

Prospective Study of Medico-Legal Aspects of Road Traffic Accidents

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Abstract

Background: Road traffic accidents (RTAs) are a significant global public health concern, contributing extensively to hospital admissions, injury-related disabilities, and mortality. Understanding injury patterns and risk factors is essential for forensic assessment and prevention efforts.

Aim: This study aimed to identify the causes and risk factors associated with RTAs, document injury patterns among different categories of victims, and evaluate clinical outcomes.

Methods: A prospective study was conducted on 220 RTA victims admitted to New Damietta Hospital. Victims were categorized as pedestrians, drivers, front seat passengers, rear seat passengers, or motorcyclists. Data collected included victim status, type of vehicle, accident timing and location, road type, injury distribution, and severity.

Results: Significant associations were found between victim status and age, particularly among pedestrians and motorcyclists ($P=0.001$). Injury distribution significantly varied with status, notably in head, neck, and limb injuries ($P=0.049$), with a specific significance for limb trauma ($P=0.007$). Males were more frequently affected than females across all age groups ($P<0.001$). Female fatalities were highest in the 0–10-year age group (6%), significantly greater than males of the same group (3%) ($P=0.002$).

Conclusion: RTAs represent a serious threat to public safety in Egypt, especially among young males, pedestrians, and motorcyclists. The study highlights the importance of preventive measures, enforcing safety regulations, and prospective medico-legal documentation in mitigating RTA-related morbidity and mortality.

Keywords: Medico-Legal Aspects; Road Traffic Accidents; Victims; Motorcyclists; Pedestrians

1. Introduction

Road traffic accidents (RTAs) are a worldwide health, social, and financial concern. RTAs are becoming a significant cause of death in emerging nations and are steadily increasing as a global burden.¹ The number of RTAs worldwide is increasing and is expected to surpass tropical diseases as the major cause of death in developing nations.²

RTAs are defined as collisions on a public road involving at least one moving vehicle and another vehicle or pedestrians, resulting in either fatal or nonfatal injuries.³ RTAs are a significant and growing global contributor to hospitalization, bodily injury, and death rates.⁴ RTAs and deaths have a significant negative influence on health and financial costs.^{5,6}

RTAs ranked as the eighth largest cause of mortality according to the World Health Organization (WHO) in 2016, with 1.35 million fatalities and 50 million injuries yearly. This is expected to worsen; by 2030, injuries from traffic accidents will rank as the sixth most common cause of mortality worldwide, and 90% of these deaths occur in low- and middle-income countries.^{7,8}

Based on statistical data, Egypt was identified as one of the Middle Eastern and African nations with the highest rates of RTAs. In 2018, there were 8,480 fewer fatal crashes than in 2017, when there were 11,098, according to data from Egypt's Central Agency for Public Mobilization and Statistics. The yearly death toll from RTAs is about 12,000, or 42 deaths per 100,000 inhabitants.^{3,9}

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This study aims to characterize the patterns, causes, and medicolegal implications of injuries among women presenting to New Damietta Hospital's emergency department, with the goal of informing policy development and strengthening gender-responsive trauma care systems.

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2. Patients and methods

This prospective study included 220 victims of road traffic accidents (RTAs) of all ages and both sexes, conducted at Al-Azhar University Hospital, New Damietta, from April 1, 2024, to March 31, 2025. Ethical approval was obtained (Approval Code: 0000011), and informed written consent was secured from all participants or their relatives. Exclusion criteria included non-RTA injuries and uninjured individuals involved in RTAs. Participants were classified as pedestrians, drivers, front seat passengers, rear seat passengers, or motorcyclists. Data collected included victim status, vehicle type, accident timing and location, anatomical injury distribution, and injury severity (categorized as mild, moderate, severe, or fatal). Toxicological urine screening for drivers was conducted for barbiturates, benzodiazepines, tramadol, morphine, and cannabis.

Statistical analysis: All data were statistically analysed using the Statistical Package for Social Sciences (SPSS for Windows, version 29.0). The numerical results were expressed as mean $\pm$ standard deviation (SD), and the categorical results were expressed as percentages (%). A chi-square test was performed to compare groups regarding categorical data, and then the p values were calculated; $p > 0.05$, <0.05 , and < 0.01 were considered as non-significant, significant, and highly significant, respectively.

3. Results

Table 1. Age groups, sex, and the site of injuries of RTA victims

		INJURED VICTIMS OF RTA N (%)
AGE GROUPS (YEARS) (N=220)	0-10	18(8%)
	11-20	68(31%)
	21-30	50(23%)
	31-40	18(8%)
	41-50	19(9%)
	51-60	22(10%)
	>60	25(11%)
SEX(N=220)	Male	197(90%)
	Female	23(10%)
THE SITE OF INJURIES OF RTA VICTIMS(N=220)	Head & Neck	51(23%)
	Thorax	12(5%)
	Abdomen and pelvis	10(5%)
	Spine	2(1%)
	Limbs	96(44%)
	Polytrauma	49(22%)

Note. A total of 220 road traffic accident (RTA) cases were analyzed. The most affected age group was 11–20 years (31%), followed by individuals aged 21–30 years (23%). Children (0–10 years) and adults aged 31–40 years each accounted for 8% of cases, while victims over 60 years represented 11%. Males were predominantly affected, comprising 90% of cases, compared to 10% for females. The most common injuries involved the limbs (44%), followed by head and neck trauma (23%) and polytrauma (22%). Thoracic and abdominal/pelvic injuries each accounted for 5%, while spinal injuries were the least common (1%). These results emphasize the increased vulnerability of young males to RTAs and the predominance of limb and head/neck injuries.

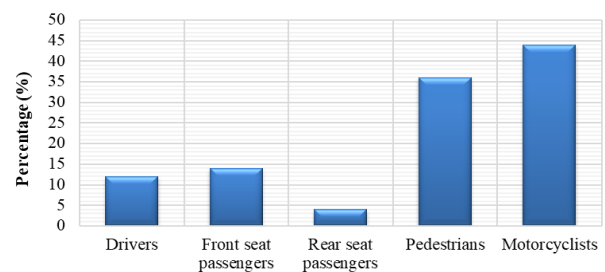


Figure 1. Distribution percentage of Road Traffic Accident Victims by Role

Note. The bar graph illustrates the percentage distribution of individuals involved in road traffic accidents according to their role. Motorcyclists represented the highest proportion of victims at approximately 45%, followed by pedestrians at around 35%. Front seat passengers accounted for about 15%, while drivers constituted approximately 12%. Rear seat passengers were the least affected group, making up only about 5% of the cases. These findings indicate that vulnerable road users, particularly motorcyclists and pedestrians, bear the greatest burden of RTA-related injuries.

Table 2. Demographic and Injury Patterns Among Road Traffic Accident (RTA) Victims by Role, Age, and Injury Site

		DRIVERS N=26	FRONT SEAT PASSENGERS N=8	REAR SEAT PASSENGERS N=9	PEDESTRIANS N=80	MOTORCYCLISTS N=97
STATUS AND AGE OF VICTIMS OF RTA						
AGE GROUPS (YEARS)	0-10	0	2	2	14	0
	11-20	2	2	2	25	37
	21-30	11	3	0	11	25
	31-40	4	0	1	5	8
	41-50	3	1	2	5	8
	51-60	3	0	2	5	12
	>60	3	0	0	15	7
X ²		2.62	3.12	2.46	14.53	15.46
P VALUE		0.105	0.077	0.116	0.0001*	< 0.0001*
SITE OF INJURIES AND AGE OF RTA VICTIMS.						
		Head and Neck n=51	Thorax n=12	Abdomen and pelvis n=10	Spine n=2	Limbs n=96 Polytrauma n=49
AGE GROUPS (YEARS)	0-10	2	2	0	0	8
	11-20	18	3	3	1	29
	21-30	16	2	3	0	16
	31-40	3	0	0	0	8
	41-50	4	1	2	1	6
	51-60	5	2	0	0	13
	>60	3	2	2	0	16
X ²		1.604	1.216	0.933	0.179	0.005
P-VALUE		0.205	0.270	0.333	0.671	0.942
SITE OF INJURIES AND STATUS OF RTA VICTIMS.		10	2	0	0	5
	Drivers					
	Front seat passengers	1	1	1	1	3
	Rear seat passengers	0	0	1	0	6
	Pedestrians	7	6	5	1	40
	Motorcyclists	33	3	3	0	44
X ²		3.866	0.2863	1.404	0.270	7.140
P-VALUE		0.049*	0.592	0.236	0.603	0.007*

Note. This study examined 220 RTA cases, classifying victims by age, role, and injury site. The 11–20 age group was the most vulnerable, especially among motorcyclists and pedestrians ($p < 0.0001$). Limb injuries were most common overall, particularly in the elderly, while head and neck injuries predominated in younger victims. Motorcyclists had the highest rates of limb and head/neck injuries ($p = 0.007$, $p = 0.049$), and pedestrians often suffered polytrauma. Children were mostly pedestrians or passengers, and no spinal injuries were seen in the youngest or oldest groups. The findings highlight young motorcyclists and pedestrians as the most at-risk groups, emphasizing the need for targeted road safety measures.

Table 3. Environmental, Temporal, and Clinical Patterns of Road Traffic Accidents

PLACE(N=220)	INTERNATIONAL COASTAL ROAD (HIGHWAY)	50(23.0%)
SEASONAL DISTRIBUTION OF RTAS (N=230)	Damietta (non-highway roads)	132(60%)
	Others (outside Damietta)	38(17%)
	Summer	98(45%)
	Autumn	37(17%)
	Winter	44(20%)
PERIODS OF THE DAY (N=220)	Spring	51(23%)
	Morning (5am:12 pm)	68(31%)
	Afternoon (12pm:5pm)	75(34%)
	Evening (5pm:9pm)	30(14%)
	Night (9pm:4am)	47(21%)
SEVERITY OF INJURIES OF RTA VICTIMS (N=220)	Mild	15(7%)
	Moderate	109(50%)
	Severe	64(29%)
	Fatal	32(15%)
SEVERITY OF INJURIES OF CHRONICALLY DISEASED RTA VICTIMS (N=51)	Mild	2(4%)
	Moderate	22(43%)
	Severe	25(49%)
	Fatal	2(4%)
TOXICOLOGICAL ANALYSIS OF VICTIM DRIVERS (N=19)	Positive	3 (16%)
	Negative	16(84%)

MORTALITY AND SITE (N=32)	Head & Neck	14(44%)
	Thorax	2(6%)
MORTALITY (N=32)	Abdomen & pelvis	1(3%)
	Spine	0(0%)
	Limbs	2(6%)
	Polytrauma	13(41%)
	Drivers	7(22%)
	Front seat passengers	3(9%)
	Rear seat passengers	0(0%)
	Pedestrians	10(31%)
	Motorcyclists	12(38%)

Note. Table (3) shows that most accidents that occurred in Damietta (non-highway roads within the governorate) were (60%) and during the summer season (45%), especially in the afternoon. Motorcyclists and pedestrians were the most vulnerable, accounting for 38% and 31% of fatalities, respectively. Moderate to severe injuries were common, with 15% of cases being fatal, particularly due to head injuries and polytrauma. Among chronically ill victims, nearly half sustained severe injuries. Only 16% of tested drivers had positive toxicology results, suggesting limited but relevant substance involvement.

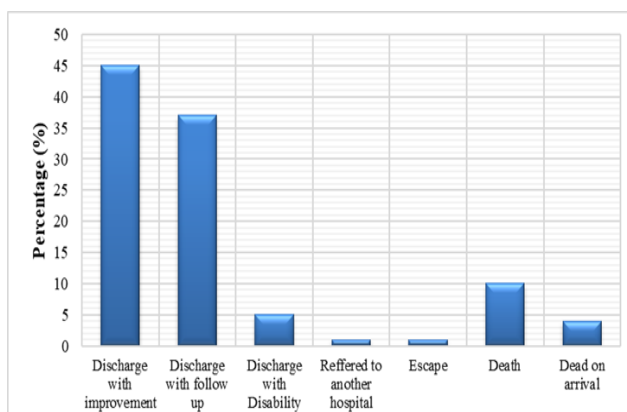


Figure 2. The discharge outcomes of RTA victims

Note. The chart illustrates the discharge

outcomes of RTA victims. The majority were discharged with improvement (45%), followed by discharge with follow-up (38%), indicating effective acute management. A small proportion experienced discharge with disability (5%), while death was reported in approximately 9% of cases. Minor fractions were referred to another hospital, escaped, or were dead on arrival (~3% each). These findings highlight that while most victims recover or require outpatient care, a notable minority face severe or fatal outcomes.

Table 4. Sex, Age, and Mortality among Road Traffic Accident Victims

		SEX OF VICTIMS		X ²	P
		Male	Femal		
AGE GROUPS (YEARS)	0-10	13	5	41.6	< 0.001*
	11-20	65	3	3.83	0.050
	21-30	46	4	16.63	< 0.001*
	31-40	16	2	0.0004	0.983
	41-50	14	5	3.49	0.061
	51-60	18	4	1.559	0.211
	>60	25	0	92.03	< 0.001*
	MORTALITY, AGE, AND SEX OF RTA VICTIMS				
AGE GROUPS (YEARS)	0-10	1	2	8.88	0.002*
	11-20	8	0	1.52	0.217
	21-30	9	0	1.78	0.181
	31-40	4	1	0.30	0.580
	41-50	0	1	7.22	0.007*
	51-60	2	0	0.30	0.580
	>60	4	0	0.65	0.419

Note. Table (4) illustrates that there is a significant male predominance was observed in the 0–10, 21–30, and >60 age groups ($p < 0.001$), highlighting higher male vulnerability in childhood, young adulthood, and elderly age. Mortality patterns showed significant associations in the 0–10 age group ($p = 0.002$) and among 41–50-year-old females ($p = 0.007$), suggesting increased fatality risk in young children and middle-aged women. Other age groups did not demonstrate statistically significant sex-based differences in death rates. Data are presented as numbers, *significant as p value < 0.05 . RTA: Road traffic accidents.

4. Discussion

One of the most common non-communicable epidemics in the world is accidents, which are a major cause of morbidity and mortality. The WHO defines RTAs as fatal or nonfatal injuries incurred because of a collision on a public road involving at least one moving vehicle and another vehicle or pedestrians.¹¹

There was a significant difference in the distribution of head & neck, and limb injuries among RTA victims. Limb injuries were most common in motorcyclists (46%), followed by

pedestrians (42%), and the least frequent in front-seat passengers (1%); this difference is statistically significant. Differences in thorax, abdomen & pelvis, spine, and polytrauma injuries among RTA victims were statistically insignificant. Thorax injuries were highest in pedestrians (50%) and lowest in rear-seat passengers (0%). Abdomen and pelvis injuries were more common in pedestrians (50%) than in motorcyclists (30%), with drivers showing the lowest percentage (0%). Spine injuries were most frequent in front-seat passengers and pedestrians (50%), while motorcyclists, drivers, and rear-seat passengers had the lowest percentage (0%). Polytrauma was more common among pedestrians (43%) compared to motorcyclists (29%), with rear-seat passengers having the lowest percentage (4%). Almost like our findings, Hassan et al.¹² found that limb injuries were the most common site of injury in RTAs, with the spine being the least affected. There were significant differences in head & neck and lower limb injuries, but no significant differences in abdomen and pelvis injuries. The most common limb injuries were in pedestrians (70.4%), followed by motorcyclists (64.06%) and passengers (58%). Supporting our findings, Kandeel and Elagamy et al.¹³ reported that limbs were the most common site of injury (70.04%), with two-thirds in the head & neck (65.5%) and chest (19.1%). Victim status significantly correlated with specific injuries, such as higher rates of limb injuries (93.6%) in motorcyclists.

In our study, most RTAs occurred in Damietta Governorate (60%) and during summer (45%) as Damietta is known as a summer resort, followed by spring (23%), while autumn was the lowest percentage (17%), with peak incidents in the afternoon (34%), considering overcrowding at this time, followed by the morning (31%) and evening hours (14%) showing the lowest percentages. Supporting our findings, Sagah et al.¹⁴ found that most incidents occur during daytime (52.32%) and nighttime (47.57%) among pedestrians, drivers, and passengers.

Almost like Kandeel and Elagamy et al.¹³ reported seasonal variation regarding the occurrence of RTAs. They found that RTAs are most observed in summer and spring (31.7%) and autumn (20.8%), with the majority occurring in early afternoons (45.20%), and only 17.3% occurring at night and early morning.

In our study, most victims sustained moderate injuries (50%), followed by severe injuries (29%), fatal injuries (15%), and mild injuries (7%). Most victims were discharged with improvement (45%), followed by discharge with follow-up (37%). Disabilities were reported in 5% of cases, and death was reported in 10% of cases, while 4% were dead on arrival. Referrals to other hospitals

and escapes during management were rare, at 1% each. Supporting our findings, Sagah et al.¹⁴ found that there were 18.6% dead on arrival. Most victims were discharged with improvement (81.39%). Moreover, Hassan et al.¹² showed that most of the patients (73.9%) who were treated surgically (4.4%) died in the hospital, while about half of the patients (50.2%) were discharged with follow-up, and 35.8% were discharged with improvement.

Our findings elucidated that among 51 chronically diseased RTA victims, severe injuries were the most common (49%), followed by moderate injuries (43%), while mild and fatal injuries were the lowest (4%). The most prevalent conditions were chronic hypertension (8%) and diabetes (7%). Other conditions included combined hypertension and diabetes (2%), chronic liver disease (3%), chronic kidney disease (0.5%), bronchial asthma (1%), thalassemia (0.5%), and ischemic heart disease (1%). No cases of epilepsy were reported. Along with our findings, Ossei et al.¹⁵ revealed that injuries and medical conditions in road traffic collisions led to driver fatalities, with latent contributing diseases and medical conditions being identified as potential causes. Moreover, Kovačević et al.¹⁶ conducted a study on road traffic injuries among RTA survivors and found that 42.0% had chronic diseases, and 19.7% experienced severe injuries.

In our study, the highest mortality was caused by head and neck injuries (44%), followed by polytrauma (41%), with no deaths from spine injuries. Male victims accounted for 88% of deaths, and females 12%. Most male fatalities occurred in the 21–30 age group (28%), while most female fatalities were in the 0–10 age group (6%), showing statistical significance. Mortality rates were highest among motorcyclists (38%), followed by pedestrians (31%) and drivers (22%), with no fatalities among rear seat passengers. In the same line as our findings, Saleh and Elsayed et al.³ reported that head injuries are linked to a 60% higher mortality rate, while spine injuries have no mortality. Drivers have the highest mortality rate (42.9%), followed by motorcyclists (33.3%) and pedestrians (10%). Moreover, Kumar et al.¹⁷ found that male fatalities were more common in the 21–30 age group (28%), with a significant difference compared to females. Mortality rates were based on the type of road user, with two motor vehicles having the highest mortality rate (54.2%), followed by pedestrians (25.1%).

In our study, toxicological analysis revealed psychoactive drugs in 16% of tested drivers, with Tramadol detected in 11% and Cannabis in 5%. In the same line as our findings, Saleh and Said et al.¹⁸ showed that about one-fourth of the

drivers were drug abusers. Tramadol and THC were the most abused drugs. Supporting our findings, Kandeel and Elagamy et al.¹³ reported that toxicological analysis revealed psychoactive drugs in 31.5% of drivers were positive for cannabinoids, and 20.7% positive for tramadol.

Limitations of the study: This study may be subject to selection bias, as it only includes RTA victims presenting to a single emergency department, potentially excluding individuals treated elsewhere or not requiring hospitalization. Dependence on hospital records and self-reported data may have led to underreporting of key factors such as drug use and chronic illnesses, especially in cases lacking routine toxicological testing. The relatively small sample size (220 cases) may have limited the ability to detect trends in less common injuries or outcomes. Additionally, the study did not assess long-term disabilities or account for environmental and infrastructural factors, such as road conditions or traffic enforcement, which may influence injury patterns.

4. Conclusion

Road traffic accidents (RTAs) pose a significant public health threat, contributing to rising morbidity and mortality. Young males, especially motorcyclists and pedestrians, were the most affected, with the highest fatality rate in the 21–30 age group. Limb injuries were most common, particularly among motorcyclists. Substance abuse emerged as a probable risk factor, while chronic diseases, though present in 23% of victims, showed no direct association with RTAs.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

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