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Epidemiology of Adult Trauma at a Tertiary Hospital in Riyadh, Saudi Arabia

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ABSTRACT

Objective: *To identify the type and mechanism of trauma-based on patients' characteristics at a tertiary hospital in Riyadh, Saudi Arabia.* ***Methods:*** *The study was a retrospective cohort observational study using the Trauma Registry of King Abdulaziz Medical City, Riyadh, Saudi Arabia. The study period was from January 2015 to December 2018. The data gathered were demographic information, mortality, type and mechanism of injury, Glasgow Coma Scale (GCS), Injury Severity Score (ISS) and the Triage Revised Trauma Scale (T-RTS). Categorical data are described with percentage and frequency, and numerical data with mean and standard deviation. A Chi-square was used to assess the relationship between the type of trauma and patient characteristics. A Fisher exact test was used to compare the type of injury with the other variables. A p-value of less than 0.05 was considered statistically significant.* ***Results:*** *A total of 4083 participants. The majority were male (79.9%, n=3263). Blunt trauma was the most prevalent type of injury (87.4%, n=3570, p<0.001). A motor vehicle accident was the most prevalent mechanism of injury (42.1%, n=1717). The highest proportion of trauma per age group was in the 21-30 year age group (32.6%, n=1331). The lowest GCS and RTS mean scores were observed in blunt trauma (p<0.001 and 0.001 respectively). In addition, the highest ISS mean score was observed in the blunt trauma subgroup (p<0.001).* ***Conclusion:*** *The study highlights the type and mechanism of trauma at KAMC in Riyadh, Saudi Arabia, based on gender, age groups, types of trauma and mechanisms of injury. This data will be a valuable resource for the local healthcare system.*

Keywords: Trauma registry, Blunt trauma, Motor vehicle accidents, Adult trauma

INTRODUCTION

Traumatic injuries are a major health concern and one of the causes of morbidity and mortality worldwide [1]. Globally, it is the sixth leading cause of mortality, and ranked as the fifth leading cause of disability for both genders, the prevalence of mortality due to trauma-related injuries is one in every ten deaths [2]. Previous studies indicated that trauma is the primary cause of mortality and disability in adults younger than 35 years [2]. The Disability-adjusted life year (DALY) represents the difference between the current life status of a patient compared to an ideal person who lives a long healthy life. Traumatic injuries are expected to be the leading cause of DALY and surpass communicable diseases globally by 2020 [3].

Road traffic accidents (RTAs) are a major socio-economic burden for not only the victims, but also their families, hospitals, rehabilitation centers, and the Saudi government. The estimated annual cost of RTAs for the country is SAR 21 billion, a loss of 2.2% to 9% of the gross domestic product [4]. Statistically, trauma is considered as the first cause of mortality in Saudi Arabia, with road traffic injuries accounting for 80% to 85% of these traumas [5]. In 2008, there were 484,805 road traffic accidents in Saudi Arabia with 6,142 deaths, translating to 17 RTA related deaths in Saudi Arabia every day [6].

A trauma registry is an important tool to improve healthcare outcomes. A well-designed trauma registry system

accumulates valuable data to be evaluated and linked to patient outcomes [7]. In addition, the data could be used by physicians to facilitate the development of preventive strategies to reduce the mortality and morbidity related to these preventable traumatic injuries. Collaboration with the Saudi Ministry of Education and the Saudi General Department of Traffic is required to educate students about general traffic rules and the avoidance of traffic accidents. Informing students about the statistics related to mortality and disability may promote a higher level of obedience to traffic rules and regulations.

The aim of the study was to identify the type and mechanism of trauma and the gender and age group distribution to provide evidence of the statistics associated with these traumatic injuries.

METHODS

The study was a retrospective cohort observational study. Data were collected using the Trauma Registry of King Abdulaziz Medical City (KAMC) Riyadh, Saudi Arabia, considered as one of the largest trauma centers in Saudi Arabia. KAMC is a governmental hospital and part of the Ministry of National Guard-Health Affairs with a capacity of 1501 beds [8]. KAMC is serving the eastern region of Riyadh and its surrounding areas within the central province. The Emergency Care Center in KAMC is considered as the best Trauma Care Center in the Kingdom of Saudi Arabia and ranked as the 4th emergency care center outside the United States, which provides the Pre-Hospital Trauma and Life Support program (PHTLS) [8].

The study included adult trauma patients (>14 years) registered in the KAMC trauma registry. The inclusion criteria were a patient who complied with at least one of the following criteria: A patient admitted to the Emergency Department (ED) due to a trauma-related injury and who was: (1) admitted to a hospital ward or intensive care unit (ICU) from the ED, or (2) required surgery immediately after admission to the ED, or (3) discharged from the ED but requested to return later. In addition, patients who died after admission to the ED of was deceased on arrival due to the trauma-related injury, as well as patients who are transferred to KAMC due to traumatic injuries were also included. A non-probability consecutive sampling technique was used and all patients admitted to the ER following a traumatic injury and meeting the inclusion criteria were included. The sample simple size was 4083. According to a previous study, the least common cause of trauma was drowning with a 1.8% frequency. If the confidence interval is considered at 95%, the margin of error would be 0.37% [9].

The following data were extracted: Demographic characteristics, type of transportation, intubation days, ICU length of stay (LOS), hospital LOS, date of admission, and mortality rate. The type of injury was classified as blunt trauma, burns, and penetrating injuries. The mechanism of injury included motor vehicle accidents (MVA), motorcycle accidents, pedestrian, falls, flame burn, scald burn due to liquid, homicide and injury inflicted by another person, suicide and self-inflicted injury, gunshots, stab wounds and other penetrating injuries, and other accidents.

The Trauma Registry Centre at KAMC records additional variables measuring the severity of the traumatic injury, including the Glasgow Coma Scale (GCS), Injury Severity Score (ISS), and Triage Revised Trauma Scale (T-RTS). Physiological severity is measured with the GCS using an ordinal scale [10]. The GCS ranges from 3 (deep coma) to 15 (normal). The GSC score is obtained by totaling the scores for three categories namely motor, verbal and eye-opening responses [11]. Anatomical severity is measured with the ISS ranging from 1 to 75, a higher score indicates a more severe injury. The Trauma Registry Centre calculates the score based on the Abbreviated Injury Scale (AIS) codes [12]. The T-RTS is combining three variables which are: GCS score, systolic blood pressure and respiratory rate. The three variables are categorized in intervals and provide a score ranging from 0 to 12, a low score indicates a severe physiological status [13].

Data was entered into a Microsoft Excel sheet and transferred to the Statistical Package SPSS version 24 for statistical analysis. Percentage and frequency were used to describe categorical data such as type of trauma. Mean and the standard deviation was used to describe numerical data such as age. A Chi-square was used to assess the relationship between the type of trauma and patient characteristics. A test with a $p<0.05$ was considered statistically significant.

RESULTS

A total of 4385 patients who were registered in the King Abdulaziz Medical City trauma registry from January 2015 to December 2018, 4083 were included in the study. The proportions of annual admissions contributing to the total

sample size were 19% (n=776) in 2015 and 26.4% (n=1079) in 2016. In 2017 and 2018, the admissions increased in comparison to 2016 with 27.4% (n=1117) in 2017 and 27.2% (n=1111) in 2018.

The highest frequency of trauma admissions occurred in December (9.8%, n=401), followed by November (9.4%, n=382). In contrast, August had the lowest frequency of trauma admissions (7.3%, n=299), followed by September (7.5%, n=307). In comparison to the prior months, in January 8.5% (n=349) was admitted, in February 7.6% (n=312), in March, 8.5% (n=347), in April 9.1% (n=373), in May 8.0% (n=327), in June 7.9% (n=322), in July 8.3% (n=337) and in October, 8.0% (n=327). There appear to be a rising trend for the second half of the year (Figure 1 and Table 1).

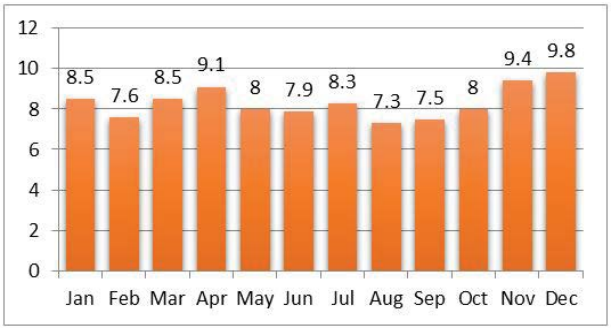

Figure 1 Trauma admissions proportion based on months

Table 1 Trauma admission proportion based on months\may be deleted

Months	Frequency	Percentage (%)
January	349	8.5%
February	312	7.6%
March	347	8.5%
April	373	9.1%
May	327	8.0%
June	322	7.9%
July	337	8.3%
August	299	7.3%
September	307	7.5%
October	327	8.0%
November	382	9.4%
December	401	9.8%
Total	4083	100%

The 21-30 year age group had the highest trauma proportion (32.6%, n=1331) in the sample followed by the 14-20 year age group with 19.7% (n=806) and the 61 plus age group 16.9% (n=689) (Table 2). The majority of the sample was male (79.9%, n=3262) and Saudi nationals (86.7%, n=3541). In terms of transportation, half of the trauma patients arrived in a private vehicle (49.1%, n=2006). Related to the type of trauma, the majority (87.4%, n=3570) was due to blunt trauma, followed by a penetrating injury (7.3%, n=300) and burn-related trauma (5.2%, n=213). Finally, the mechanism of injury with the highest proportion was MVA (42.1%, n=1717) followed by fall injury with 28.4% (n=1159).

Table 2 Demographic characteristics of the participants, type of injury and mechanism of injury

Variable	Category	Count N (%)
Age (years)	14-20	806 (19.7%)
	21-30	1331 (32.6%)
	31-40	598 (14.6%)
	41-50	339 (8.3%)
	51-60	320 (7.8%)
	61+	689 (16.9%)

Gender	Male	3263 (79.9%)
	Female	820 (20.1%)
Nationality	Saudi	3541(86.7%)
	Non-Saudi	542 (13.3%)
Transportation	ALS ambulance	115 (2.8%)
	BLS ambulance	1903 (46.6%)
	Private vehicle	2006 (49.1%)
	Helicopter	49 (1.2%)
	Police	6 (0.1%)
	Not done	4 (0.1%)
Type of injury	Blunt	3570 (87.4%)
	Burn- Scald	213 (5.2%)
	Penetrating	300 (7.3%)
Mechanism of injury	Motor Vehicle Accident	1717 (42.1%)
	Motorcycle Accident	195 (4.8%)
	Pedestrian	219 (5.4%)
	Burn due to fire or flames	139 (3.4%)
	Fall	1159 (28.4%)
	Scald or burn due to liquid	33 (0.8%)
	Homicide and Injury Purposely Inflicted by Other Persons	49 (1.2%)
	Suicide and Self-Inflicted Injury	7 (0.2%)
	Penetrating - Gunshot	109 (2.7%)
	Penetrating-stab	133 (3.3%)
	Penetrating-other	58 (1.4%)
	Other Accidents	265 (6.5%)

The type of injury with the highest proportions for the 14-20 year age group was Blunt trauma (86.5%, n=697) (Table 3). The proportion of burn injury and penetrating were relatively small, 5.0% and 8.6% respectively. An equally high proportion of the 21-30 year age group was due to blunt trauma (85.0%, n=1132). However, the proportion of Penetrating injury increased to 11.0% (n=146). It is noteworthy that the proportion of Blunt injury increased with age. The highest proportion of Blunt trauma in the various age groups was in the 61 years plus age group (96.4%, n=664) and secondly, 89.7% (n=287) for the 51-60 year age group. The p-value was less than 0.001.

Table 3 Distribution of type based on age group, gender, nationality and mode of transportation

Variable	**Category**	**Type of Injury**			**p-value**
		Blunt	**Burn- Scald**	**Penetrating**	
		N (%)	**N (%)**	**N (%)**	
Age (years)	14-20	697 (86.5%)	40 (5.0%)	69 (8.6%)	<0.001
	21-30	1132 (85.0%)	53 (4.0%)	146 (11.0%)	
	31-40	503 (84.1%)	42 (7.0%)	53 (8.9%)	
	41-50	287 (84.7%)	29 (8.6%)	23 (6.8%)	
	51-60	287 (89.7%)	28 (8.8%)	5 (1.6%)	
	61+	664 (96.4%)	21 (3.0%)	4 (0.6%)	
Gender	Male	2828 (86.7%)	163 (5.0%)	272 (8.3%)	<0.001
	Female	742 (90.5%)	50 (6.1%)	28 (3.4%)	
Nationality	Saudi	3123 (88.2%)	158 (4.5%)	260 (7.3%)	<0.001
	Non-Saudi	447 (82.5%)	55 (10.1%)	40 (7.4%)	
Transportation	ALS ambulance	100 (87.0%)	2 (1.7%)	13 (11.3%)	<0.001*
	BLS ambulance	1708 (89.8%)	96 (5.0%)	99 (5.2%)	
	Private vehicle	1714 (85.4%)	114 (5.7%)	178 (8.9%)	
	Helicopter	43 (87.8%)	1 (2.0%)	5 (10.2%)	
	Police	1 (16.7%)	0 (0.0%)	5 (83.3%)	
	Not done	4 (100.0%)	0 (0.0%)	0 (0.0%)	
*Fisher exact test					

In terms of gender, the proportion of blunt trauma for males were 86.7% (n=2828) which is lower when compared to the female subgroup (90.5%, n=742) (Table 3). The proportion for both genders for burn injury was relatively small (5.0% for males and 6.1% for females) However, regarding Penetrating injuries, the males (8.3%, n=272) had a higher proportion compared to the females (3.8%, n=28) (p<0.001). Blunt trauma was also the majority for both nationality subgroups (88.2%, n=3123 for Saudis and 82.5%, n=447 for non-Saudis). The non-Saudi subgroup had a higher proportion of Burn (scald) injuries than the Saudi subgroup (10.1% *vs* 4.5%) (p<0.001).

When comparing the GCS mean scores with the type of injury, the lowest GCS score was recorded for Blunt trauma (13.2, SD ± 3.7), followed by the Penetrating injuries (14.1, SD ± 2.9) and burn scalding injuries (14.3, SD±2.6) (p<0.001). For the RTS the findings were as follows: the lowest score was for blunt trauma (11.2, SD ± 2.1), followed by penetrating injuries (11.4; SD ± 1.8) and burn (scalding) (11.7, SD ± 1.2) (p=0.001). Finally, the highest ISS mean score was found for Blunt trauma (11.9, SD ± 13.4), followed by burn injury (scalding) (10.8, SD ± 12.8) and penetrating injury (7.9, SD ± 10.9) (p<0.001) (Table 4).

Table 4 Trauma scoring systems and types of injury

Variable	Type of Injury	Mean + SD	Median	(Q1, Q3)	p-value
GCS	Blunt	13.2 + 3.7	15	(14.0, 15.0)	<0.001
	Burn-Scald	14.3 + 2.6	15	(15.0, 15.0)	
	Penetrating	14.1 + 2.9	15	(15.0, 15.0)	
RTS	Blunt	11.2 + 2.1	12	(12.0, 12.0)	0.001
	Burn-Scald	11.7 + 1.2	12	(12.0, 12.0)	
	Penetrating	11.4 + 1.8	12	(12.0, 12.0)	
ISS	Blunt	11.9 + 13.4	9	(4.0, 13.0)	< 0.001
	Burn-Scald	10.8 + 12.8	4	(4.0, 16.0)	
	Penetrating	7.9 + 10.9	5	(1.0, 9.0)	
GCS: Glasgow Coma Scale; RTS: Revised Trauma Score; ISS: Injury Severity Score					

Regarding the type of injury and mortality rate (Table 5), the majority was Blunt trauma (87.4%, n=3570). Of this subgroup, a small proportion (2.40%, n=87) was deceased on arrival and 4.1% (n=146) died after being admitted to the ER. For Penetrating injuries (7.3%, n=300), the proportion who was deceased on arrival was 1.7% (n=5) and 4.3% (n=13) died after admission. The smallest proportion in terms of the type of injury was Burn (scalding) (5.2%, n=213) and for this subgroup, none was deceased on arrival and 7.50% (n=16) died after admission (p=0.028).

Table 5 Type of injury and mortality

Type of Injury	Death on arrival	Death at hospital	p-value
	N (%)	N (%)	
Blunt	87 (2.4%)	146 (4.1%)	0.028
Burn- Scald	0 (0.0%)	16 (7.5%)	
Penetrating	5 (1.7%)	13 (4.3%)	

The mechanism of injury and mortality was also investigated. The most prevalent mechanism of injury was a MVA (42.1%, n=1717). Of this subgroup, 3.3% (n=57) was deceased on arrival and 5.5% (n=95) died after admission. The second most prevalent mechanism was fall (28.4%, n=1159) with a small proportion who were deceased on arrival (0.3%, n=3) or died after admission (1.4%, n=16). Of the Pedestrian injury subgroup (5.4%, n=219), 5.5% (n=12) was deceased on arrival and 11.0% (n=24) died after admission. Regarding Penetrating injuries, the category was subdivided in gunshot, stab and others. Of the gunshot subgroup (2.7%, n=109), 4.60% (n=5) was deceased on arrival and 8.30% (n=9) died after admission.

For burn injuries, the total was 3.4% (n=139) and 11.5% (n=16) died after admission. Lastly, the proportion of the suicide subgroup was relatively small (0.2%, n=7) and 14.3% (n=1) was deceased on arrival (p<0.001) (Table 6).

Table 6 Mechanism of injury and mortality

Mechanism of injury	Death on arrival	Death at hospital	p-value
	N (%)	N (%)	
Motor Vehicle Accident	57 (3.3%)	95 (5.5%)	<0.001
Motorcycle Accident	3 (1.5%)	5 (2.6%)	
Pedestrian	12 (5.5%)	24 (11.0%)	
Burn due to fire or flames	0 (0.0%)	16 (11.5%	
Fall	3 (0.3%)	16 (1.4%)	
Scald or burn due to liquid	0 (0.0%)	0 (0.0%)	
Homicide and Injury Purposely Inflicted by Other Persons	0 (0.0%)	0 (0.0%)	
Suicide and Self-Inflicted Injury	1 (14.3%)	0 (0.0%)	
Penetrating-Gunshot	5 (4.6%)	9 (8.3%)	
Penetrating-stab	0 (0.0%)	4 (3.0%)	
Penetrating-other	0 (0.0%)	0 (0.0%)	
Other Accidents	11 (4.2%)	6 (2.3%)	

DISCUSSION

The Trauma Registry of KAMC is an excellent instrument to support trauma-related research and the mortality rate associated with trauma. The availability of the data enables researchers, the Ministry of Health and the Saudi General Department of Traffic to investigate the problem and develop safety measures to reduce the prevalence of these preventable injuries in Saudi Arabia.

Though the epidemiology of trauma is readily available in developed countries, there is a significant lack of studies regarding trauma epidemiology in Saudi Arabia. The objective of the current study was to determine the epidemiology of adult trauma based on the data obtained from one of the biggest trauma centers in Saudi Arabia. A national trauma registry is recommended to be used in each trauma center to enable the centers to contribute to a national database to increase our understanding of trauma injuries, the mechanism of injury and the most affected population in Saudi Arabia.

Blunt trauma was the most prevalent type of injury (87.4%), predominantly male. RTAs are the most prevalent mechanism of blunt trauma, accounting for 42.1% of all cases, again predominantly male. It should be noted that females were not allowed to drive in Saudi Arabia for a major part of the study period. In the future, the results may be different regarding gender distribution. Penetrating injuries were the second most frequent type of injury (7.3%) followed by a small proportion of burn injuries (5.2%).

The current study investigated the mortality rate in terms of age, gender, nationality, type of injury and mechanism of injury. The proportion of the 21-50 year age group who died after admission was 9.6% (n=72) compared to 2.2% (n=18) in the 14-20 year age group and 0.6% (n=2) of the 51-60 year age group. The finding provides evidence that traumatic injury is more likely to occur in active age groups. Regarding gender, the majority were male (79.9%, n=3263), though this finding is not unexpected, and 2.7% (n=88) was pronounced deceased on arrival at the hospital. We also found that pedestrians have a higher likelihood of mortality, followed by burns due to fire or flames, MVA, and blunt trauma.

Our study highlighted the types of traumatic injuries with a higher risk of mortality. The study provides valuable baseline data for future studies in this area due to the recent shifting of protocols in the Saudi system. The study provided evidence that the most prevalent mechanism of injury was a motor vehicle accident.

CONCLUSION

Traumatic injuries are a major socio-economic burden for victims, families of victims, hospitals, rehabilitation centers, and the Saudi government. The most common mechanism of injury was motor vehicle accidents and the estimated annual cost of MVAs to the Saudi government is 21 billion SAR, which is a loss of 2.2% to 9% of the gross domestic product.4 Statistically, trauma is considered as the first cause of mortality in Saudi Arabia, with road traffic injuries accounting for 80% to 85% of these traumas. This study highlighted the epidemiology of adult trauma >14 years old who were admitted to one of the largest trauma centers in Riyadh.

The results of the study showed that the majority of the included data of traumatic patients was male (79.9%, n=3263). Blunt trauma was the most prevalent type of injury (87.4%, n=3570). A motor vehicle accident was the most prevalent mechanism of injury (42.1%, n=1717). The highest proportion of trauma was admitted in December (9.8%, n=401) and the highest proportion of trauma per age group was in the 21-30 year age group (32.6%, n=1331). The lowest GCS and RTS mean scores were observed in blunt trauma. In addition, the highest ISS mean score was observed in the blunt trauma subgroup.

The findings of this study emphasize the need to develop a national cooperative institution to investigate more about these preventable injuries at the national level and to develop an effective strategy in order to decrease the trauma incidence. Moreover, collaboration with the Saudi Ministry of Education and the Saudi General Department of Traffic is required to educate students about general traffic rules and the avoidance of traffic accidents. Informing students and the general population through campaigns about trauma statistics related to mortality and disability may promote a higher level of obedience to traffic rules and regulations. Finally, physicians should provide anticipatory guidance about trauma to their patients.

DECLARATION

Conflict of Interest

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

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