ORIGINAL ARTICLE

Comparison of trauma severity in and out of the navigation ring around the metropolis: a case of Tabriz, Iran

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Abstract

Objective: One of the causes of severe injuries in urban accidents is the occurrence of accidents on urban highways and city outskirts. The present study will determine the severity of accidents in the complete urban ring of Tabriz, including Shahid Kasaei highway, Pasdaran, Dizel Abad, Sento road, and Airport road in Tabriz during the years 2016-2022.

Methods: In a cross-sectional descriptive study, the injuries from traffic accidents that were registered in the pre-hospital emergency center of Tabriz city were included. The study variables included all the information recorded in the pre-hospital emergency file between 2016 and 2022 and included 44,712 injured patients. Timing of the missions, variables related to the injured (demographics, vital signs), the accident's location, the injury's severity, and the accident's outcome were evaluated at the scene. Data were analyzed by SPSS 24 software.

Results: Among 44,712 patients, 32,299 (72.2%) were men and the rest were women. Regarding the location of the accident, 34321 (76.8%) of the injured were inside the city, and 10391 (23.2%) had an accident in the city traffic ring. The most common accident site was in the traffic ring on Pasdaran highway, with 3179 injured (30.6%). The rate of on-scene death was higher in traffic accidents inside the traffic ring (1.3% vs. 0.9%). The severity of trauma was higher inside the traffic ring (P-value <0.001). Reaction and response time were higher in missions outside the traffic ring, leading to death at the scene (P value<0.001).

Conclusion: Based on the study results and the role of arrival time on the outcome of missions, it seems necessary to establish new pre-hospital emergency stations inside the city. It is necessary

to pay more attention to education through the media and improve the general culture of society to reduce the accidents and injuries caused by it.

Keywords: Emergency Medical Services; Mortality; Trauma

1. Introduction

One of the most critical health problems is the injuries caused by traffic accidents. In addition to physical injuries, traffic accidents cause psychological injuries and also economic losses. Therefore, effective and sustainable measures should be taken to prevent traffic accidents (1,2). According to the world health organization (WHO) report in 2020, the number of deaths caused by traffic accidents in the world has increased, and it is among the ten leading causes of death worldwide, among which low-income countries had the highest number of traffic accidents (3). However, in many of these countries, injuries caused by traffic accidents are not given much attention, and the health sector in these countries does not consider traffic accident injuries as a priority (4). In this regard, Iran has the highest frequency of trauma in the Middle East, the most important cause of which is traffic accidents (5).

Traumatic injuries in traffic accident victims can be fatal (6). It is one of the main problems of the health care system worldwide. According to the report of the South Korean Emergency Medical Organization, the proportion of trauma patients and their mortality rates are steadily increasing (7). Understanding traffic incidents' main causes, extent, and consequences is the first step toward developing effective and efficient prevention programs (8). In various studies, risk factors for causing injuries following traffic accidents have been mentioned. Based on the results of these studies, human factors such as sleepiness while driving, gender, age, smoking, and factors related to the vehicle such as not using seat belts, speed while driving, the nature of the vehicle, and environmental factors such as day, week, travel time, driving and road design, traffic laws have been reported as the main factors of accidents (9,10). In another study, while pointing to the

factors affecting traffic accidents (11,12), head, chest, abdominal pelvis, and spine injuries that can lead to fatal consequences have also been mentioned (13).

Traffic accidents are one of the most common non-communicable diseases in the country in terms of the mortality index in the health sector. To improve these indicators, there is a need to identify the effective factors in the occurrence of accidents. In this study, examined. The dependent factors are evaluated in the field of the outcome of accidents. Therefore, the present study will determine the factors affecting the leading causes of accidents in Tabriz urban ring road including Shahid Kasaei highway, Pasdaran, Dizel Abad, Sento road, and airport road in Tabriz during 2016-2023 years.

2. Methods

2.1. *Study design*

In a cross-sectional descriptive study, the injured from traffic accidents in Tabriz city who were registered in the pre-hospital emergency center were included in this study. The study period was from September 2022 to March 2024. The study inclusion criteria included all the injured patients from traffic accidents recorded in the pre-hospital emergency center in Tabriz city. Exclusion criteria included incomplete documentation of the patient's hospital emergency file. The sampling method was a full census.

2.2. Ethical considerations

This study, which was approved by the Ethics Committee of Tabriz University of Medical Sciences on 09.03.2022, with the code IR.TBZMED.REC.1400.1234. Before starting the research, the necessary permissions to collect data were obtained from the relevant authorities. The study's results were used only in accordance with its objectives, and the patients' information remained confidential.

2.3. Data gathering

The variables of the study included all the information recorded in the pre-hospital emergency file, which includes the age and gender of the injured, the time of the accident, the reaction time and response time of the pre-hospital emergency, the patient's vital signs (level of consciousness based on Glasgow coma scale (GCS), arterial oxygen saturation and blood pressure), The result of the mission (transfer to the hospital, death, lack of consent to transfer and outpatient treatment at the scene of the accident), the location of the accident (inside and outside the traffic ring around the city) and the severity of the accident were based on GCS, age, pressure (GAP) and revised GAP (RGAP) criteria (14).

Data was collected retrospectively from the recorded data of the injured patients based on the inclusion and exclusion criteria between 2016 and 2022. During this study, all information about the injured was included. In this study, 59,966 patients with multiple trauma caused by traffic accidents were included. Fifteen thousand two hundred fifty-four patients were excluded from the study due to the lack of documentation, and finally, the pre-hospital emergency files of 44,712 patients were evaluated and analyzed.

2.4. ***Statistical analysis***

Finally, all data were entered into SPSS 24 software. The normal distribution of the data was evaluated by Kolmogorov-Smirnov or the Q-Q plot tests. To describe the data, the descriptive test of mean ± standard deviation (Mean ± SD) was used if the data distribution was normal, and if the data distribution was abnormal, the median and interquartile range indicators were used. For qualitative variables, frequency (percentage) was used. The Independent Sample's T-test was used to compare quantitative data to see if the data distribution was normal. Mann-whitney's U-test was

used to assess if the distribution was abnormal. The chi-squared test was used to compare qualitative data. In all cases, a P value less than 0.05 was considered

3. Results

This study included 44,712 multi-trauma patients from traffic accidents in the final analysis. Regarding gender, 32,299 (72.2%) were men and the rest were women. Among the patients, 8769 (19.6%) had a traffic accident in spring, 14348 (32.1%) in summer, 11955 (26.7%) in autumn, and 9640 (21.6%) in winter.

The description of the quantitative variables of age, vital signs, timing of missions, and the severity of injuries of the patients is given in table 1. Regarding the location of the accident, 34,321 (76.8%) of the injured were inside the city, and 10,391 (23.2%) of the injured were on the highways around the city, as part of the city traffic ring. Among the patients who had an accident in the guided traffic ring around the city, 3179 (30.6%) patients on Pasdaran highway, 3030 (29.2%) patients on Shahid Kasaei highway, 2031 (19.5%) patients on Sento road, 1147 (11%) patients on Dizel Abad road, and 1004 (9.7%) patients had traffic accidents in the area around Basij square.

According to the results of the pre-hospital emergency missions, the patients were divided into two groups according to the location of the accident. Two groups include accidents inside the traffic ring around the city and accidents inside city and outside of the traffic ring. The result of the missions included being transported to the hospital, not consenting to the transfer, death on the scene, and outpatient treatment of the patients at the accident scene. The frequency of each of these cases in the traffic accidents inside the guided ring was 8590 (82.7%), 1601 (15.4%), 139 (1.3%), and 61 (0.6%), respectively. In the traffic accidents outside the guide ring, the frequency was 28459 (82.9%), 5373 (15.7%), 309 (0.9%), and 180 (0.5%), respectively. The comparison of the two groups showed a statistically significant difference between the two groups of patients in terms

of the results of the missions (P-value=0.001). The rate (percentage) of on-scene deaths was higher in traffic accidents inside the traffic ring (1.3% vs. 0.9%).

The patients were also evaluated in terms of the severity of the trauma. The severity of trauma was calculated based on GAP and RGAP criteria and compared in two groups based on the location of the accident (inside and outside the traffic ring). Table 2 shows the comparison of trauma severity in the two groups. As can be seen from the table, the two groups have a statistically significant difference in terms of trauma severity (P-value<0.001). In the group of accidents inside the traffic ring, the severity of trauma is higher.

Among the patients, 37329 were transferred to the hospital. Regarding transfer to the trauma center, the patients were divided into two groups. Among the patients who had an accident in the guided traffic ring around the city, 4999 (57.82%) patients were transferred to the trauma center, and the rest were transferred to other medical centers. In the rest of the patients, 17359 (60.54%) were transferred to the trauma center, and the rest were transferred to other medical centers. The comparison of the two groups showed a statistically significant difference between the two groups of patients in terms of transfer to the trauma center (P-value<0.001).

Also, patients were divided into four groups in terms of death in the pre-hospital emergency stage and at the scene of the accident. In terms of the higher than the timing of the missions. Two groups were compared, the results of which are given in table 3. As can be seen from the table, the reaction time and response time in missions outside the guided ring (inside urban accidents) leading to death are higher, and this difference is statistically significant (P-value<0.001).

4. Discussion

In the current study, the factors affecting traffic accidents in the area of the complete urban ring were evaluated. The urban traffic was compared with the severity of trauma inside and outside the urban traffic ring. The results of this study showed that most of the patients with driving injuries were male. In terms of age distribution, most patients were young. Also, based on the findings of this study, the rate of death of patients at the scene, and the severity of the accident inside the traffic ring were higher than the traffic accidents that happened outside of it. Also, reaction time and response time in pre-hospital emergency missions outside the traffic ring (inside city traffic accidents) leading to death have been higher.

The results of this study showed that most of the patients with driving injuries were male. In terms of age, most patients were young. Therefore, young age groups are likely to be more vulnerable due to not having a driver's license, being young, having dangerous driving behaviors, and the cultural and social conditions of society. Also, this group is among the economic activists of the society and has more mobility and dynamism compared to other age groups (5).

According to accident studies, the accident rate among males is 3 to 5 times higher than that of females. In addition, its highest rate is between the ages of 15 and 44. This issue imposes a great economic burden on society (6,15,16). In the study of Golfiroozi et al., the risk of injury severity was higher in all age groups than in the age group of less than 16 years (17). The results of a study conducted in the United States on young people aged 16 to 19 while driving confirm this issue, and the reasons for it include the use of high speed, crossing unauthorized areas, dangerous driving for fun and recreation, and passing between cars (7).

According to the findings of the present research, the deaths at the scene in traffic accidents inside the guide ring are more, which is probably due to the higher speed of cars on the highways, more traffic of trucks and the increase in the severity of the accident, the lack of speed cameras

and also the congestion of Kesai highway, and Pasdaran is due to the passage of roads from neighboring provinces. So that only in Kasai highway more than 160,000 daily traffic is carried out in both lanes of this highway (18). The results of the study conducted by Haji Nabi in Iran showed that the death rate of traffic accident victims at the scene of the accident in the outskirts of Tehran (highways and roads) is higher than in the inner city of Tehran, which is probably due to the higher speed of cars and less accessibility to hospitals (19). In Ghahremanzadeh et al.'s study, 73% of the deaths were on roads, 5% on highways, and only 6% were in cities, which is consistent with our study. Also, in a study conducted by Rezazadeh et al. in Iran, the trend of deaths caused by road accidents was examined from 2009 to 2018, and the results showed that 67% of deaths occurred on highways and suburban roads. Only 23% of deaths occurred in cities. In this study, the number of deaths on suburban roads in East Azerbaijan province (centered in Tabriz) was 62% (20).

The present study investigated and compared the predictive value of mortality in traffic accident trauma patients with GAP and RGAP scoring systems. In this study, both scoring systems performed well in predicting the outcome of trauma patients, which was consistent with the study by Jeong et al. (21).

In this study, similar to other studies, the highest frequency of patients in terms of trauma severity occurred in low-risk, medium-risk, and high-risk groups, respectively (22,23). In the current study, the severity of trauma based on low, moderate, and severe GAP levels was 97.4%, 1.3%, and 1.3%, respectively. The severity of trauma based on RGAP levels of low risk, moderate, severe, and very severe was 91.4%, 7.00%, 0.4%, and 1.3%, respectively. In a study conducted by Ghahremanzadeh et al., the severity of trauma based on GAP levels in people who used helmets was 98% at the low-risk level, and this rate was 86% in people without helmets (8). In this study,

the severity of trauma based on GAP, RTS, and NTS was significantly different in two groups of patients (P<0.05). Also, Alejandro et al.'s study showed that high mortality was related to age, type of accident (road), low blood pressure when entering the hospital's emergency department, and GAP score. Therefore, the patients who died had lower average GAP scores than the survivors (24).

Also, in the current study, the mean arterial blood pressure (MAP) in the injured was 90-183.33 mmHg, and the mean of Spo2 in the injured was 97%. In the study of Khajaei et al., the average blood pressure (BP) in the deceased patients was 73.57 ± 50.32 mmHg, which was lower compared to the average BP in the surviving patients compared to the surviving group. (25). The results of studies by G Manley et al. and Spaite et al. also showed increased mortality in BP <70 mmHg (26,27). Therefore, regular control of BP by pre-hospital emergency technicians and decisions to transfer patients to higher level trauma centers, as well as fluid resuscitation based on the patient's clinical conditions, can have a significant impact on reducing patient mortality. In the studies conducted by Filipescu et al. and Sittichanbuncha et al., a decrease in arterial SpO2 was also associated with an increase in mortality in trauma patients (3,28). Controlling arterial blood oxygen levels and providing oxygen to patients by reducing SpO2 will also play an essential role in reducing patient mortality.

Finally, in this study, the reaction time and response time in missions outside the guided ring (intra-urban accidents) leading to death were higher and this difference is statistically significant, which seems to be related to the crowded streets and the low culture of people in opening path for ambulances. In Wei Lam et al.'s study, they concluded that the pre-hospital emergency response time and reaching the scene of the accident will be high in heavy traffic, rainy weather, and the occurrence of an accident in residential or commercial places (29). In the study

by Maryam Bigdeli and her colleagues, the average response time for urban locations was 5.0 minutes and for roads was 10.6 minutes (30). Therefore, there are many factors involved in the response time and time intervals of the pre-hospital emergency in traffic accidents, which must be analyzed with a comprehensive view.

5. **Limitations**

This study is a retrospective study, which is considered to be the most important limitation. In this regard, a number of cases (included about 25% of the cases) did not have sufficient documentation were excluded from the study. Also, the patients who were transported to the hospital by personal vehicle or by other organizations (such as Red Crescent) were not included in this study.

6. **Conclusion**

Based on the results of the study, the severity of the accident and the deaths on the scene are higher inside the traffic ring and the response time of the missions in cases leading to death is higher outside the traffic ring. Considering the important role of arrival time on patient outcomes in pre-hospital emergency missions, it seems necessary to establish new pre-hospital emergency stations.

Identifying the factors affecting the occurrence of traffic accidents and the severity of injuries resulting from these accidents, including the safety of cars along with the proper and correct use of the equipment is very important. Taking the necessary measures to prevent accidents, and paying attention to more education through the media, and training centers for people in it is

necessary to comply with traffic laws and regulations. All active organizations regarding traffic have to improve the general culture of society to reduce accidents and injuries caused by it.

7. Declarations

7.1. Acknowledgment

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7.2. Authors' contributions

All authors of this paper have directly participated in the planning, execution, or analysis of this study, and have approved the final version submitted data availability.

7.3. Conflict of interest

The authors declare no conflict of interest in this study.

7.4. Funding

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Table 1 Description of the quantitative variables and the severity of injuries of the patients

Variables	Median	IQR 25-75	Range
Age (year)	32	22-45	1-92
Vital sign			
• GCS	15	15-15	3-15
• Saturation of O2 (%)	97	96-98	0-100
• MAP (mmHg)	90	83.33-93.33	90-183.33
Mission timing (second)			
• Reaction time	48	31-98	14-233
• Response time	638	489-869	52-3497
Trauma severity			
• GAP	24	22-24	3-24
• R-GAP	22	22-24	0-24
• NTS	23	23-23	3-23

GCS: Glasgow coma scale; MAP: Mean arterial pressure; GAP: GCS, Age, Pressure; R-GAP: Revised GAP; NTS: New trauma score

Table 2 Comparison of trauma severity in two groups

Trauma severity	Inside of ring	Outside of ring	P value
GAP	24 (22-24)	24 (22-24)	<0.001*
Category of GAP			<0.001#
• Mild	10118 (97.4%)	33646 (98%)	
• Moderate	135 (1.3%)	365 (1.1%)	
• Severe	138 (1.3%)	310 (0.9%)	
RGAP	22 (22-24)	22 (22-24)	<0.001*
Category of RGAP			<0.001#
• Mild	9493 (91.4%)	31137 (90.7%)	
• Moderate	723 (7.00%)	2775 (8.1%)	
• Severe	38 (0.4%)	101 (0.3%)	
• Very severe	137 (1.3%)	308 (0.9%)	

* Mann-Whitney's U-test; # Chi-squared test; GAP: GCS, Age, Pressure; R-GAP: Revised GAP

Table 3 The relation between the timing of the missions and death at the incident scene

Time	**Ring**	**Death**		**P value***
		Yes	**No**	
Reaction time (seconds)	Yes	52 (34-120)	51 (32-100)	0.274
	No	66 (36-120.50)	47 (31-96.75)	<0.001
Response time (seconds)	Yes	660 (521-891)	681 (513-947)	0.556
	No	653 (527-883)	627 (483-849)	0.005

* Mann-Whitney's U-test