Ain Shams Journal of Forensic Medicine and Clinical Toxicology
July 2023, 41: 1-13

Pattern of Injuries among Victims of Motor Car Accidents admitted to Tanta University Emergency Hospital

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Abstract

Background: Road traffic accidents (RTAs) are one of the leading causes of death and disability worldwide. Trauma patterns will depend on the victim's position. Determination of the pattern of injuries in both pedestrians and car occupants is a step to improve road safety. **Objectives:** To evaluate the pattern of injuries among pedistrians, drivers and passengers of motor car accidents admitted to Tanta University Emergency Hospital. **Methodology:** It was a prospective cross-sectional study that was conducted on victims of motor car accidents admitted to Tanta University Emergency Hospital from the 1st of November 2021 to the end of October 2022. Socio-demographic, details of accident, clinical evaluation, and pattern of injuries, treatment and outcomes were recorded. Injury Severity Score (ISS) and New Injury Severity Score (NISS) were calculated. **Results:** 86 victims of motor car accidents were admitted to Tanta Emergency Hospital (38 pedestrians, 41 driver and 7 passengers). There was a significant association between head & neck, facial &chest injuries and the studied groups with a significantly higher incidence among pedestrians. The face skin injuries were significantly higher among passengers. Upper limb, lower limb and spine injuries were higher among drivers. **Conclusion:** Identification of pedestrians, drivers and passengers could be based on pattern of sustained injuries. Concerning pedestrians, head & neck injuries, facial injuries and chest injuries were characteristic. Drivers showed different combination as, upper & lower limbs injuries together with spine injuries were most detected. Face skin injuries were the most specific injuries that occurred in passengers.

Received in original form: 23 December 2022 Accepted in a final form: 31 May 2023

Key words pattern of injuries, pedestrians, drivers, passengers, motor car accidents

Introduction

Road traffic accidents (RTAs) are one of the leading causes of death and disability worldwide (Al-Zamanan et al., 2018; Ambade et al., 2021). According to World Health Organization (WHO), RTAs result in death of nearly 1.36 and 1.9 million people in 2018 and 2020 respectively (Tekyol et al., 2020; Ambade et al., 2021). This public health problem is most prominent in developing countries where most of global road traffic deaths occur (Younis and Adel, 2019).

Egypt was reported to be one of the highest countries with RTAs rate in Africa and Middle East as stated by statistics of WHO (2018). Although, protective technologies in modern vehicles and great advances in road infrastructures, motor car accidents remain a leading cause of mortality and disability in younger people (Daskal et al., 2018).

Great attention has been made to improve safety measures for both drivers and passengers. However, pedestrian injuries have been less assessed with more attention to mortality (Ambade et al., 2021). European countries have started to pay attention to pedestrian injuries to decrease such injuries (Malin et al., 2020).

In severe injuries, trauma patterns will depend on the victim's position. Determination of the pattern of injuries in both pedestrians and car occupants along with accident circumstances is a step to improve road safety (Daskal et al., 2018; Solinas et al. 2019).

There has been a relative dearth of studies conducted to describe pattern of injuries in pedestrians, drivers and passengers of motor car accidents. Therefore, the aim of this study was to evaluate the pattern of injuries among pedestrians, drivers and passengers of motor car accidents admitted to Tanta University Emergency Hospital.

Patients and Methods

This study was a prospective cross-sectional study. Based on ethical approval of the medical research ethical committee of Tanta Faculty of Medicine, all patients (or their guardians) were asked to provide informed written consent for participation after receiving detailed information about the study. Confidentiality of the data was maintained by making code numbers for each patient.

Eligibility criteria include victims of motor car accidents admitted to Tanta University Emergency Hospital from the 1st of November 2021 to the end of October 2022.

Any patient admitted to Tanta University Emergency Hospital due to any cause rather than motor car accidents was excluded from the study. Furthermore, pregnant females, victims who are returning for check-ups and/or victims who died either at the scene or en route to the hospital were similarly excluded. Moreover, victims with any intervention before reaching the hospital were excluded.

Socio-demographic data of included cases were recorded. Details of the accident including; accident location, time and delay time till reach the hospital were reported. Clinical evaluation included assessment of vital signs, conscious level using Glasgow Coma Score (GCS), followed by full trauma survey using both clinical and radiological assessment as needed.

Injury evaluation included assessment of all injuries, recording and sorting according to site into: head and neck injuries, facial injuries, chest injuries, abdomen and pelvic contents injuries, bony pelvis, spine and limbs injuries. Using clinical and radiological data the Injury Severity Score (ISS) and New Injury Severity Score (NISS) were calculated for all included patients.

- Injury Severity Score (ISS) is an index of anatomical injury. ISS more than 15 was considered to represent severe injury (Nayeem et al., 1992).
- New injury severity score (NISS) has been proposed to consider the three most severe injuries, regardless of body region. It is highly predictive of patient's survival with good statistical performance (Stevenson et al., 2001).

Both ISS and NISS were calculated from the Abbreviated Injury Scale (AIS) as shown in table (I) (Nayeem et al., 1992; Van Natta & Morris, 2000). Abbreviated Injury Scale divides the human body into seven regions (head, neck, thorax, abdomen and pelvis, spine, extremities, and external) representing the reference system for injury grading in different body regions.

For ISS, these seven body regions are grouped into six (head and neck, face, chest, abdominal and pelvic contents, extremities and pelvic girdle, and finally external). Each region take a score of injuries ranging from minor (1) to major (6) depending on the severity of the injury on a trauma chart.

The ISS is calculated as the sum of squares of the highest three scores of these six body regions (Greenspan et al., 1985). On the other hand, the NISS depends on the sum of squares of the three most severe AIS regardless the body region (Stevenson et al., 2001).

Treatment was either operative or conservatory, with recording of the place of admission and final outcome either improved or died.

Statistical analysis

Data analysis was performed using the Statistical Package for Social Sciences (IBM SPSS Statistics) version, version 26 for Windows (IBM Corp., Armonk, N.Y., USA). Categorical variables were summarized as numbers and percentages. Continuous numerical variables were first tested for distribution using the Shapiro-Wilk test for normality. The variables did not follow the normal distribution and were described as the median and interquartile range (IQR; expressed as the 25^{th}-75^{th} percentiles). The association between categorical variables was tested using Pearson’s Chi-square test for independence of observations or Fisher-Freeman Halton exact test as indicated. Continuous numerical variables were compared between the groups using the Kruskal-Wallis test. The correlation between numerical and ordinal variables was tested using the Spearman’s rank-order correlation. MedCalc Statistical Software version 15.8 was used to perform the analysis of receiver operating characteristics (ROC) curve. The area under the curve (AUC) was graded excellent (0.90-1.00), good (0.80-0.90), fair (0.70-0.80) and poor (0.60- 0.70). Pairwise comparisons of the AUCs of the studied scores were done. A p-value <0.05 was chosen to interpret the results of statistical tests.

Results

During the study period, 86 victims of motor car accidents were admitted to Tanta Emergency Hospital (38 pedestrians, 41 driver and 7 passengers).Table (1) shows sociodemographic data of the three studied groups. There was a significant association between sex and the three categories of motor car accidents victims. The percentage of female victims in pedestrians was significantly higher, while the male victims were significantly higher in the drivers.

A significant association was found between time of accident and the three studied categories. In day time accidents, pedestrians registered a significantly higher incidence of injuries. Conversely, drivers’ injuries were significantly higher during night time (Table 2). Regarding the accident location, highway roads were significantly higher in drivers’ injuries, while in town roads were significantly higher in pedestrians’ injuries (Table 2).

There was no statistical significant difference between the three studied groups in both clinical stability and GCS. On the other hand, a statistically significant difference was found between pedestrians and drivers in both Injury Severity Score (ISS) and New Injury severity score (NISS) at the time of admission (Table 3).

As regard the pattern of injuries, there was a significant association between head & neck injuries and the three studied groups. The percentage of head & neck injuries was significantly higher in pedestrians. Moreover, a significant association was found between the scalp wounds, brain injuries and the three studied categories. The percentage of scalp contusion, laceration and brain injuries were significantly higher among pedestrians (Table 4).

Table (4) showed significant association between facial injuries, face skin injuries and the three studied groups. The percentage of facial injuries in pedestrians was significantly higher, while the face skin injuries were significantly higher among passengers.

Table (5) revealed significant association between chest injuries and the three studied groups, with a significantly higher incidence among pedestrians. Regarding abdomen, pelvis, upper limb, lower limb and spine injuries, there was non-significant association between these injuries and the studied groups. However, injuries in abdomen & pelvis were higher in pedestrians' group, while upper limb, lower limb and spine injuries were higher among drivers.

Figures (1&2) showed examples of reported injuries among pedestrians in motor car accidents. Figure (3) demonstrated Computerized Tomography (CT) scan of chest in motor car accident victim (Driver) showing bilateral hemothorax.

There was a significant association between the three studied groups and received treatment. Operative treatment was significantly higher among drivers. Likewise, there was significant association between place of admission and the three studied groups. The percentage of hospital wards admission was significantly higher in drivers, while the ICU admission was significantly higher in pedestrians' group. On the other hand, no significant association between mortality and the three studied groups was noticed (Table 6).

Table (7) and figure (4) present the receiver operating characteristics (ROC) curve analysis for the prediction of mortality using ISS & NISS. ISS had an area under the curve (AUC) of 0.875 which indicate its being a good predictor for mortality in victims of motor car accident, with 62.5% sensitivity at cut off value > 29 (specificity 94.3 %). NISS was also found to be good predictor for mortality in victims of motor car accident, (AUC =0.899) with 87.5% sensitivity at cut off value > 36 (specificity 78.6 %). However, there was no statistically significant difference among the AUCs of the studied scores (p values > 0.05).

Table (1): Socio-demographic data (age, gender and residence) of victims of motor car accidents admitted to Tanta University Emergency Hospital (N=86).

		Victims							
		Pedestrian (n = 38)		Driver (n = 41)		Passengers (n = 7)		Statistical test	p-value
Age									
Age (years)	Median[IQR]	26.5 [11.0 – 52.0]		30.0 [24.0 – 38.0]		18.0 [18.0 – 35.0]		Z = 1.773	0.412
	Min - Max	2.5 – 82.0		16.0 – 63.0		4.0 – 44.0			
	Mean rank	41.8		46.6		34.3			
	Mean rank	51.8		37.2		35.2			
Gender and Residence									
		N	%	n	%	n	%		
Gender	Female	12	31.6 $+	4	9.8 $-	1	14.3	X^2 = 5.833	0.048*
	Male	26	68.4 $-	37	90.2 $+	6	85.7		
Residence	Rural	25	65.8	21	51.2	3	42.9	X^2 = 2.370	0.384
	Urban	13	34.2	20	48.8	4	57.1		

N: number, Min: minimum, Max: Maximum, IQR: Inter quartile range, Z: Kruskal-Wallis test, X2: Chi-square Test, $+ significantly higher frequency than expected by chance, $- significantly lower frequency than expected by chance, * p-value significant < 0.05.

Table (2): Accident circumstances (time, location and delay before hospital admission) of victims of motor car accidents admitted to Tanta University Emergency Hospital (N=86).

		Victims							
		Pedestrian (n = 38)		Driver (n = 41)		Passengers (n =7)		Statistical test	p-value
Time and site of accident									
		N	%	n	%	n	%		
Accident time	Daytime	26	68.4 $+	16	39.0 $-	3	42.9	X^2 = 7.117	0.031*
	Nigh time	12	31.6 $-	25	61.0 $+	4	57.1		
Accident location	Highway roads	0	0.0 $-	13	31.7 $+	2	28.6	X^2 = 2.227	<0.001*
	Single carriageway roads	14	36.8	20	48.8	4	57.1		
	In-town road	24	63.2 $+	8	19.5 $-	1	14.3		
Time before hospital admission									
Delay time(hours)	Median [IQR]	1.00 [0.50-1.00]		1.00 [1.00-1.00]		1.00 [1.00-2.00]		Z = 3.904	0.142
	Min - Max	0.25-2.00		0.50-2.00		0.50-2.00			
	Mean rank	38.5		46.6		52.4			
	Mean rank	51.8		37.2		35.2			

N: number, Min: minimum, Max: Maximum, IQR: Inter quartile range, Z: Kruskal-Wallis test, X2: Chi-square test, $+ significantly higher frequency than expected by chance, $- significantly lower frequency than expected by chance, * p-value significant < 0.05.

Table (3): Clinical stability and clinical scores (GCS, ISS & NISS) reported on admission in victims of motor car accidents admitted to Tanta University Emergency Hospital (N=86).

		Victims							
		Pedestrian(n = 38)		Driver(n = 41)		Passengers(n = 7)		Statistical test	p-value
Clinical stability									
		N	%	n	%	n	%		
Clinical stability	Arrested	2	5.3	0	0.0	1	14.3	$X^2 = 5.264$	0.213
	Shock	12	31.6	10	24.4	1	14.3		
	stable	24	63.2	31	75.6	5	71.4		
Clinical scores									
GCS	Median [IQR]	9 [7-15]		14 [10-15]		14 [7-15]		Z = 2.078	0.354
	Min - Max	3-15		5-15		3-15			
	Mean rank	39.3		46.9		46.8			
NISS	Median [IQR]	34 [19-42] a		21 [10-33] a		18 [6-41]		Z = 9.181	0.010*
	Min - Max	5-75		1.0-48.0		2-75			
	Mean rank	52.6		36.2		36.7			
ISS	Median [IQR]	21 [17-29] a		17 [10-22] a		11 [6-26]		Z = 7.74	0.022*
	Min - Max	5-75		1-41		2-75			
	Mean rank	51.8		37.2		35.2			

N: number, Min: minimum, Max: Maximum, GCS: Glasgow Coma Scale, ISS: Injury Severity Score, NISS: New Injury Severity Score, IQR: Inter quartile range, Z: Kruskal-Wallis test, X2: Chi-square test, $+ significantly higher frequency than expected by chance, $- significantly lower frequency than expected by chance, * p-value significant < 0.05.

Table (4): Pattern of injuries (head, neck and face) in victims of motor car accidents admitted to Tanta University Emergency Hospital (N=86).

		Victims						**Statistical test**	
		Pedestrian(n=36)		**Driver(n=41)**		**Passengers(n=6)**		X^2	**p-value**
		n	**%**	**n**	**%**	**N**	**%**		
Head & neck injuries		23	63.9$+	13	31.7 $-	1	16.7	9.781	0.005*
Scalp wounds	Total cases	10	27.8	1	2.4	0	0.0	10.71	0.004*
	Contusion	5	13.9$+	0	0.0 $-	0	0.0	6.085	0.026*
	Lacerated wound	5	13.9$+	1	2.4	0	0.0	3.449	0.172
Skull fracture	Total cases	8	22.2	10	24.4	1	16.7	0.263	1.000
	Fissure	7	19.4	3	7.3	0	0.0	2.760	0.258
	Depressed	1	2.8	7	17.1	1	16.7	4.757	0.081
Meningeal hemorrhage	Total cases	10	27.8	10	24.4	1	16.7	0.314	0.927
	EDH	3	8.3	9	22.0	0	0.0	3.147	0.180
	SDH	4	11.1	3	7.3	0	0.0	0.887	0.522
	SAH	2	5.6	0	0.0	1	16.7	4.750	0.054
	IVH	3	8.3	0	0.0	0	0.0	3.478	0.185
Brain contusiuon/ Laceration /edema	Total cases	8	22.2$+	1	2.4 $-	0	0.0	7.486	0.019*
	Cerebellum contusions	2	5.6	0	0.0	0	0.0	F2.528	0.325
	Diffuse axonal injury	1	2.8	0	0.0	0	0.0	2.187	0.506
	Brain edema	2	5.6	0	0.0	0	0.0	2.528	0.325
	Intracerebral hematoma.	1	2.8	0	0.0	0	0.0	2.187	0.506
	Pneumocephalus	2	5.6	1	2.4	0	0.0	0.906	0.679
Facial injuries		22	61.1$+	12	29.3 $-	5	83.3	11.044	0.002*
Face skin	Total cases	17	47.2	12	29.3$-	5	83.3$+	7.073	0.026*
	Abrasions	2	5.6	0	0.0	0	0.0	2.528	0.325
	Contusion	7	19.4	4	9.8	2	33.3	3.164	0.176
	Black eye	2	5.6	5	12.2	0	0.0	F1.124	0.675
	Lacerated wound	6	16.7	3	7.3	2	33.3	3.876	0.110
	Cut wound	0	0.0	0	0.0	1	16.7	5.770	0.072
Facial bones & mandible		2	5.6	1	2.4	0	0.0	0.906	0.679

Eye	0	0.0	1	2.4	0	0.0	1.927	1.000
Ear	4	11.1	0	0.0	0	0.0	4.699	0.080

N: number, X2: Chi-square test, $+ significantly higher frequency than expected by chance, $- significantly lower frequency than expected by chance, * p-value significant < 0.05.

Table (5): Pattern of injuries (chest, abdomen, pelvis, extremities and spine) in victims of motor car accidents admitted to Tanta University Emergency Hospital (N=86)

		Victims						Statistical test	
		Pedestrian (n = 36)		Driver (n = 41)		Passengers (n = 6)		X^2	p-value
		n	%	n	%	n	%		
Chest injuries		19	52.8 $+	9	22.0 $-	4	66.7	9.871	0.007*
Chest bones	Fracture ribs & sternum	8	22.2	4	9.8	1	16.7	2.421	0.239
Lung	Contusion	12	33.3	6	14.6	1	16.7	3.776	0.113
Pleura	Total cases	11	30.6	5	12.2	2	33.3	4.613	0.091
	Hemothorax	5	13.9	2	4.9	0	0.0	1.971	0.359
	Pneumothorax	4	11.1	3	7.3	1	16.7	1.233	0.501
	Hemopneumothorax	2	5.6	0	0.0	1	16.7	4.750	0.054
Pericardium	Total cases	1	2.8	1	2.4	0	0.0	0.825	1.000
	Effusion	1	2.8	0	0.0	0	0.0	2.187	0.506
	Hemopericardium	0	0.0	1	2.4	0	0.0	1.927	1.000
Abdominal& pelvic injuries		8	22.2	5	12.2	1	16.7	1.518	0.592
Abdominal organs	Liver contusion	0	0.0	1	2.4	1	16.7	4.409	0.140
	Rupture spleen	0	0.0	2	4.9	0	0.0	2.001	0.566
Abdominal haemorrhage	Total cases	6	16.7	4	9.8	1	16.7	1.206	0.519
	Intraperitoneal haemorrhage	1	2.8	2	4.9	0	0.0	0.639	1.000
	Pelvic hematoma	4	11.1	1	2.4	1	16.7	3.578	0.131
	Retroperitoneal hematoma	1	2.8	1	2.4	0	0.0	0.825	1.000
Pelvic bones		7	19.4	3	7.3	0	0.0	2.760	0.258
Upper limb injuries		6	16.7	13	31.7	0	0.0	3.744	0.127
Upper limb skin	Total cases	2	5.6	6	14.6	0	0	1.803	0.406
	Abrasion	0	0.0	1	2.4	0	0.0	1.927	1.000
	Contusion	1	2.8	1	2.4	0	0.0	0.825	1.000
	Lacerated W	1	2.8	4	9.8	0	0.0	1.547	0.567
Upper limb bone	Total cases	5	13.9	12	29.3	0	0	3.736	0.175
	Amputation fingers	0	0.0	1	2.4	0	0.0	1.927	1.000
	Clavicle	2	5.6	1	2.4	0	0.0	0.906	0.679
	Hand	0	0.0	1	2.4	0	0.0	1.927	1.000
	Humerus	2	5.6	3	7.3	0	0.0	0.325	1.000
	Metacarpals	1	2.8	0	0.0	0	0.0	2.187	0.506
	Radius	0	0.0	3	7.3	0	0.0	2.675	0.398
	Scapula	0	0.0	2	4.9	0	0.0	2.001	0.566
	Ulna	0	0.0	1	2.4	0	0.0	1.927	1.000
Upper limb joint	Total cases	1	2.8	1	2.4	0	0	0.825	1.000
	Elbow dislocated	1	2.8	0	0.0	0	0.0	2.187	0.506
	Shoulder dislocated	0	0.0	1	2.4	0	0.0	1.927	1.000
Lower limb injuries		11	30.6	16	39.0	0	0.0	3.508	0.159
Lower limb skin	Total cases	3	8.3	7	17.1	0	0	1.580	0.412
	Contusion	1	2.8	2	4.9	0	0.0	0.639	1.000
	Lacerated wound	2	5.6	4	9.8	0	0.0	0.614	0.798
	Cut wound	0	0.0	1	2.4	0	0.0	1.927	1.000
Lower limb bone	Total cases	8	22.2	13	31.7	0	0	2.645	0.285
	Femur	3	8.3	4	9.8	0	0.0	0.272	1.000
	Fibula	0	0.0	1	2.4	0	0.0	1.927	1.000
	Tibia	0	0.0	2	4.9	0	0.0	2.001	0.566
	Tibia fibula	5	13.9	6	14.6	0	0.0	0.488	1.000
Lower limb joint	Ankle dislocated	0	0.0	1	2.4	0	0.0	1.927	1.000

Spine injuries	0	0.0	2	4.9	0	0.0	2.001	0.566

N: number, X2: Chi-square test, $+ significantly higher frequency than expected by chance, $- significantly lower frequency than expected by chance, * p-value significant < 0.05

Table (6): Management and outcome in victims of motor car accidents admitted to Tanta University Emergency Hospital (N=86).

		Victims						Statistical test	
		Pedestrian(n = 38)		Driver(n = 41)		Passengers(n = 7)		X^2	p-value
		n	%	n	%	N	%		
Treatment	Conservative	28	73.7	23	56.1	6	85.7	10.915	0.013*
	CPR	2	5.3	0	0.0	1	14.3		
	Operative	8	21.1	18	43.9$+	0	0.0		
Place of admission	Emergency Room	2	5.3	0	0.0	1	14.3	15.811	0.006*
	Hospital ward	7	18.4$-	22	53.7$+	2	28.6		
	ICU	18	47.4$+	8	19.5$-	2	28.6		
	ICU & MV	11	28.9	11	26.8	2	28.6		
Mortality	Died	8	21.1	7	17.1	1	14.3	0.318	0.913
	Improved	30	78.9	34	82.9	6	85.7		

N: number, X2: Chi-square test, $+ significantly higher frequency than expected by chance, $- significantly lower frequency than expected by chance, * p-value significant < 0.05.

Table (7): Comparison between ISS and NISS in outcome prediction in victims of motor car accidents admitted to Tanta University Emergency Hospital (N=86).

	ISS (all victims)	NISS (all victims)	P-value for pairwise comparison
AUC	0.875	0.899	0.5105
95% CI	0.792 to 0.958	0.824 to 0.974	
p-value (null hypothesis AUC =0.5)	<0.001*	<0.001*	
Cut-off	>29	>36	
Sensitivity	62.5	87.5	
Specificity	94.3	78.6	
PPV	71.4	48.3	
NPV	91.7	96.5	

AUC: area under the ROC curve; CI: confidence interval; PPV: positive predictive value; NPV: negative predictive value; * significant at p<0.05

Figure (1): Computerized Tomography (CT) scan of brain (soft tissue window) in 42-year-old motor car accident victim (Pedestrian) showing right lateral intraventricular haemorrhage.

Figure (2): Computerized Tomography (CT) scan with 3D reconstruction of a head in 38- year-old motor car accident victim (Pedestrian) showing fissure fracture in the right frontal bone.

Figure (3): Computerized Tomography (CT) scan of chest (lung tissue window) in 45-year- old motor car accident victim (Driver) showing bilateral haemothorax.

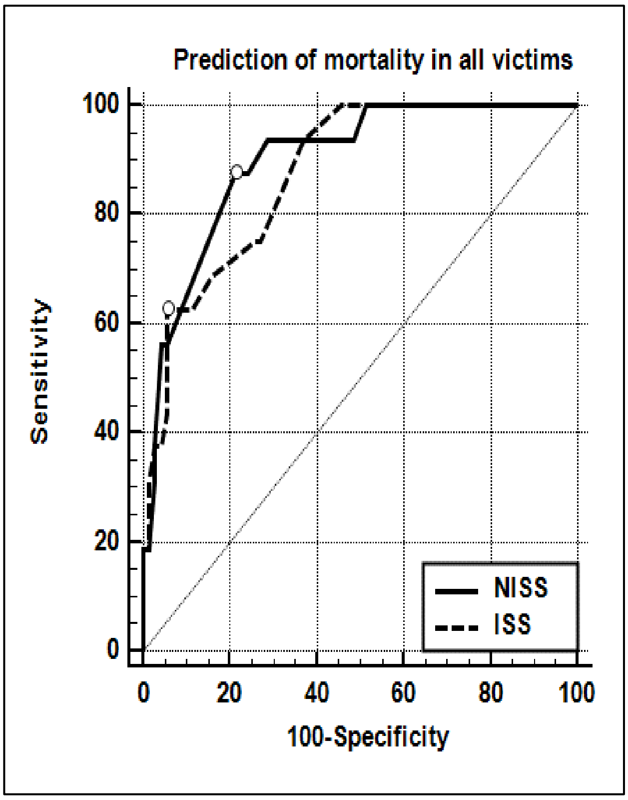

Figure (4): Receiver Operating Characteristic (ROC) comparing between ISS and NISS in outcome prediction among victims of motor car accidents admitted to Tanta University Emergency Hospital.

Discussion

The current study was designed to describe different patterns of injuries in motor car accidents in Tanta university emergency hospital. Availability of different patterns of injuries sustained in various locations inside and outside the car might help in identification of pedestrians, drivers and passengers.

In the current study, most of victims were males. Similar observations were reported by Rizk et al. (2020), Tekyol et al. (2020) and Bhandari et al. (2022). Male predominance might be because males have frequent outdoor visits to earn for their families. Male tendency to break traffic rules and negligent driving are contributing factors.

However, there was an association between sex and different categories of motor car accidents victims. Male victims were significantly higher in drivers than in other categories. Comparable results were obtained by El Bakash et al. (2016) and Malin et al. (2020).This could be explained according to Singh et al. (2016) by greater risk taking behavior, speeding, neglecting seat belt, alcohol consumption, fatigue and sleepiness.

Female victims were reported to be higher in pedestrians than females in other categories. This result comes in line with Yadukul (2013). It could be attributed to less risk taking behavior that makes females relatively safer as drivers (Singh et al., 2016; Ambade et al., 2021). However, females are at higher risk as pedestrians because of socioeconomic standards in developing countries that make females earn less money so; female victims are more pedestrians than drivers (Ambade et al., 2021; Mphela et al., 2021).

In the current study, pedestrians' injuries were more during daytime accidents. Different studies with relative results were obtained over world across longtime (Al-Senan et al., 1993; Chalya et al., 2012; Al-Omari & Obaidat., 2013; Singh et al., 2016; Ahmad et al., 2018; Shakeer Kahn et al., 2018 and Al musawi & Baiee, 2021).

These results are expected because this study was conducted in Tanta university emergency hospital which serves for urban and rural areas around the city where most of pedestrian trips end with the sunset (Shakeer Kahn et al., 2018). Moreover, daytime represents peaks of traffic activity including beginning and end of working hours for most of public agencies and schools in Tanta (Ahmad et al., 2018).

In the current study, drivers' injuries were higher during night time coinciding with results gathered by Cavalcanti et al. (2014), Al-Zamanan et al. (2018) and Carvalho Laureano et al. (2021). Such result might be related to the poor visibility in the dark, stationary vehicles parking by the road side, speeding up during night, the use of alcohol or drugs at night by some drivers and disrespect for rood signs (Carvalho Laureano et al., 2021).

Factors including human behavior, vehicle, and road might contribute to causation of motor car accidents (Rolison et al., 2018). Highway roads registered significantly higher drivers' injuries than passengers and pedestrians in the present study. The later was zero; this might be attributed to pedestrian crossing places at residential areas in highway roads. Together with prevent of pedestrian crossing by concrete separators for highway roads (Rolison et al., 2018). It is expected to find that, pedestrians' injuries were significantly higher among in-town roads. This could be explained by lack of commitment to pedestrian crossing places and traffic lights inside towns (Rolison et al., 2018). Data gathered by Singh et al. (2016) and Febres et al. (2021) was more or less in line with results of the current study.

Both ISS & NISS constitute anatomical scoring systems that provide numerical description of injuries severity which in turn is associated with clinical condition and mortality in traumatized patients (Lee et al., 2016; Rizk et al., 2020). In the current study both ISS & NISS were significantly higher in pedestrians than in drivers. Coinciding with this result, Reith et al. (2015) registered that; pedestrian group was overall severely injured with a higher mean ISS & NISS.

In the present study as well as Millo et al. (2008), pedestrians represent the most injured category of victims. Relatively small pedestrian mass, compared to motor vehicle mass, offers little resistance absorbing impact energy. Therefore, morbidity and mortality rates are elevated for this group of victims (Cavalcanti et al., 2014). Head & neck, facial and chest injuries were significantly higher in pedestrians than drivers and passengers. This finding is supported by comparable data gathered by different authors (Markogiannakis et al. (2006); Reith et al. (2015), Lilhare & Swarnkar, 2017; Jakhar et al., 2019 and Ambade et al., 2021). Abdominal & pelvic injuries were higher in pedestrians than drivers and passengers similar to results obtained by Markogiannakis et al. (2006) & Reith et al. (2015). However, this elevation was insignificant; this might be attributed to small sample size and pedestrian underestimation due to exclusion of died pedestrians on hospital arrival.

In the current study, pedestrians' head injuries ranged between scalp wounds, skull fractures, brain injuries and meningeal hemorrhage. Different head injuries could be attributed to variations in age of study population, site of impact and collision speed. The predominance of head injuries in pedestrians could be explained by the fact that, pedestrian victims sustain three types of impact injuries (Parkinson et al., 2013, El Bakash et al., 2016 and Hassan et al.2022).

Pedestrians' injuries might be due to primary, secondary or tertiary impacts. Primary impact injuries are implicated on first vehicle contact (bumper). Secondary impact injuries occur on second vehicle contact (vehicle hood and windscreen). By falling onto the street, tertiary impact injuries take place. Injury type will depend on collision speed. Up to 20 km/h speed, the patient will either fall under the car tiers with a resultant run over or found in vehicle front or side. From 20–60 km/h, pedestrian is expected to hits the car hood or windshield. From 60–100 km/h, pedestrian is expected to be thrown into air; where contact with windshield and consequent fall onto the ground causes severe head injuries (Tambuzzi et al., 2021).

In the current study, upper limb, lower limb and spine injuries were higher among drivers than pedestrians and passengers. However, the association between them was non-significant. A result that coincides with El Bakash et al. (2016) who reported that, upper limb injuries were more common in drivers. Meanwhile, lower limb injuries represent 54% in all vehicle occupants. Moreover, according to Singh et al. (2016) lower limb injuries, upper limb injuries and cervical spine injuries represented 92.6 %, 85.2 % and 22.2 % respectively.

Both upper and lower limb injuries could be considered as defense injuries, because the driver exerts severe stress on his lower limbs trying to press the brake pedal for emergency braking (Knight, 1996, El Bakash et al., 2016 and Li et al., 2020). However, many factors might influence upper and lower limb injuries e.g., driver size, pre-collision posture, seat installation position, seat back angle, seat belts use and vehicle speed (Xiao et al., 2022). According to Chang et al. (2009), bending moment of the femur shaft increased when the lower extremities muscle is tense, resulting in femur shaft fracture. In addition, rigid contact between the knee and dashboard can cause injuries to knee, femur, tibia, and pelvis (Xiao et al., 2022).

In the current study as well as the study carried out by Breen et al. (2021), drivers demonstrated significantly higher frequencies of fractures to upper & lower extremities and spinal injuries compared with passengers. This higher incidence of spinal injuries may be attributed to hyperflexion as a result of great forward momentum (Pedley and Thakore, 2004).

Face skin injuries showed significant higher association with passengers rather than other studied groups. In particular, Kim et al. (2019) noted that, passengers are at higher risk in term of facial soft-tissue injuries than drivers. This conclusion was explained through their results that reveal an effective reduction in facial soft-tissue injuries by wearing a seat belt. Passenger's false belief that, they are better protected by their central position inside the vehicle makes them less careful about wearing seat belts as supposed by Franco Fonseca et al. (2007) and Agbara et al. (2018).

Both operative treatment and hospital ward admission were significantly higher among drivers than the other two groups. Abdel Razik et al. (2021) could anticipate long hospital stay, high morbidity and mortality following motor car accidents. Meanwhile, ICU admission was significantly higher among pedestrians than other two groups. This could be expected according to Chelly et al. (2019) who supposed traumatic head injuries as a prevalent cause of ICU admission following motor car accidents.

In a comparable study by Reith et al. (2015) surgical intervention was required in drivers rather than pedestrians. They conclude more severe injuries contradict less aggressive therapy regime. This finding is caused by pedestrians' death before entering the operation room according to their results. A hypothesis supported by results of the current study; maximum death rate was reported in pedestrians as well as significant elevation in ISS & NISS. Both of the later were found to be good predictors of mortality in the studied groups.

Pattern characterization of motor car accident induced injuries is important for their prevention. Hence, results of the current study reported regional characterization of motor car accidents induced injuries in each category of victims. Concerning pedestrians, combination of head & neck injuries (scalp contusion, laceration and brain injuries), facial injuries and chest injuries were characteristic. Drivers showed different combination as, upper & lower limbs injuries together with spine injuries were most detected. Face skin injuries were the most specific injuries that occur in passengers. Hence, identification of pedestrians, drivers and passengers could be based on pattern of sustained injuries.

Data about injuries pattern sustained in various car seats locations can highlight protective requirements and suggest additional improvements in safety accessories for specific car seats locations (Daskal et al., 2018). Seat belts, airbags, collapsible steering should be mandatory fitments in all ranges of motor cars (Singh et al., 2016 and Shamim, 2017). Furthermore, Xiao et al. (2022) believed that, controlling dashboard stiffness and sufficient space between knee and dashboard were essential to reduce risk of drivers' lower limb injuries. Strict implementation of traffic safety rules especially speed limits (Singh et al., 2016).

Conclusion

Identification of pedestrians, drivers and passengers could be based on pattern of sustained injuries. Concerning pedestrians, combination of head & neck injuries, facial and chest injuries were characteristic. Drivers showed different combination as, upper & lower limbs injuries together with spine injuries were most detected. Face skin injuries were the most specific injuries that occurred in passengers.

Recommendations

It is essential to increase the awareness of health care providers about the most commonly expected pattern of injuries among victims of motor car accidents to enhance early diagnosis and to prevent complications. Strict implementation of laws regarding driving of cars, applying seat belts and alcohol or drug consumption during driving are required.

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نمط الإصابات بين ضحايا حوادث السيارات بمستشفى طوارئ طنطا الجامعي

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الملخص العربي

المقدمة: تعدالحوادث المرورية على الطرق واحدة من الأسباب الرئيسية للوفاة والإعاقة في جميع أنحاء العالم .كما أثبتت الدراسات أن شدة الإصابة تختلف بإختلاف وضع الضحية داخل السيارة وخارجها ولذلك يعد تحديد نمط الإصابات في كل من المشاة وراكبي السيارات خطوة مهمه لتحسين السلامة على الطرق. **الهدف من الدراسة:** كان الهدف من هذه الدراسة هو تقييم نمط الإصابات بين المشاة وسائقي السيارات والركاب في ضحايا حوادث السيارات بمستشفى طوارئ طنطا الجامعي. **طريقة البحث:** تعد الدراسة الحالية دراسة مستقطعة تم إجراؤها على ضحايا حوادث السيارات بمستشفى الطوارئ الجامعي بطنطا في الفترة من الأول من نوفمبر لعام ٢٠٢١ إلى نهاية أكتوبر لعام ٢٠٢٢. وقد تم تسجيل البيانات الاجتماعية ، تفاصيل الحادث ، التقييم السريري و نمط الإصابات لجميع الضحايا المدرجين بالبحث. وكذلك تم حساب درجة خطورة الإصابة باستخدام قياسي درجة الخطورة ودرجة الخطورة المعدل (ISS, NISS) لجميع المرضى بالدراسه وتم تسجيل العلاج ومكان الدخول والنتائج. **النتائج:** تم دخول ٨٦ ضحية من ضحايا حوادث السيارات إلى مستشفى طوارئ طنطا الجامعي (٣٨ مشاة و ٤١ سائق و ٧ ركاب). وقد أثبتت الدراسة وجود إرتباط ذو دلالة إحصائية بين كل من إصابات الرأس والرقبة والوجه والصدروالمجموعات الثلاثة محل الدراسة حيث أظهرت الدراسة ارتفاع نسبة هذه الإصابات في المشاة. كما أظهرت الدراسة إرتفاع نسبة إصابات جلد الوجه بشكل ملحوظ في الركاب.بدراسة إصابات البطن والحوض والطرف العلوي والطرف السفلي والعمود الفقري تبين عدم وجود إرتباط ذو دلالة احصائية بين هذه الإصابات والمجموعات محل الدراسة وبالرغم من ذلك فان إصابات الأطراف العلوية والسفلية والعمود الفقري كانت الأعلى بين السائقين. **الخلاصة:** يمكن الإستناد في تحديد المشاة وسائقي السيارات والركاب في الحوادث المرورية على الطرق إلى نمط الإصابات التي لحقت بهم. فيما يتعلق بالمشاة ،كانت مجموعة إصابات الرأس والرقبة وإصابات الوجه والصدرهي الأكثر حدوثا. في حين إرتفعت نسبة الإصابات في الأطراف العلوية والسفلية بالإضافة إلى إصابات العمود الفقري بين سائقي السيارات وكانت إصابات جلد الوجه هي الأكثر حدوثا بين الركاب.

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