods

Study design and setting

Ethical approval was obtained from the Ethics Board of the Kuwait Ministry of Health (ref: 2019/1198) in accordance with the Declaration of Helsinki. No contact with patients was required; however, patients' privacy of personal information was maintained. The study started in March 2020 and ended in February 2021.

A retrospective research design involving non-probability convenience sampling was used.[21] The epidemiology of spinal fractures from January 2018 to February 2020 was analyzed by reviewing the Orthopedic Admission Database of Al-Adan Hospital. Al-Adan Hospital is a level II trauma center, which covers one of six health regions in Kuwait; Al-Ahmadi Governance Health Region serves 1.2 million people from the Kuwaiti population, bearing in mind that Kuwait's total population is 4.2 million. Al-Adan hospital is the main and only hospital serving the population of Al-Ahmadi Governance Health Region. Using the method of convenience sampling, the study included samples from the years 2018, 2019, and 2020. The sample for the year 2020 is before COVID-19 was announced as a pandemic in Kuwait, and prior to the Kuwait Ministry of Health applying restriction measures. Including a sample from the period of the COVID-19 pandemic might have risked the generalizability of the study, as curfews and quarantines were applied nationally, which would have altered the epidemiology of fractures, including both prevalence figures and associated risk.[22] All trauma patients admitted from January 2018 to February 2020 were included: men and women, adults and pediatrics, and Kuwaiti and non-Kuwaiti patients. The exclusion criteria was (1) patients initially resuscitated or managed in other hospitals, (2) patients transferred from other hospitals, and (3) patients who were brain dead upon arrival. These types of patients were excluded because they are not registered on the database used.

Data collection

The Orthopedic Admission Database of Al-Adan Hospital was reviewed, which is a chart filled in on a daily basis by

an orthopedic registrar for the admissions to the Orthopedics Department for management purposes, where X-ray and computed tomography are routinely used to diagnose spinal fractures. The medical records and radiology system were checked to compensate for any missing data. A dedicated excel sheet was used for data collection, including demographic information on age, gender, and nationality: Kuwaiti or non-Kuwaiti. The anatomical site of the fracture and the mechanism of injury were recorded. The anatomical sites of the spinal fractures included were cervical, thoracic, lumbar, sacral, and coccyx fractures. The fracture site was also recorded with consideration of the thoracolumbar junction, and the subcategories were thoracic (T1–T12), thoracolumbar junction (T10–L2) and lower lumbar (L3–L5). The mechanism of injury was divided into RTA, falling down, falling from height, motorcycle accident, fall of a heavy object, knocked over by a car, and assault. The type of fracture and the management approach were recorded, and the mortality rate was also retrieved. Sub-analysis was conducted for the variables explored, including the patients' nationality and comparing between Kuwaitis and non-Kuwaitis.

Statistical analysis

Statistical Package for Social Sciences (SPSS) was used for the statistical analysis (Version 23, IBM Corp., Armonk, NY, USA). In terms of descriptive statistics, means and standard deviations were used for continuous variables, and percentages were used for categorical variables.[23,24] Chi-square testing was used to assess the relationship between the variables and to explore the risk factors. A p value of <0.05 was defined as statistically significant.[23,24]

Results

4270 patients were admitted to the Orthopedics Department of Al-Adan Hospital from January 2018 to February 2020. The study included 564 patients with 788 traumatic injuries, presenting a sample size of 13.2% from the total admissions. A total of 162 patients in the cohort sustained a vertebral fracture at 181 different vertebral anatomical levels in terms of cervical, thoracic, lumbar, sacrum, and coccyx, resulting in a prevalence rate of 28.72% in regard to the total patient number, and 22.96% in regard to the total number of traumatic injuries per anatomical site. In terms of demographic characteristics, the patients' mean age (standard deviation) was 37.10 (18.25) years. The gender distribution was 79.2% men, and 57.8% of the patients were Kuwaitis (Table 1).

The most prevalent fracture site of the spine was the lumbar spine at 47.5%, followed by the thoracic spine at 31.5%, then cervical fractures at 15.5% (Table 1). Analyzing the prevalence rate by considering the thoracolumbar junction,

the most prevalent fracture site was the thoracolumbar junction at 39.9%, followed by the thoracic (T1–T12) at 27.2%, and then the lower lumbar (L3–L5) at 12.1%. The most common mechanism of injury was RTA at 54.5% (Table 1 and Figures 1 and 2); 30.9% of the vertebral fractures sustained were associated with other fractures, and 43.2% of spinal fractures required operative management (Table 1 and Figures 3 and 4). Compression fractures were the most prevalent at 46.7%. Burst fractures form 12.4%, fracture-dislocation type forms 4.7%, and chance fractures form 3.6%. Other types of fractures form 32.5%, such as fractures to the transverse and spinous processes. Significant association was found between the fracture type and the management provided (p=0.001). Operative management was provided for 40.5% of compression fractures, 100.0% for burst fractures, 100.0% for fracture-dislocation, and 83.3% for chance fractures.

The results show that 80.1% of the patients had no other injuries; however, splenic injury and being intubated were the most prevalent at 3.0% for each (Table 1). In addition, 25.3% of the patients required immediate admission to the intensive care unit or the operating theater. The chi-square test suggests statistically significant relationships between age-specific group and sex, nationality, the fracture's anatomical site, and the mechanism of injury; all ps < 0.05 (Table 1 and Figure 5). The prevalence rates of vertebral fractures per anatomical injuries were 3.55% for cervical fractures, 7.23% for thoracic fractures, 10.91% for lumbar fractures, 1.14% for sacrum fractures, and 0.12% for coccyx fractures (Table 2). From January 2018 to February 2020, 441 orthopedic cases were admitted to the intensive care unit with trauma-related injuries, where 57 deaths were recorded, and 24 deaths were associated with spinal fractures, resulting in a mortality rate of 42.10%; yet no mortality was recorded for patients with isolated spinal fractures.

Significant association was identified between nationality (Kuwaitis and non-Kuwaitis) and the mechanism of injury (p=0.001), where spinal fractures among Kuwaitis mainly resulted from RTA (58.8%) and falling down (24.7%), while spinal fractures among non-Kuwaitis mainly resulted from RTA (44.3%) and FFH (42.6%). Significant association was found between nationality and age group (p=0.001). In particular, a higher number of spinal fractures were found among the non-Kuwaiti patients between the age of 19 and 49 years (71.2%) compared to the Kuwaiti patients (48.2%), while below the age of 18 years, a higher number of spinal fractures were found among Kuwaitis (27.7%) when compared to non-Kuwaitis (0.00%). The anatomical site of the fracture was significantly associated with nationality (p=0.004), as the most frequent fracture site of the spine among Kuwaitis was the thoracic at 36.0% followed by the lumbar at 34.8% then the cervical at 22.5%; while the most frequent spinal fracture site among the non-Kuwaitis was the

Table 1. Demographic and clinical characteristics of patients with spinal fractures stratified per age group.

	All age groups n = 146	≤18 years old n = 23	19–49 years old n = 86	≥50 years old n = 37	Pearson chi-square between age group
Age mean (SD) years old	37.10 (18.25)	14.26 (4.12)	31.93 (8.10)	62.05 (10.32)	–
Sex	79.2% men 20.8% women	86.95% men 13.04% women	86.04% men 13.95% women	54.05% men 45.95% women	0.001*
Nationality	57.8% Kty 42.2% Nkty	100% Kty	48.78% Kty 51.21% Nkty	54.05% Kty 45.95% Nkty	0.001*
Prevalence rate	22.96%	15.8%	58.9%	25.3%	–
Cervical Fr	15.5%	17.39%	22.09%	2.7%	0.036*
Thoracic Fr	31.5%	52.17%	30.23%	24.32%	
Lumbar Fr	47.5%	26.08%	43.02%	64.86%	
Sacrum Fr	5.0%	4.34%	3.48%	8.10%	
Coccyx Fr	0.6%	0.0%	1.16%	0.0%	
Mechanism of injury	RTA 54.5% Fall down 17.5% FFH 18.2% Motorcycle accident 4.5% Fall heavy object over 0.6% Knocked by a car 2.6% Assault 1.3% Traumatic torticollis 0.6%	RTA 54.54% Fall down 22.72% Motorcycle accident 13.63% Assault 4.54% Traumatic torticollis 4.54%	RTA 60.49% Fall down 4.93% FFH 27.16% Motorcycle accident 4.93% Knocked by a car 1.23% Assault 1.23%	RTA 28.57% Fall down 45.71% FFH 17.14% Fall heavy object over 2.85% Knocked by a car 5.7%	0.001*
Association with other trauma (not spine)	Yes 30.9%	Yes 21.73%	Yes 36.04%	Yes 29.72%	0.399
	No 69.1%	No 78.26%	No 63.95%	No 70.27%	
Other injuries	No other injuries 80.1% Spleen injury 3.0% Lung contusion 0.6% Head injury 2.4% Intubated 3.0% Pneumothorax 2.4% Hemothorax 3.0% Semiconscious 0.6% Liver tear 2.4% Subgaleal hematoma 0.6% Ventricular hemorrhage 0.6% Chest trauma 0.6% Bladder rupture 0.6%	No other injuries 82.60 % Spleen injury 4.34% Pneumothorax 13.04%	No other injuries 82.55% Spleen injury 3.48%% Lung contusion 1.16%% Head injury 3.48% Intubated 3.48% Hemothorax 2.32% Liver tear 1.16% Subgaleal hematoma 1.16% Chest trauma 1.16%	No other injuries 81.08% Head injury 2.70% Intubated 2.70% Hemothorax 5.40% Semiconscious 2.70% Liver tear 5.40%	0.096
Management	Operative 43.2% Conservative 56.8%	Operative 47.8% Conservative 52.2%	Operative 47.7% Conservative 52.3%	Operative 32.4% Conservative 67.6%	0.270
Spinal cord involvement	Yes 3.1% No 96.9%	Yes 0.00% No 100%	Yes 4.65% No 95.34%	Yes 2.70% No 97.29%	0.531
Multi-vertebral fracture	Yes 42.2% No 57.8%	Yes 26.08% No 73.91%	Yes 43.02% No 56.97%	Yes 32.43% No 67.56%	0.247
Mean (SD) Number of vertebral fractures at the same spinal anatomical level	1.57 (0.83) vertebra Min 1.00 Max 4.00 57.5% one Vertebra 26.0% two Vertebra 10.5% 3 Vertebra 6.1% 4 Vertebra	1.52 (0.92) vertebra Min 1 Max 4	1.67 (0.90) vertebra Min 1 Max 4	1.40 (0.60) vertebra Min 1 Max 3	0.262
ICU/OR direct admission	Yes 25.3% No 74.7%	Yes 27.27% No 72.72%	Yes 29.41% No 70.58%	Yes 16.66% No 83.33%	0.338

SD: standard deviation; Fr: fracture; Kty: Kuwaiti; Nkty: non-Kuwaiti; RTA: road traffic accident; FFH: fall from height; ICU: intensive care unit; OR: operating theater.

*Refers to statistically significant correlation between each age group and the variable cross-named in each row at a significance level of p < 0.05.
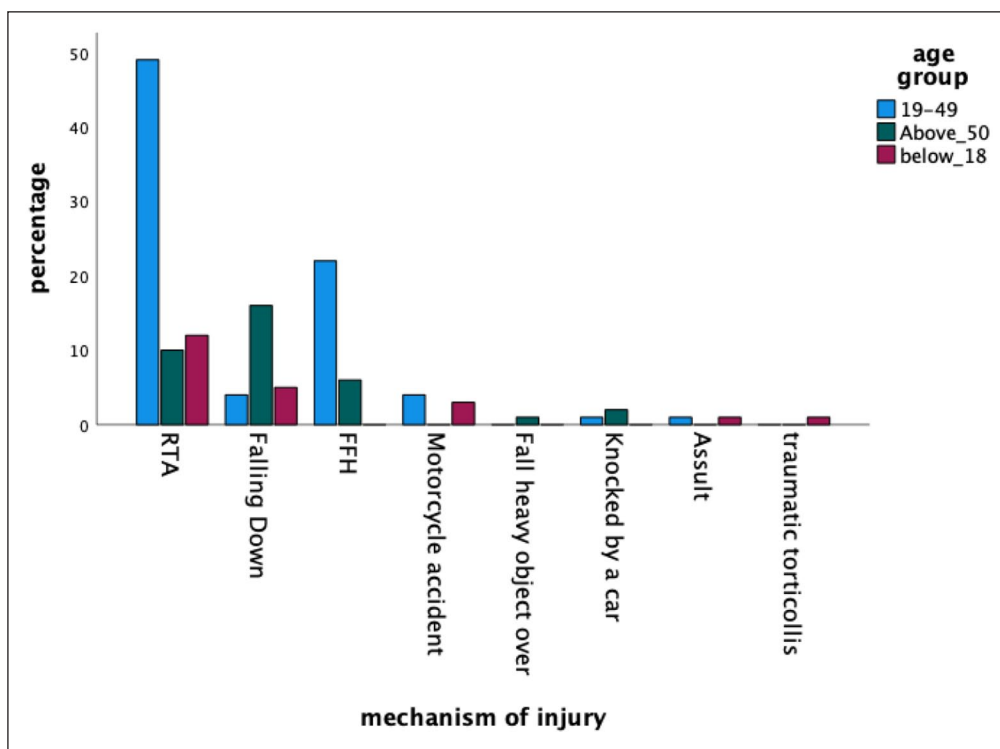
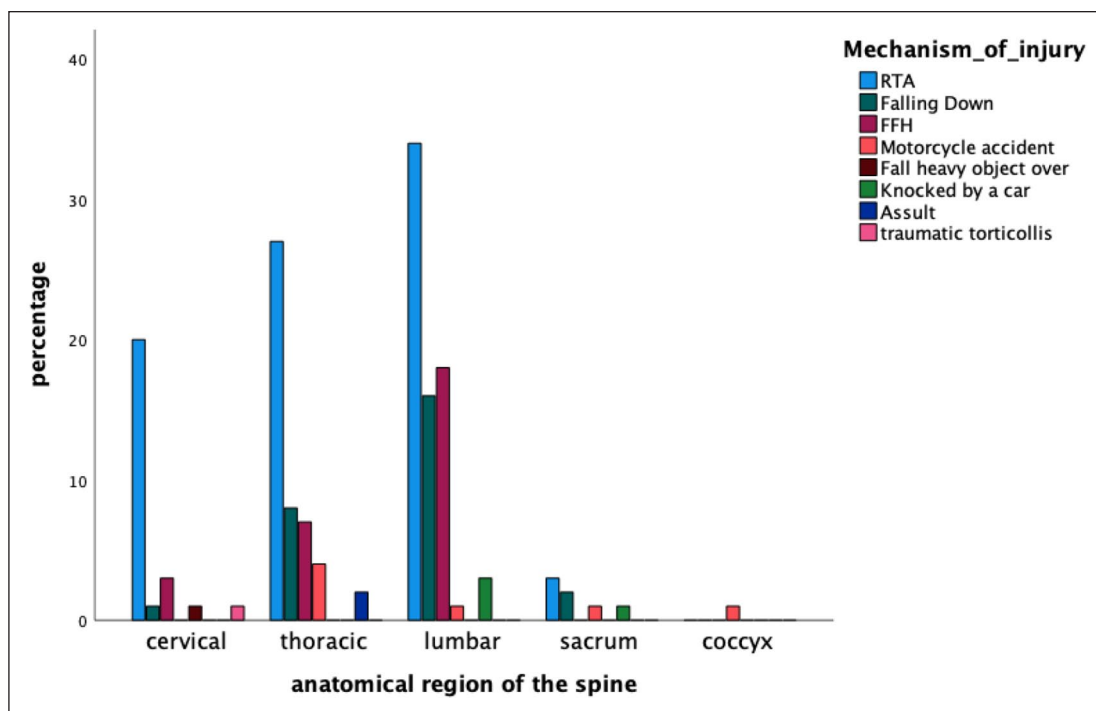**Figure 1.** The percentage of the mechanism of injury per age group for sustaining spinal fractures.

Figure 2. The percentage of the mechanism of injury per anatomical region of the spine.

lumbar spine at 64.6%, followed by the thoracic at 26.2% then the cervical at 7.7%. Significant association was found between nationality and the management provided (p=0.002). The non-Kuwaitis significantly rely on operative management (56.9%), compared to the non-Kuwaitis (31.8%). No significant associations were found between
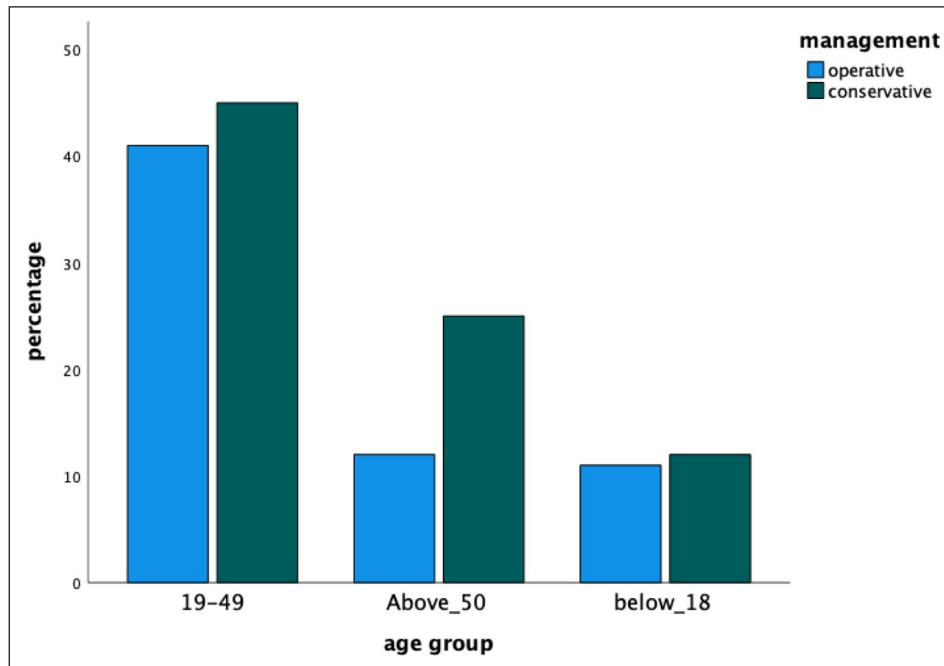
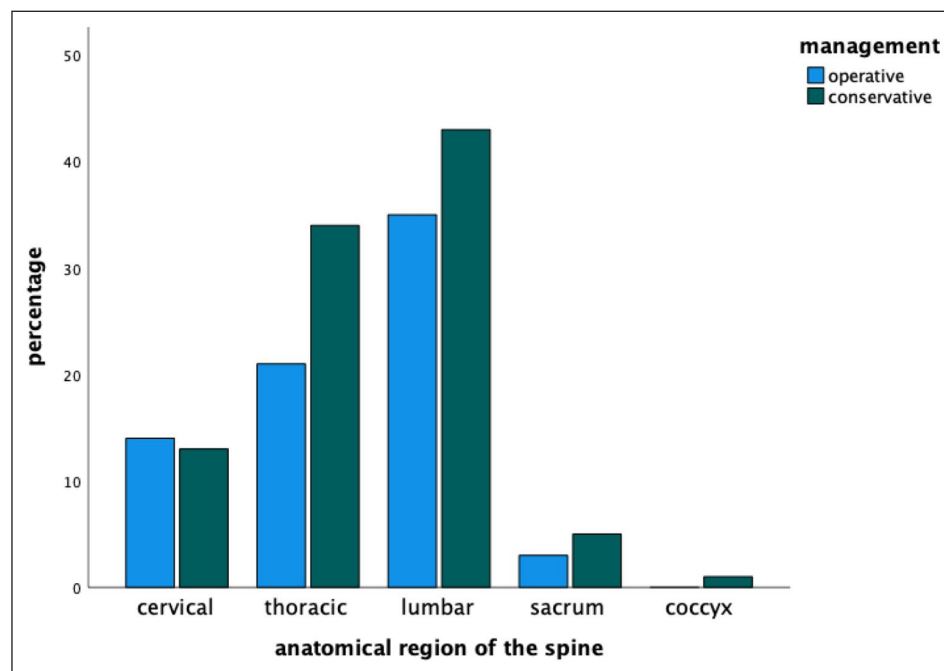**Figure 3.** The management provided for spinal fractures of operative or conservative per age group.

Figure 4. The management provided for spinal fractures of operative or conservative per anatomical region of the spine.

nationality and sustaining multiple trauma or spinal cord injury, the number of injured vertebrae, and ICU admission.

Discussion

The current study presents a novel exploration of the epidemiology of spinal fractures in one of the high-income countries of the Middle East region, considering the anatomical distribution of the spine and covering a sample from a 26-month period from 2018 to 2020. Such a comprehensive exploration of the epidemiological figures for spinal fractures is required to inform and direct management and build a preventive strategy toward a specified goal. The current study shows that spinal fractures are more prevalent among men and young adults in their thirties, and more common among Kuwaitis. However, the prevalence of spinal fractures
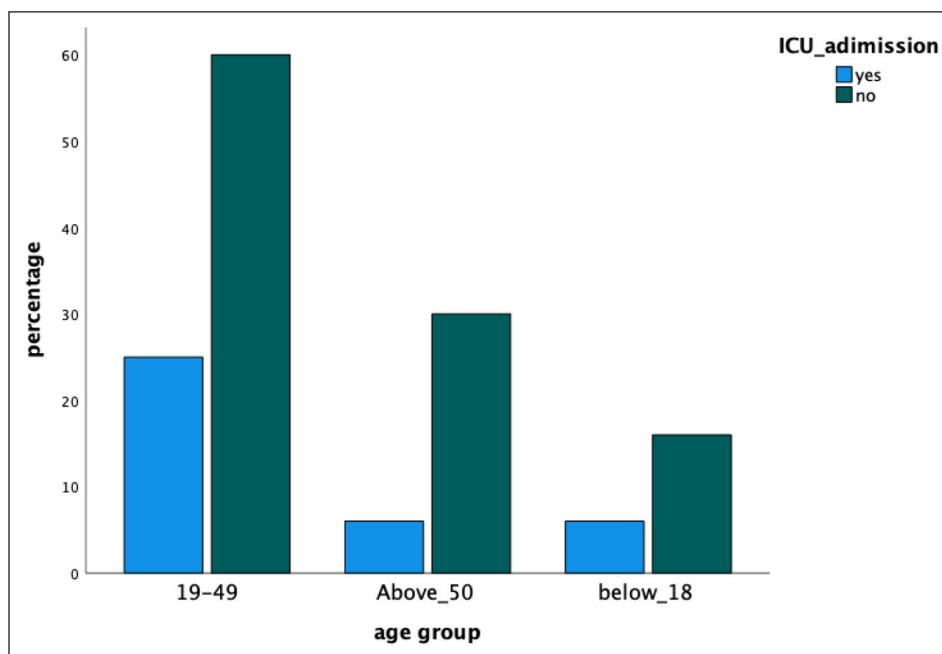
Figure 5. The percentage of intensive care unit (ICU) admission per age group.

Table 2. Demographic and clinical characteristics of patients with spinal traumatic injuries stratified per spinal anatomical site.

	Cervical fracture	Thoracic fracture	Lumbar fractures	Sacrum fractures
Prevalence per total anatomical injuries of 788	3.55%	7.23%	10.91%	1.14%
Sex	85.2% men	80.0% men	79.2% men	33.3% men
	14.8% women	20.0% women	20.8% women	66.7% women
Nationality	80.0% Kty	66.0% Kty	43.4% Kty	75.0% Kty
	20.0% Nkty	34% Nkty	56.5% Nkty	25.0% Nkty
Age: Mean (SD) years old	30.00 (13.40)	33.24 (17.74)	42.41 (18.44)	40.14 (25.17)
	Min 8.00	Min 3.50	Min 9.00	Min 9.00
	Max 73.00	Max 83.00	Max 92.00	Max 83.00
≤18 years	16.7%	23.9%	9.9%	22.2%
19–49 years	79.2%	56.5%	56.3%	44.4%
≥50	4.2%	19.6%	33.8%	33.3%
Mechanism of injury	RTA 76.9%	RTA 57.4%	RTA 47.4%	RTA 33.3%
	Fall down 3.8%	Fall down 17.0%	Fall down 21.1%	Falling down 33.3%
	FFH 11.5%	FFH 14.9%	FFH 26.3%	FFH 11.1%
	Fall heavy object over 3.8%	Motorcycle accident 6.4%	Motorcycle accident 1.3%	Motorcycle accident 11.1%
	Traumatic torticollis 3.8%	Assault 3.9%	Knocked by a car 3.9%	Knocked by a car 11.1%
Association with other trauma (not spine)	Yes 25.0%	Yes 36.0%	Yes 27.8%	Yes 66.7%
	No 75.0%	No 64%	No 72.2%	No 33.3%
Other injuries	No other injuries 75.0%	No other injuries 80.4%	No other injuries 84%	No other injuries 66.7%
	Spleen injury 3.6%	Spleen injury 3.9%	Spleen injury 2.5%	Head injury 11.1%
	Intubated 3.6%	Head injury 2.0%	Lung contusion 1.2%	Intubated 11.1%
	Pneumothorax 3.6%	Intubated 2.0%	Head injury 2.5%	Semiconscious 11.1%
	Hemothorax 7.1%	Pneumothorax 5.9%	Intubated 2.5%w	
	Liver tear 3.6%	Hemothorax 3.9%	Hemothorax 2.5%	
	Bladder rupture 3.6%	Subgaleal hematoma 2.0%	Liver tear 2.5%	
			Ventricular hemorrhage 1.2%	
			Chest trauma 1.2%	

(Continued)

Table 2. (Continued)

	Cervical fracture	Thoracic fracture	Lumbar fractures	Sacrum fractures
Spinal cord involvement	Yes 10.7%	Yes 4.0%	Yes 1.3%	Yes 0.00%
	No 89.3%	No 96.0%	No 98.7%	No 100.0%
Management	Operative 51.9%	Operative 38.2%	Operative 44.9%	Operative 37.5%
	Conservative 48.1%	Conservative 61.8%	Conservative 55.1%	Conservative 62.5%
Multi-vertebral fracture	Yes 39.3%	Yes 45.3%	Yes 40.5%	Yes 11.1%
	No 60.7%	No 54.7%	No 59.5%	No 88.9%
Number of vertebral fracture	1v 60.7%	1v 54.7%	1v 58.8%	1v 88.9%
	2v 21.4%	2v24.5%	2v 25.9%	2v 11.1%
	3v 14.3%	3v 13.2%	3v 10.6%	
	4v 3.6%	4v 7.5%	4v 4.7%	
ICU/OR direct admission	Yes 44.0%	Yes 24.5%	Yes 19.7%	Yes 44.4%
	No 56.0%	No 75.5%	No 80.3%	No 55.6%

SD: standard deviation; Fr: fracture; Kty; Kuwaiti; Nkty; non-Kuwaiti; RTA: road traffic accident; FFH: fall from height; ICU; intensive care unit; OR; operating theater.

changes according to age group. In particular, the study shows that the prevalence of spinal fractures in men was the highest in the two age groups ≤18 years old and between 19 and 49 years old at 86.9% and 86.0%, respectively. This high prevalence figure for spinal fractures in men is lower in the age group ≥50 years, reaching 54.0% only. The reduction in the prevalence of spinal fractures in men over the age of 50 years old could be related to the post-menopausal osteoporotic factor in women, where at the age of 50, the risk of fractures due to osteoporosis reaches 40%, and this increases women's risk of sustaining spinal traumatic fractures.[25] This observation suggests that osteoporosis could be an important factor to consider in future research and preventive programs. In addition, spinal fractures were found to be more prevalent among Kuwaitis. However, stratifying the research cohort into age groups has revealed changes in the figures between different age groups. For age ≤18 years old, spinal fractures were 100% among Kuwaitis, and this could be related to the absence of this age group among non-Kuwaitis, where non-Kuwaitis are from the workers age group. However, these figures vary significantly among older age groups, where spinal fractures were more prevalent among non-Kuwaitis in the age group 19–49 years old, reaching 51.21%, and this age group represents the worker population. However, for the older age group of ≥50 years, spinal fractures were more prevalent among Kuwaitis, at 54.05%. The variation in prevalence among Kuwaitis and non-Kuwaitis from different age groups suggests that laborer workers of non-Kuwaiti nationality are at higher risk of spinal fractures, and more work-related safety measures are required.

Focused and effective preventive programs for spinal fractures should be directed toward the mechanism of injury and toward specific anatomical areas. Generally, RTA was found to be the leading mechanism of injury for spinal fractures, followed by falling from height, and then falling down. RTA can lead to various events, including front, side, and run-off-road impact, which induces axial load to the spine and extensive acceleration of the upper body.[26] Such impacts explain the high prevalence of spinal fractures from RTA.[26] However, this figure significantly changes at age ≥50 years, where falling down becomes the leading mechanism of injury. This could be related to the impact of aging on bone density, muscle strength, and balance in the older population, which increases the risk of falling and consequently increases the risk of spinal fractures.[25,27,28] In addition, a significantly higher frequency of FFH was identified among non-Kuwaitis. Ultimately, preventive programs could be directed toward two routes: (1) increasing traffic safety measures for younger adults; (2) reducing the effect of aging on bone density, strength, and balance in older adults by increasing their awareness through public health systems, and through preventive programs; and (3) increasing work-related safety measures for non-Kuwaiti workers. Fractures of the lumbar spine were found to be the most prevalent, followed by the thoracic and then the cervical spine. However, this figure changed in people under the age of 18 years old, where thoracic fractures were most prevalent, followed by the lumbar then the cervical. This observation has also been reported previously, where thoracic fractures were the most common among pediatric patients.[29] In particular, the sub-analysis shows that the thoracolumbar junction was the most prevalent fractures site at 39.9%. The correlation between patients' ages and the most prevalent fracture sites could help in resource allocation in trauma centers, and in optimizing their management and preventive strategies.

Spinal fractures are complex and can be further challenged by the association with other fractures and injuries. Considerable numbers of spinal fractures are associated with other non-spinal fractures, ranging from 21% in pediatrics, increasing to 36% in adults and to 29% in people older than 50 years. In addition, spleen and liver injuries were associated with spinal fractures at 3.0% and 2.4%, respectively. Various injuries to the chest were also highlighted in association with spinal fractures, including hemothorax, pneumothorax, lung contusion, chest trauma, and the need for ventilation systems. It has been highlighted

that sacral fractures are the most complicated fracture of the spine in terms of their association with other fractures, at 66.7%; while cervical fractures are the least complicated fractures of the spine in terms of the association with other fractures, at 25.0%. This observation in the present study has also been noticed previously, where sacral fractures showed a high number of associations with other injuries, including head trauma, need for ventilation, and semi-consciousness. Specialized trauma centers should be prepared to manage spinal fractures and consider the association between spinal fractures and other fractures and injuries to optimize the delivery of care, including the association with other injuries in different spinal anatomical sites and age groups. Specifically, the current study shows that 50.8% of spinal fractures were associated with other fractures and injuries; 30.9% of non-spinal fractures, and 19.9% of other injuries to the internal organs. These figures support previously reported figures, which range from 43% to 78%.[14,30,31] In addition, the complexity of spinal fractures is further challenged by the high mortality rate, where in the current study, the mortality rate associated with spinal fractures reached 42.10% from trauma cases admitted to the intensive care unit. This factor needs to be considered in health care management strategies.

The world is divided into six regions according to the World Health Organization to discern between social and economic differences, which can change the burden of disease between world regions, and countries are further divided into high-, middle- and low-income countries according to the World Bank Country and Lending Groups classification system.[6,32,33] In addition, the incidence of spinal traumatic injuries in middle-income countries is different compared to the incidence in high-income countries.[19] Therefore, the results for middle-income countries cannot be generalized to low- or high-income countries. Kuwait represents high-income countries in the Middle East region.[6,32,33] Therefore, the findings of the current study should be compared to studies conducted in other high-income countries in the Middle East region to account for the social and economic differences. However, the epidemiology of spinal fractures has been explored in only two studies in the Middle East region, and these were in a middle-income country as both were conducted in Iran.[18,19] In addition, the first study focused on different outcome measures than those explored in the current study as they focused on the disability-adjusted life year to measure the burden of spinal fractures, therefore, comparison is difficult.[18] The second study explored the epidemiology of the cervical spine only and found that cervical fractures are more prevalent at age 37 years old and in men at 75.2%.[19] The figures established by Kamravan et al.[19] present one of the middle-income countries of the Middle East region, but differ from those identified in a the high-income country in the current study, where the demographics of the cervical fractures in Kuwait were found to be more prevalent in younger adults of 30 years old; also, the prevalence rate in men is higher at 85.2%.[19] The spinal cord injuries reported in

one of the middle-income countries in the Middle East region of 26.2%[19] is much higher than the figure identified in the current study, which is 10.7% due to cervical fractures. However, similar percentages for lung injuries were found between the two studies at 9.7% in middle-income countries by Kamravan et al.,[19] and 10.7% in the current study.

A great deal of controversy exists between the current study and the global epidemiological studies, which support the need for regional epidemiological figures. A systematic review of the global epidemiology of traumatic spinal injury has highlighted that RTA is the most frequent mechanism of injury, followed by falls, and it indicates that 48.8% of traumatic spinal injuries required operative management, which is similar to the current study's findings.[6] Similarly, RTA was also the dominant mechanism of injury for spinal fractures in Oklahoma at 48%, supporting the current study's finding of 54.5%.[12] However, in North Finland, low falls was the dominant mechanism of injury, and in the Netherlands, FFH was the dominant.[5,17] The most commonly injured site in North Finland was the lumbar spine similar to the current study while the thoracic spine was the most common in Netherlands.[5,17] In North Finland, 31.7% of patients with spinal fractures suffered from associated injuries, as in the current study, which revealed 30.9%, where 38.7% required operative management which is fairly similar to the current study's finding of 43.2%.[5] In contrast, in the Netherlands, patients with spinal fractures rely less on operative management at only 16%.[17] A higher figure for association with other injuries was found in the Netherlands of 73%, which could be mainly related to FFH as the dominant mechanism of injury.[17]

The study is limited due to several factors, where various essential variables were not available from the database used, and the used design was retrospective. The outcome for spinal fractures was not available to estimate the social and economic impact, and there was no information regarding contiguous and noncontiguous multilevel fractures. In addition, neurological deficit is the leading cause of morbidity following spinal fractures; however, no details were available regarding neurological deficit at the time of presentation and the latest follow-up. Therefore, these areas are recommended for future research. No prior sample size calculation was conducted; however, the sample size for prevalence studies can be estimated using the calculations of Hajian-Tilaki (2011).[34] The required sample size for an epidemiological study with 28% prevalence figure and a degree of marginal error of estimate of 1/4P is 158 subjects,[34] which indicates that the sample size of the current study is sufficient for the estimated prevalence of spinal fractures of 28.72% using the data of 162 patients.

Conclusion

The epidemiological figures identified for spinal fractures can be considered essential benchmarks for preventive and management strategies, and may assist health care stakeholders in planning for medical workforce training,

developing an efficient health care system, and resources allocation. Further epidemiological studies are required, as there is an absence of basic epidemiological information in the Middle East region. The Kuwait health care system lacks a trauma registry, which makes it hard for researchers to conduct epidemiological studies; therefore, establishing a trauma registry in Kuwait will aid future exploration.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

Ethical approval for this study was obtained from The Ethics Board of Kuwait Ministry of Health: ref (2019/1198).

Informed consent

Not applicable, this is an epidemiological study, only database were reviewed, there was no contact with the patients. "We confirm that written informed consent prior to the study initiation from all subjects was waived by the Institutional Review Board/Ethics Committee."

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