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Research Article

Epidemiology of Traumatic Spinal Fractures Due to Road Traffic Accidents Referred to Valiasr Hospital in Markazi Province

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Abstract

Introduction: Spinal fractures in some situations could be catastrophic, life-changing, and costly injuries for affected individuals, their families, and society. Road traffic accidents (RTA) are one of the leading causes of traumatic spinal Fractures. The first step in prevention is to know the epidemiological factors.

Objective and Methods: The purpose of this study is to investigate the epidemiology of traumatic spine injuries due to RTA. A retrospective cohort study was conducted on 473 trauma patients hospitalized with spinal injuries due to RTA during 2022-2023 in Markazi Province. The patient's information included demographic and clinical characteristics. The effects of various factors were assessed on the level of injury, the type of vehicle involved in the accident, and the type of accident. Data analysis was done with SPSS 24 software.

Results: The mean (SD) Age of the patients was 40.5 (16.6) years. Of the 333 patients (70.4%), 333 were male. 290 (61.3%) patients were drivers. 74.4% of accidents were with cars. 52.9% were injured in a rollover accident. The level of injury was related to the length of hospital stay, admission to ICU, mortality, occupant position, type of accident, surgery, GCS, and AIS ($p<0.05$). Moreover, gender, marital status, and neck injury had a statistically significant relationship with the type of vehicle leading to the accident($p<0.05$). In addition, Age, gender, marital status, education, occupational position, and back and neck injuries have a significant relationship with the type of accident.

Conclusion: Spine fractures due to RT are the most common cause in developing countries, which is the leading cause of people's disability. To implement adequate preventive measures, it is necessary to understand the causes and prevalence of these injuries and mitigate the factors that contribute to their occurrence.

Keywords: Epidemiology, Trauma, Spinal Fracture, Traffic Accidents, Motor Vehicle

Introduction

Any kind of blow, injury, shock, or damage or accident inflicted on the human body, provided that it enters the body from the outside and is not caused by internal factors or diseases, is called trauma [1,2]. Acute spine injuries are among the most common causes of referring injured people to the emergency departments of hospitals, and these injuries are the leading cause of disability and death due to trauma and cause high costs of health and treatment [3-4].

The RTA is a significant cause of morbidity, mortality, and financial burden worldwide [5-6]. In most countries, traffic accidents are the most common Mechanism of traumatic injuries [7-10]. Traumatic spinal injury (TSI) is a serious injury with a mortality rate ranging from 3.8% to 15.4%, mainly caused by RTA [11]. The highest frequency of traumatic injury due to RTA is observed in West Africa at 89% and the lowest frequency in Greenland at 4%, and also in Pakistan and Nepal at 7% [12-17]. Epidemiological studies of TSI in developed countries showed that proper documentation and analysis of available data lead to the formulation of proper protocols for the prevention of spinal trauma and improvement of patient behavior during transportation [18]. Oliver et al. examined the change in spine injuries over 13 years. They demonstrated that the incidence of injuries from motor vehicle accidents (MVAs) decreased significantly during the study period, and the reasons for this decrease included improvements in road safety, stricter vehicle safety laws, and enhanced enforcement of traffic laws [19].

Considering the spine injury as one of the most dangerous consequences of road accidents that sometimes cause spinal vertebrae fractures and maybe associated with serious complications and even death, so the epidemiology of spinal injury caused by RTA necessitate to be defind as well as characteristics of these injuries and related factors, which can help prevent and better manage them. Therefore, the present study was conducted to investigate the epidemiological characteristics of traumatic spine fractures due to traffic accidents to increase awareness and provide information about these injuries in Markazi Province in Iran.

Methods

The current retrospective cohort study was conducted on all patients with spinal trauma due to traffic accidents during 2022-2023. Patient information including demographic and clinical characteristics, age, gender, cause of injury, occupation, American spinal cord injury scale (ASIA), level of injury (cervical, thoracic, lumbar, multiple), type of transferring patients to emergency, number of injured vertebrae, surgery, duration of hospitalization, GCS, spinal cord injury, accident mechanism (collision-rollover) position (driver, passenger and pedestrian), type of vehicle (car-bicycle and motorcycle-passenger).

Data analysis was performed using the chi-square and Kruskal-Wallis tests, and the results were analyzed with SPSS 24 software. A significance level of 5% was considered.

Results

In this study, 473 patients with spinal fractures due to traffic accidents were examined. The mean (SD) age of the patients was 40.5 (16.6) years (Range:1-93). Of the 333 (70.4%) patients, 70.4% were men. (61.3%) 290 of them were drivers. 43.4% of drivers (126 out of 290) and 14% (20 out of 143) of passengers were wearing helmets or seat belts. 3.4% of patients died in the hospital. Table 1 shows the frequency distribution of demographic and clinical characteristics of spinal trauma patients according to the level of injury.

The level of injury was 40.6% lumbar, 24.9% thoracic, 15% cervical, and 19.5% multiple. The length of stay in patients with cervical injury was higher than in patients with other levels of injury. Most of the patients with cervical and multiple injuries were admitted to the ICU. The frequency of cervical injuries in patients who were hospitalized due to a car rollover was higher than in patients who were injured due to a collision, and the injury site of the patients who were injured due to a collision was more in the lumbar area. The frequency of cervical injuries was higher in car accidents, while the frequency of lumbar injuries was higher in motorcycle and bicycle accidents. Moreover, according to Table 1, length of stay in the hospital, admission to ICU, mortality, cord injury, Car occupant position, Vehicle type, Mechanism of accident, surgery, and ASIA had a statistically significant relationship with the level of injury.

Table 1: Frequency distribution of demographic and clinical characteristics of spinal fracture trauma patients according to injury level.

variable	level	Level of injury				total	p.value
		cervical	thoracic	lumbar	Multiple		
age		40.7(16.2)	40.5(18.2)	40.9(16.5)	40.9(16.6)	40.9(16.6)	0.86
LOS		10.5(17.1)	7.5(9.2)	6.4(9.9)	8.6(10.3)	7.7(11.2)	0.001**
Number of injured vertebrae		1.6(0.7)	1.8(1.1)	1.7(1.1)	3.6(1.9)	2.1(1.4)	0.23
Age (year)	0-19	7(9.9)	16(13.6)	19(9.9)	6(6.5)	48(10.1)	0.39
	20-29	14(19.7)	14(11.9)	34(17.7)	14(15.2)	76(16.1)	
	30-39	12(16.9)	34(28.8)	40(20.8)	24(26.1)	110(23.3)	
	40-49	16(22.5)	24(20.3)	41(21.4)	21(22.8)	102(21.6)	
	50-59	12(16.9)	9(7.6)	31(16.1)	17(18.5)	69(14.6)	
	>=60	10(14.1)	21(17.8)	27(14.1)	10(10.9)	68(14.4)	
Gender	female	18(25.4)	36(30.5)	54(27.6)	32(36.4)	140(29.6)	0.39
	meal	53(74.6)	82(69.5)	142(72.4)	56(63.6)	333(70.4)	
ICU	no	52(73.2)	104(88.1)	176(89.8)	67(76.1)	399(84.4)	0.001
	yes	19(26.8)	14(11.9)	20(10.2)	21(23.9)	74(15.6)	
Job	private sector	18(25.4)	36(30.5)	55(28.1)	22(25)	131(27.7)	0.96
	retired	5(7)	9(7.6)	13(6.6)	4(4.5)	31(6.6)	
	laborer	11(15.5)	11(9.3)	16(8.2)	6(6.8)	44(9.3)	
	driver	2(2.8)	3(2.5)	6(3.1)	4(4.5)	15(3.2)	
	staff	4(5.6)	2(1.7)	10(5.1)	4(4.5)	20(4.2)	
	former	3(4.2)	2(1.7)	8(4.1)	2(2.3)	15(3.2)	
	student	5(7)	14(11.9)	17(8.7)	8(9.1)	44(9.3)	
	house wife	14(19.7)	22(18.6)	40(20.4)	20(22.7)	96(20.3)	
	unkown	9(12.7)	19(16.1)	31(15.8)	18(20.5)	77(16.3)	
Marital status	married	50(70.4)	80(67.8)	143(73)	71(80.7)	344(72.7)	0.24
	single	21(29.6)	33(28)	49(25)	15(17)	118(24.9)	
	other	0(0)	5(4.2)	4(2)	2(2.3)	11(2.3)	
education	illiterate	8(11.3)	18(15.3)	21(10.7)	9(10.2)	56(11.8)	0.15
	Elementary school	10(14.1)	21(17.8)	30(15.3)	16(18.2)	77(16.3)	
	Middle school	9(12.7)	6(5.1)	26(13.3)	8(9.1)	49(10.4)	
	High school	7(9.9)	23(19.5)	25(12.8)	12(13.6)	67(14.2)	
	diploma	27(38)	34(28.8)	68(34.7)	21(23.9)	150(31.7)	
	college and more	10(14.1)	16(13.6)	26(13.3)	22(25)	74(15.6)	
GCS	3-8	4(5.6)	1(0.8)	2(1)	5(5.7)	12(2.5)	0.11
	9-12	5(7)	2(1.7)	3(1.5)	2(2.3)	12(2.5)	
	13-15	62(87.3)	115(97.5)	191(97.4)	81(92)	449(94.9)	
Spinal Cord injury	No	57(80.3)	115(97.5)	186(96.9)	84(91.3)	442(93.4)	<0.001
	yes	14(19.7)	3(2.5)	6(3.1)	8(8.7)	31(6.6)	
Transportation services	Ambulance	68(95.8)	105(89)	187(95.4)	83(94.3)	443(93.7)	0.11
	Non-ambulance	3(4.2)	13(11)	9(4.6)	5(5.7)	30(6.3)	
Car occupant position	Driver	46(64.8)	67(56.8)	125(63.8)	52(59.1)	290(61.3)	0.04
	pedestrian	2(2.8)	9(7.6)	24(12.2)	5(5.7)	40(8.5)	
	passenger	23(32.4)	42(35.6)	47(24)	31(35.2)	143(30.2)	
Vehicle type	car	61(85.9)	83(70.3)	135(70.3)	73(79.3)	352(74.4)	0.047

	MotorcycleBicycle	8(11.3)	26(22)	34(17.7)	13(14.1)	81(17.1)	
	pedestrian	2(2.8)	9(7.6)	23(12)	6(6.5)	40(8.5)	
In hospital mortality	Survived	64(90.1)	116(98.3)	193(98.5)	84(95.5)	457(96.6)	0.006
	death	7(9.9)	2(1.7)	3(1.5)	4(4.5)	16(3.4)	
type of accident	collision	26(36.6)	52(44.1)	110(56.1)	35(39.8)	223(47.1)	0.008
	Rollover	45(63.4)	66(55.9)	86(43.9)	53(60.2)	250(52.9)	
surgery	No	41(57.7)	62(52.5)	135(68.9)	45(51.1)	283(59.8)	0.007
	yes	30(42.3)	56(47.5)	61(31.1)	43(48.9)	190(40.2)	
ASIA IMPAIRMENT SCALE	A	7(9.9)	1(0.8)	0(0)	3(3.4)	11(2.3)	<0.001
	C	2(2.8)	0(0)	2(1)	0(0)	4(0.8)	
	D	5(7)	2(1.7)	4(2)	5(5.7)	16(3.4)	
	E	57(80.3)	115(97.5)	190(96.9)	80(90.9)	442(93.4)	
**** In the multiple comparisons, the Mann-Whitney Test revealed that the difference in length of stay (LOS) was significant only for cervical and lumbar levels of injury.**							

Table 2 presents the distribution of demographic and clinical characteristics of patients according to the type of vehicle.

74.4% of accidents leading to spinal injuries were caused by cars, and 17.1% of those injured were cyclists and motorcyclists. Out of 333 men, 266 (79.9%) were injured by cars, and 97 out of 140 women (69.3%) were injured by motorcycles and bicycles. Pedestrian injuries were primarily observed in women and people over 60 years old. Most of the people injured by bicycles and motorcycles were under 20 years old. 64.9% of those injured by cars were between 20 and 49 years old, and 65% of pedestrians were between 30 and 60 years old. More than 95% of patients had a spinal cord injury in a car accident, and the frequency of neck injury in a car accident was higher than in other vehicle collisions. Moreover, gender, marital status, and neck injury had a statistically significant relationship with the type of vehicle that caused the accident.

Table 3 presents the frequency distribution of demographic and clinical characteristics of patients according to the role of the injured.

61.3% of patients were drivers, 30.2% were passengers, and the rest were pedestrians. Most of the passengers were women, and the drivers were men. Table 4 shows that age, gender, marital status, education, occupation, injured role, and back and neck injuries have a significant relationship with the occupant position.

The distribution of demographic and clinical characteristics of patients according to the Mechanism of the accident is presented in Table 4. Table 4 shows that 52.9% were injured due to a car rollover and 40.2% underwent surgery. The frequency of car rollovers was higher among individuals under 50 years old, while car collisions were more common among those over 50 years old. Women were more involved in car rollovers, and men were more involved in car collisions. Patients requiring surgery in car rollovers were more likely to be. Patients who had neck injuries were more likely to be in car rollover and collision accidents, which caused more chest injuries. Table 4 demonstrated that occupant position, waist, and neck injuries had a statistically significant relationship with the Mechanism of the accident.

Table 3: Frequency distribution of demographic and clinical characteristics of spinal trauma patients by the type of vehicle

variable	Vehicle involved				Total	p.value
	level	**care**	**pedestrian**	**Motorcycycle&Bicycle**		
ICU	no	292(82.7)	33(82.5)	74(92.5)	399(84.4)	0.09
	yes	61(17.3)	7(17.5)	6(7.5)	74(15.6)	
Gender	Male	234(66.3)	21(52.5)	78(97.5)	333(70.4)	<0.001
	Female	119(33.7)	19(47.5)	2(2.5)	140(29.6)	
Marital status	married	260(73.7)	32(80)	52(65)	344(72.7)	0.11
	single	83(23.5)	7(17.5)	28(35)	118(24.9)	
	Other*	10(2.8)	1(2.5)	0(0)	11(2.3)	
age	0-19	30(8.5)	3(7.5)	15(18.8)	48(10.1)	0.07
	20-29	61(17.3)	3(7.5)	12(15)	76(16.1)	
	30-39	85(24.1)	9(22.5)	16(20)	110(23.3)	
	40-49	83(23.5)	7(17.5)	12(15)	102(21.6)	
	50-59	48(13.6)	10(25)	11(13.8)	69(14.6)	
	>=60	46(13)	8(20)	14(17.5)	68(14.4)	
Job	private	98(27.8)	8(20)	25(31.3)	131(27.7)	<0.001
	retired	17(4.8)	3(7.5)	11(13.8)	31(6.6)	
	laborer	29(8.2)	3(7.5)	12(15)	44(9.3)	
	driver	15(4.2)	0(0)	0(0)	15(3.2)	
	staff	16(4.5)	3(7.5)	1(1.3)	20(4.2)	
	former	8(2.3)	0(0)	7(8.8)	15(3.2)	
	student	30(8.5)	3(7.5)	11(13.8)	44(9.3)	
	house	84(23.8)	12(30)	0(0)	96(20.3)	
	unknow	56(15.9)	8(20)	13(16.3)	77(16.3)	
GCS	3-8	7(2)	3(7.5)	2(2.5)	12(2.5)	0.12
	9-12	9(2.5)	0(0)	3(3.8)	12(2.5)	
	13-15	337(95.5)	37(92.5)	75(93.8)	449(94.9)	
Transporta tion	Ambula	272(93.8)	35(87.5)	136(95.1)	443(93.7)	0.22
	Non-	18(6.2)	5(12.5)	7(4.9)	30(6.3)	
Spinal cord injury	no	337(95.5)	39(97.5)	80(100)	456(96.4)	0.13
	yes	16(4.5)	1(2.5)	0(0)	17(3.6)	
In hospital mortality	Survive	341(96.6)	38(95)	78(97.5)	457(96.6)	0.77
	death	12(3.4)	2(5)	2(2.5)	16(3.4)	
Surgery	No	210(59.5)	24(60)	49(61.3)	283(59.8)	0.96
	yes	143(40.5)	16(40)	31(38.8)	190(40.2)	
Waist injury?	no	70(19.8)	4(10)	13(16.3)	87(18.4)	0.27
	yes	283(80.2)	36(90)	67(83.8)	386(81.6)	
Neck injury	no	281(79.6)	38(95)	71(88.8)	390(82.5)	0.01
	yes	72(20.4)	2(5)	9(11.3)	83(17.5)	
ASIA IMPAIRM ENT SCALE	A	11(3.1)	0(0)	0(0)	11(2.3)	0.27
	C	4(1.1)	0(0)	0(0)	4(0.8)	
	D	10(2.8)	3(7.5)	3(3.8)	16(3.4)	
	E	328(92.9)	37(92.5)	77(96.3)	442(93.4)	

Table 3: Demographic and clinical characteristics of patients with spinal Fracture by Car occupant position

Variable	Level	Car occupant position			Total	p.value
		Driver	pedestrian	passenger		
age	0-19	21(7.2)	3(7.5)	24(16.8)	48(10.1)	0.008
	20-29	50(17.2)	3(7.5)	23(16.1)	76(16.1)	
	30-39	76(26.2)	9(22.5)	25(17.5)	110(23.3)	
	40-49	69(23.8)	7(17.5)	26(18.2)	102(21.6)	
	50-59	41(14.1)	10(25)	18(12.6)	69(14.6)	
	>=60	33(11.4)	8(20)	27(18.9)	68(14.4)	
ICU	no	246(84.8)	33(82.5)	120(83.9)	399(84.4)	0.92
	yes	44(15.2)	7(17.5)	23(16.1)	74(15.6)	
Gender	Male	266(91.7)	21(52.5)	46(32.2)	333(70.4)	<0.001
	Female	24(8.3)	19(47.5)	97(67.8)	140(29.6)	
Marital status	married	218(75.2)	32(80)	94(65.7)	344(72.7)	0.04
	single	69(23.8)	7(17.5)	42(29.4)	118(24.9)	
	Other*	3(1)	1(2.5)	7(4.9)	11(2.3)	
GCS	3-8	7(2.4)	3(7.5)	2(1.4)	12(2.5)	0.11
	9-12	10(3.4)	0(0)	2(1.4)	12(2.5)	
	13-15	273(94.1)	37(92.5)	139(97.2)	449(94.9)	
Education	illiterate	23(7.9)	9(22.5)	24(16.8)	56(11.8)	0.003
	Element	37(12.8)	9(22.5)	31(21.7)	77(16.3)	
	Middle school	36(12.4)	2(5)	11(7.7)	49(10.4)	
	High school	39(13.4)	5(12.5)	23(16.1)	67(14.2)	
	diploma	105(36.2)	9(22.5)	36(25.2)	150(31.7)	
	college and more	50(17.2)	6(15)	18(12.6)	74(15.6)	
Job	private	107(36.9)	8(20)	16(11.2)	131(27.7)	<0.001
	retired	24(8.3)	3(7.5)	4(2.8)	31(6.6)	
	laborer	34(11.7)	3(7.5)	7(4.9)	44(9.3)	
	driver	14(4.8)	0(0)	1(0.7)	15(3.2)	
	staff	16(5.5)	3(7.5)	1(0.7)	20(4.2)	
	former	15(5.2)	0(0)	0(0)	15(3.2)	
	student	16(5.5)	3(7.5)	25(17.5)	44(9.3)	
	house wife	18(6.2)	12(30)	66(46.2)	96(20.3)	
	unkown	46(15.9)	8(20)	23(16.1)	77(16.3)	
Transportation services	Ambulan	272(93.8)	35(87.5)	136(95.1)	443(93.7)	0.22
	Non-ambulan	18(6.2)	5(12.5)	7(4.9)	30(6.3)	
Spinal cord injury	no	280(96.6)	39(97.5)	137(95.8)	456(96.4)	0.86
	yes	10(3.4)	1(2.5)	6(4.2)	17(3.6)	
In hospital mortality	Survived	281(96.9)	38(95)	138(96.5)	457(96.6)	0.72
	death	9(3.1)	2(5)	5(3.5)	16(3.4)	
surgery	no	168(57.9)	24(60)	91(63.6)	283(59.8)	0.52
	yes	122(42.1)	16(40)	52(36.4)	190(40.2)	
Waist injury	no	58(20)	4(10)	25(17.5)	87(18.4)	0.29
	yes	232(80)	36(90)	118(82.5)	386(81.6)	
Neck injury	no	236(81.4)	38(95)	116(81.1)	390(82.5)	0.09
	yes	54(18.6)	2(5)	27(18.9)	83(17.5)	
ASIA IMPAIRMENT SCALE	A	6(2.1)	0(0)	5(3.5)	11(2.3)	0.36
	C	2(0.7)	0(0)	2(1.4)	4(0.8)	
	D	11(3.8)	3(7.5)	2(1.4)	16(3.4)	
	E	271(93.4)	37(92.5)	134(93.7)	442(93.4)	
***(divorce, widowed, dead wife)**						

Table 4: Frequency distribution of demographic and clinical characteristics of spinal cord? trauma patients by mechanism of accident.

variable	level	mechanism of accident		Total	p.value
		Car collision	Car Rollover		
Age (year)	<20	20(9)	28(11.2)	48(10.1)	0.28
	20-29	30(13.5)	46(18.4)	76(16.1)	
	30-39	53(23.8)	57(22.8)	110(23.3)	
	40-49	45(20.2)	57(22.8)	102(21.6)	
	50-59	36(16.1)	33(13.2)	69(14.6)	
	>=60	39(17.5)	29(11.6)	68(14.4)	
ICU	no	187(83.9)	212(84.8)	399(84.4)	0.89
	yes	36(16.1)	38(15.2)	74(15.6)	
Job	private sector	56(25.1)	75(30)	131(27.7)	0.16
	retired	20(9)	11(4.4)	31(6.6)	
	laborer	26(11.7)	18(7.2)	44(9.3)	
	driver	4(1.8)	11(4.4)	15(3.2)	
	staff	9(4)	11(4.4)	20(4.2)	
	former	9(4)	6(2.4)	15(3.2)	
	student	20(9)	24(9.6)	44(9.3)	
	house wife	41(18.4)	55(22)	96(20.3)	
	unkown	38(17)	39(15.6)	77(16.3)	
Gender	Male	162(72.6)	171(68.4)	333(70.4)	0.31
	Female	61(27.4)	79(31.6)	140(29.6)	
Marital status	married	166(74.4)	178(71.2)	344(72.7)	0.1
	single	49(22)	69(27.6)	118(24.9)	
	Other*	8(3.6)	3(1.2)	11(2.3)	
education	illetrate	38(17)	18(7.2)	56(11.8)	0.015
	Elementary school	32(14.3)	45(18)	77(16.3)	
	Middle school	19(8.5)	30(12)	49(10.4)	
	High school	26(11.7)	41(16.4)	67(14.2)	
	diploma	71(31.8)	79(31.6)	150(31.7)	
	college and more	37(16.6)	37(14.8)	74(15.6)	
Car occupant position	pedestrian	43(19.3)	2(0.8)	45(9.5)	<0.001
	Driver	129(57.8)	158(63.2)	287(60.7)	
	passenger	51(22.9)	90(36)	141(29.8)	
GCS	3-8	6(2.7)	6(2.4)	12(2.5)	0.96
	9-12	6(2.7)	6(2.4)	12(2.5)	
	13-15	211(94.6)	238(95.2)	449(94.9)	
Transportation services	Ambulance	205(91.9)	238(95.2)	443(93.7)	0.14
	Non-ambulance	18(8.1)	12(4.8)	30(6.3)	
surgery	No	141(63.2)	142(56.8)	283(59.8)	0.15
	yes	82(36.8)	108(43.2)	190(40.2)	
Neck injury	No	193(86.5)	197(78.8)	390(82.5)	0.03
	yes	30(13.5)	53(21.2)	83(17.5)	
Waist injury	No	21(9.4)	41(16.4)	62(13.1)	0.025
	yes	202(90.6)	209(83.6)	411(86.9)	
ASIA IMPAIRMENT SCALE	A	5(2.2)	6(2.4)	11(2.3)	0.29
	B	0(0)	4(1.6)	4(0.8)	
	C	7(3.1)	9(3.6)	16(3.4)	
	D	211(94.6)	231(92.4)	442(93.4)	

***(divorce, widowed, dead wife)**

In this study, 660 hospitalized patients with fractured vertebrae underwent surgery. Fig. 1 shows the frequency distribution of vertebral fractures. The highest frequency of cervical vertebrae fractures was in the C6 vertebra, the highest frequency of fractured lumbar vertebrae was in L1-L2, and the highest frequency of thoracic fractures was in T12 (Fig. 1).

Fig. 2 shows the frequency distribution of operated vertebrae by gender. At the site of cervical injury, the frequency of C5-C7 vertebrae was higher in men and C1-C4 in women. In the lumbar vertebrae, only the frequency of injury in the L2 vertebra was higher in women than in men. T1, T8-T9, and T12 vertebrae were the most frequently operated vertebrae in men (Fig. 2).

Figure 3 illustrates the frequency of operated vertebrae according to the position of the injured person. The highest frequency of injuries in pedestrians was in the thoracic and lumbar region, and they did not have any cervical fractures. In pedestrians, it was observed in L2, L1, T11, and T12 vertebrae, respectively. In injured motorcyclists and cyclists, the highest frequency of injured vertebrae was observed in L1, T12, L2, and T11, respectively. The cervical vertebrae were the most frequently fractured level in car passengers (Fig. 3).

Figure 4 demonstrates the distribution of operated vertebrae according to the type of accident leading to injury. In the patients who suffered damage to the spinal vertebrae due to the collision, the frequency of vertebrae requiring surgery in the C2 to C5 vertebrae had a decreasing trend, and from L1 to L5, an increasing trend. In almost all the vertebrae, the frequency of operated vertebrae due to accidents was less than 50%, and only in the T6 and T11 vertebrae was the frequency of operated vertebrae equal due to car collisions and rollovers (Fig. 4).

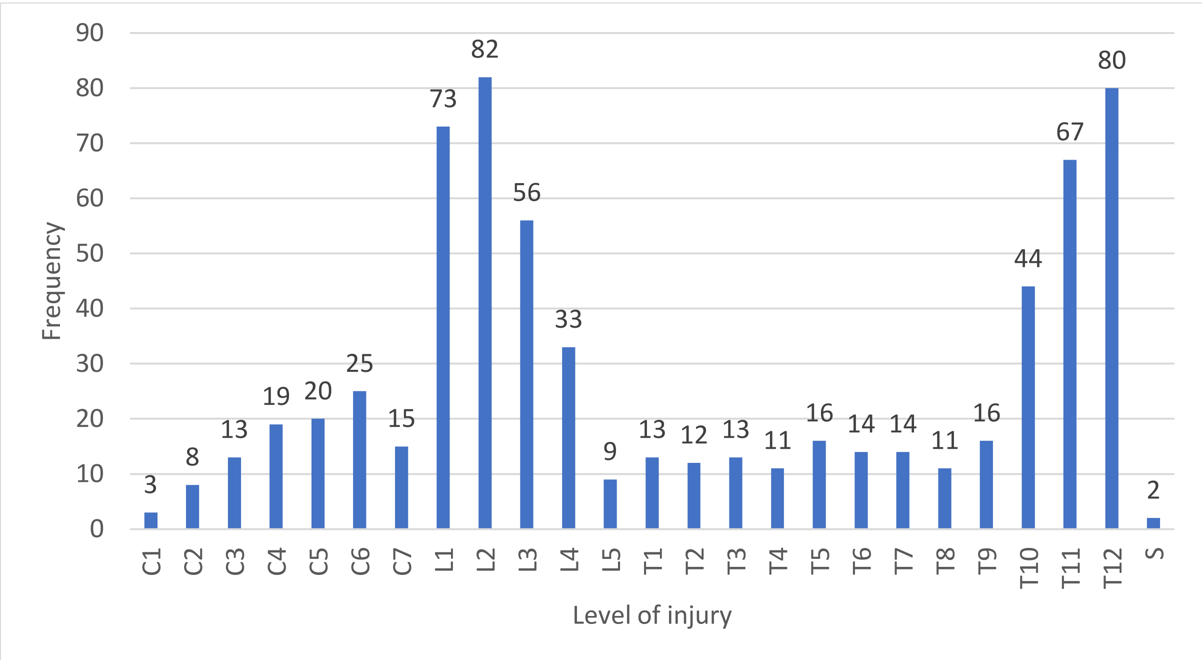

Figure 1: Frequency distribution of operated vertebrae in hospitalized patients

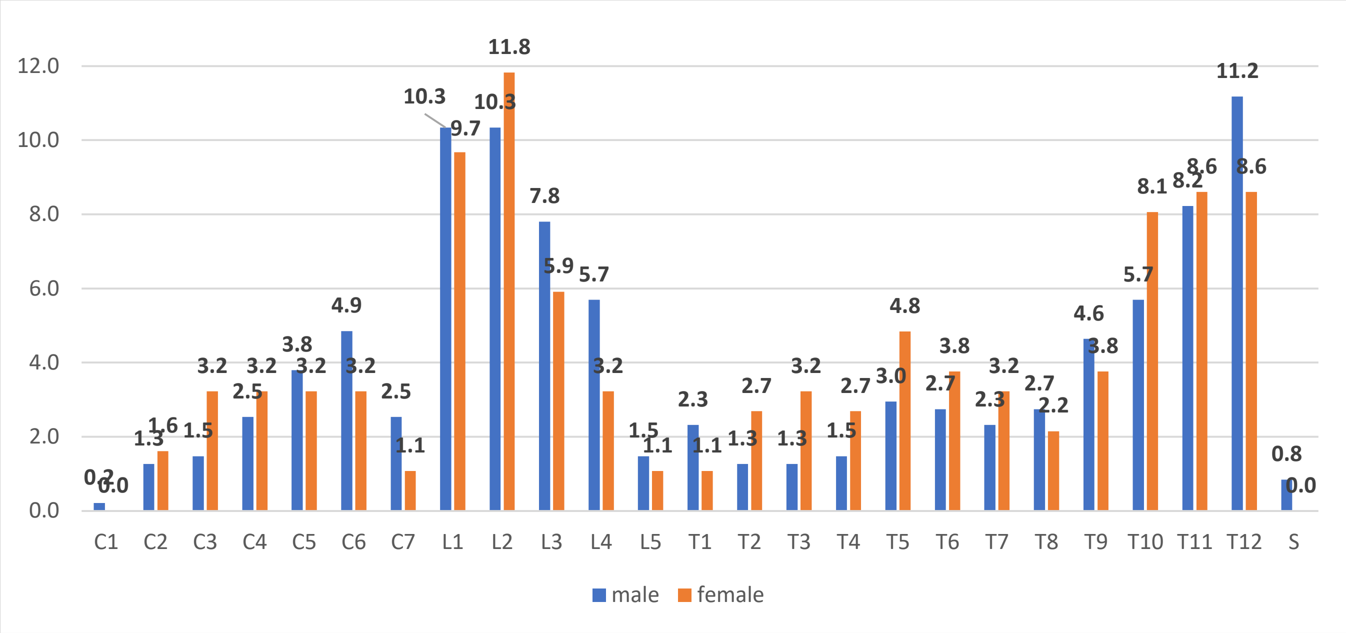

Figure 2: distribution of operated vertebrae according to gender

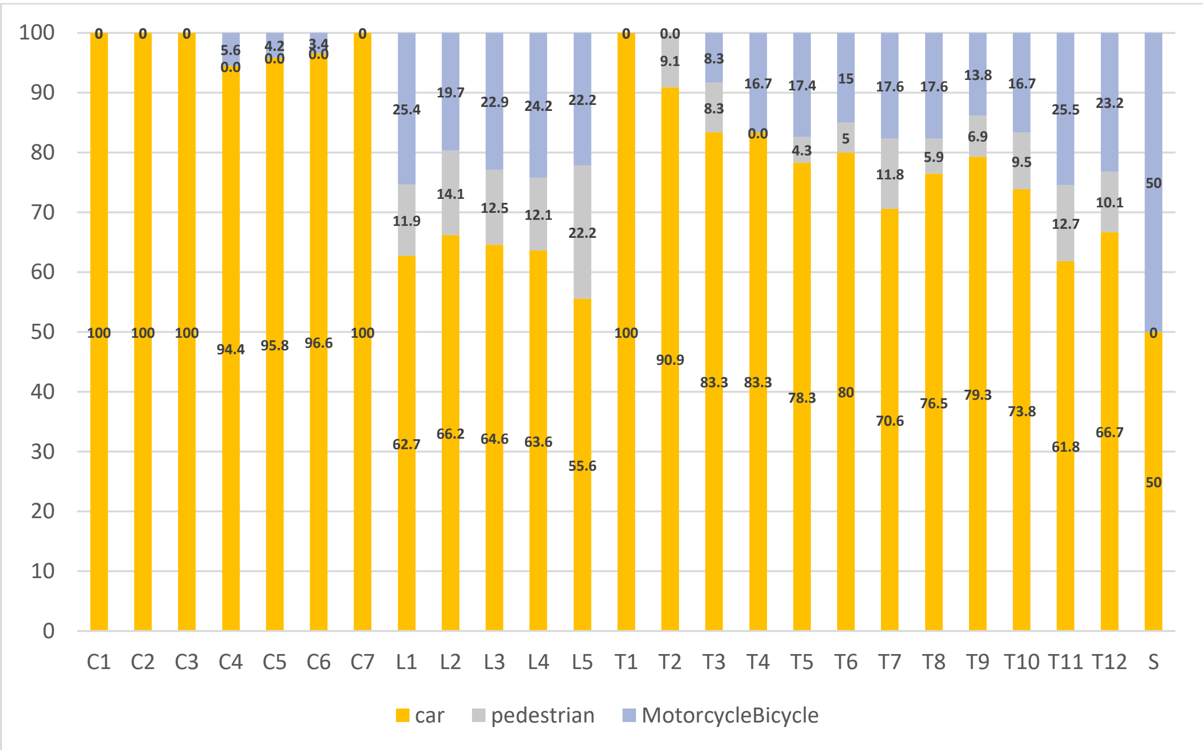

Figure 3: Distribution of operated vertebrae by occupant position of the injured person

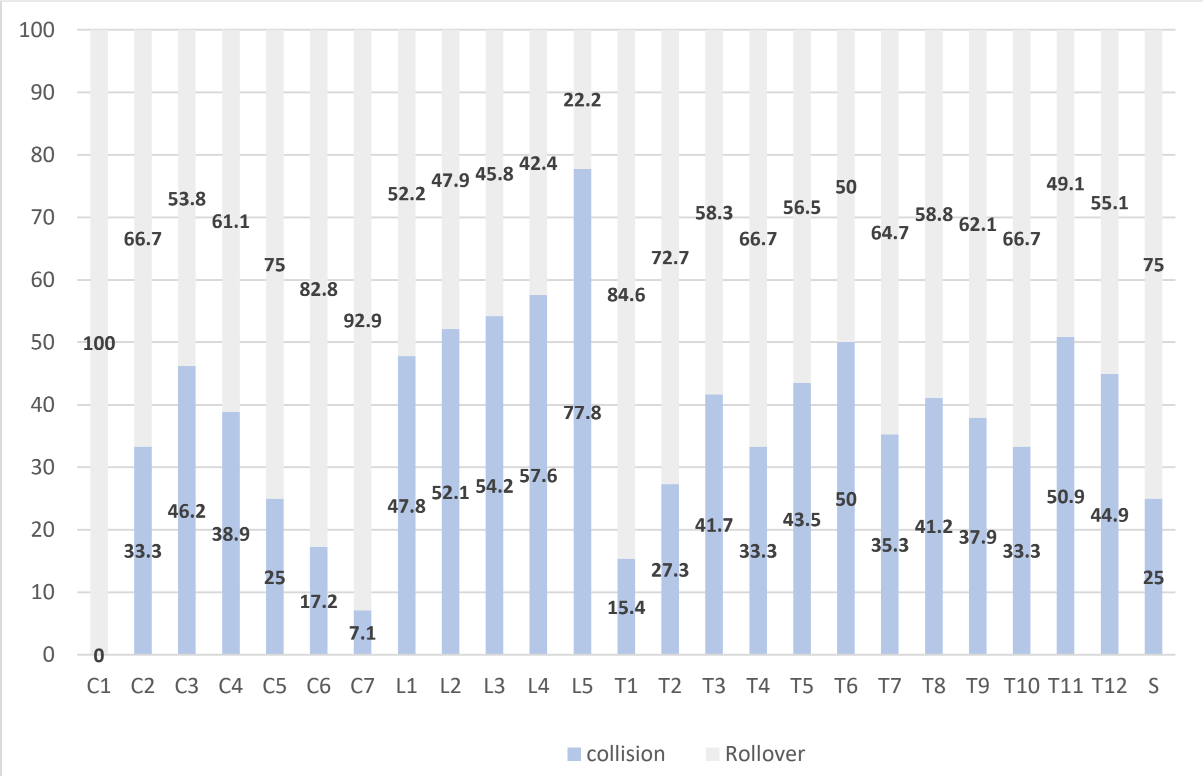

Figure 4: Frequency distribution of operated vertebrae according to the type of accident

Discussion

Traffic accidents have become a threat to public health in developing countries. In Iran, as well as in other developing countries, the number of vehicles is increasing rapidly. At the same time, the quantity and quality of roads remain unchanged, increasing accidents, casualties, and financial and personal losses.[20] Considering that RTAs are the leading traumatic causes of spinal injury and few studies have been conducted on spinal injury due to traffic accidents in Iran, the purpose of this article was to describe the epidemiology of TSI patients.

Gender plays an important role in spinal injury due to traffic accidents. In this study, 70.4% of the patients were men. 66.3% of men had an accident with a car, and 97.5% of them with a bicycle or motorcycle, and a significant relationship between the type of vehicle and gender was observed ($p<0.001$). Additionally, 91.7% of the injured were male drivers, and 67.8% of the injured were female passengers; the gender of the injured was significantly related to the type of accident ($p < 0.001$). In Yuan et al.'s study, 65.3% of the injuries were reported in males. Moreover, car and bicycle motorcycle accidents in men were 64.6% and 69.6%, respectively, and a significant relationship was observed between the type of vehicle and gender [21]. In the study by Fakharian et al. in Iran, 56% were men [22]. In the study by Degais et al. in Sudan, 85% of the injured were men [23]. In two studies conducted by Alghahtani et al. in Saudi Arabia in 2021 and 2022, the frequencies were 86.4% and 87.28%, respectively [11,24]. In a study by Wu et al. in China, 73% of the participants were men [25]. In Wang et al.'s study in southwest China, 66.5% of the participants were men [26]. Fernández et al., in a meta-analysis study in North America, estimated the rate of men with spinal trauma due to traffic accidents to be 76.66% [27].

In this study, as in other studies, the frequency of men was higher than that of women, and the frequency of men in other countries was also higher than in this study. The high frequency of traffic accidents leading to spinal Fracture in Iranian men can be due to risky driving behaviors in men compared to women, and the lack of safety standards in domestic cars, so to reduce the statistics of accidents leading to injuries in Iran, there is a need for safe driving training, improving road and vehicle safety standards and enforcing stricter driving laws.

In the present study, the mean (SD) age of the patients at the time of injury was 40.5 (16.6) years. Sixty-one percent were between 20 and 49 years, and 14.4% were over 60 years old. In the study by Degais et al. in Sudan, 42% of the participants were between 20 and 39 years old, and 15% were over 50 years old (Degais et al., [23]). In the Alghahtani et al. study in Saudi Arabia, 54.9% of patients were between 21 and 40 years old [11]. In another study, Alghahtani reported that 66.3% of patients were between 19 and 45 years old [24]. In Wu et al.'s study, the mean age was 37.3 years (Wu et al., [25]). Fernández et al. conducted a meta-analysis study in North America, showing that the mean age was 30.2 years, with the main age group of injured patients being 15-35 years [27]. In Yuan et al.'s study of spine injury in motor vehicle collisions in people over 18 years old, the mean age was 44.4 years, and 13.1% were over 60 years old [21]. In the study by Wang et al. in southwest China, the mean age was 40.5 years [26]. This issue may be because younger people with limited driving experience are more at risk of being involved in traffic accidents. Therefore, addressing this problem requires increased attention to safe driving training for younger age groups.

In this study, the highest frequency of injury was observed in the lumbar (40.6%) and thoracic (24.9%) regions. The highest frequency of fractured vertebrae was noted in L2, T12, L1, and T11, respectively. Additionally, 3.1% of patients had a spinal cord injury. In addition, length of hospital stay, admission to ICU, mortality, cord injury, occupant position, type of vehicle, type of accident, surgery, and ASIA had a statistically significant relationship with the level of injury. In Fakharian et al.'s study, 68.4% of patients were injured in the lumbar, 20.9% in the thoracic, and 6.6% had a spinal cord injury [22]. In Alghahtani et al.'s study in Saudi Arabia, 3.3% had spinal cord injury, and the leading site of injury was lumbar and sacral. The level of injury had a significant relationship with gender and length of stay [11]. In another study by Alghahtani on spinal cord trauma due to traffic accidents in Saudi Arabia, lumbar and cervical were the most frequent sites of injury, and 6.9% had spinal cord injury [24]. In Wu et al.'s study, the frequency of cervical and thoracic injuries was the highest, and a statistically significant relationship was observed between the level of injury and age [25]. In a meta-analysis study in North America, Fernández et al. showed that the frequency of injuries due to traffic accidents was thoracic (57.87%), cervical (35.32%), and lumbar (6.8%), respectively [27]. In the study of Rao et al., the leading site of injury was the thoracic and lumbar [28]. In Yuan et al.'s study, the most common fracture location was the lumbar (36%), cervical (30.6%), and thoracic (21.9%), respectively, and the fracture location was correlated to age, sex, and car occupant position [21]. In Wang's et al. study on the pattern of traumatic spine fractures (TSFs) caused by motor vehicle collisions (MVCs), The most common fracture levels were L1, T12, and C2, and the most common fracture levels of motorcycle drivers were C3-C7. In contrast, drivers and passengers had fractures in T11-L2 [26]. Considering that in accidents, fractures of lumbar and thoracic vertebrae are very common and if the injury is severe, it causes damage to the spinal cord. Hence, the results of this study differ from some studies in terms of the location of the injury; however, in terms of the number of lesions, the spinal cord findings are similar to those of other studies.

In the present study, 61.3% of the injured were drivers and 30.2% were passengers. Gender, marital status and neck injury had a statistically significant relationship with car occupant position leading to the accident. In Fakharian et al.'s study, 86.8% of the participants were drivers, and no relationship was found between occupant position and the accident mechanism, spinal cord injury, or injury level. However, a significant relationship was observed between the accident mechanism and the level of injury [22]. In Wu et al.'s study, 43.9% of the injured were passengers, and 40.2% were drivers; moreover, a significant relationship was found between gender, type of vehicle, injury level, and car occupant position [25]. In the meta-analysis study by Fernandez et al., car accidents accounted for 50.61% and motorcycle accidents for 49.06%, respectively [27]. In the study by Degais et al., 63% of the injured were drivers [23]. In Yuan et al.'s study, 41.7% of the participants were drivers, and car occupant position was correlated with age, sex, type of vehicle, spinal cord injury, and fracture site [21]. In Wang's study, the highest frequency of injury was observed in accidents involving a collision mechanism, with rates of 27.1% for drivers, 22.2% for pedestrians, and 20.8% for passengers [26]. The rate of accidents among vehicle drivers in Iran is high compared to other countries. This can be due to improper driving behaviors, such as not following the rules, illegal speed, driver fatigue, and distraction, as well as technical vehicle defects that indicate weaknesses in vehicle maintenance and technical inspection.

In this study, 52.9% were injured due to car rollover, and education, car occupant position, waist, and neck injuries had a statistically significant relationship with the vehicle accident mechanism. In the study by Fakharian et al., the mechanism of the accident in 70.3% of cases was a car rollover, and this mechanism had a significant relationship with the location of the injury [22]. In Farag's study, 58% of traffic accidents were due to rollover [29]. In Alslamah et al.'s study, 15% of the cases were due to the rollover of the car [30]. In Wu's study, 13.9% was due to care rollover [25].

Spine injuries in a car rollover usually cause cervical or lumbar vertebrae fractures, which cause serious and sometimes irreparable injuries. Considering that car rollovers can be caused by various factors, such as human factors, the car's technical defects, road conditions, and environmental factors, the severity of these injuries can be reduced by eliminating the defects and improving the factors that cause them, as well as improving the car's safety systems and using seat belts.

In this study, 3.4% of patients with spinal fractures died in the hospital. In Alghahtani's study, 5.18% of patients died [24]. In a review study in Saudi Arabia, the death rate due to accidents was estimated at 4.7% [30]. In Australia, Great Britain, and the United States of America, what is the percentage of deaths from road accidents? It is less than 1.7% [31]. In the study by Andalib et al., 1.6% of participants died [32]. The mortality rate of patients with spinal injuries in road accidents in Iran is higher than other countries, which can be because the severity of spinal injuries with car rollover and severe collisions in road accidents cause serious injuries to the spine such as vertebral fractures, dislocations and injuries, that can lead to paralysis and death, also the low quality of cars due to defects in the design and manufacturing causes more serious injuries to the passengers in accidents, can also be a reason for the high rate of deaths in road accidents in this study.

Some Limitations of the present study

First, the retrospective study design and the small sample size limited its findings. Second, there may be a selection bias because this study included patients referred to our teaching hospitals.

Conclusion

Traumatic spine injuries caused by traffic accidents are usually associated with vertebral fractures. As in other studies, the frequency of young people and the proportion of men injured due to traffic accidents were higher. The leading cause of traffic accidents was vehicle rollover, and drivers had the most spinal injuries. Therefore, considering that various reasons such as human factors(improper driving and disobeying driving rules such as high speed, illegal overtaking and driver's distraction and driver's inexperience), vehicle technical defects, road conditions and environmental factors cause the occurrence of traffic accidents leading to injuries to the spine, especially in high-risk populations such as young men, therefore, the severity of these injuries can be reduced by removing the defects and Improving the factors that cause it, also improving car safety systems and increasing the use of seat belts.

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Conflict of Interest Disclosures

There is no conflict of interest.

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Authors' Contributions

Study conception: GR, SJ, MS, AS, AH
Data collection: SJ, YP, DB, SB, AM, AS
Analysis: GR, AH, MS, AA
Investigation: SJ, AH, GR, MS, AS, AM
Writing: MS, FG, GR
Critical review and revision: all authors
Final approval of the article: all authors

Ethical Statement

This article is part of a project with the specific Ethics ID code IR.ARAKMU.REC.1403.006.

Declaration of Generative AI and AI-assisted technologies

Not cleared.

Informed consent information

Consent was not required because this study used data from a registry system rather than personalized data.

Availability of data and materials

In order to protect the supporting data of this manuscript, it will not be available publicly. The author may provide data upon request.

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