Original Article

Road Safety as an Essential Need of Aged Population: A Case of Tabriz City, Iran

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Abstract
Objectives: To investigate and determine the hotspot points of traffic accidents in the Tabriz metropolis during 2020-2021.
Design: Cross-sectional descriptive study.
Setting(s): Tabriz, Capital of East Azarbaijan province in northwest Iran.
Participants: The patients were injured in traffic accidents and transferred to hospitals with the prehospital system in Tabriz in 2020 and 2021.
Interventions: Prehospital ambulances.
Outcome measures: The data included the number of traffic accidents, demographic variables of patients, vital signs, the severity of the accident, the type of vehicle involved in the accident, and the location of each accident based on the division of the municipal area.
Results: In this study, the ratio of male to female was 3:1, and the mean age of patients was 35 ± 15 years. In 2020, there were 5423 traffic accidents, of which 17.6% occurred in the 7th municipal region, 16.9% in the 4th municipal region, and 12.2% in the 6th municipal region of Tabriz. In 2021, 6611 missions were carried out, 16.6% of which occurred in the 4th and 7th municipal regions, while 12.6% occurred in the 6th municipal region of Tabriz city.
Conclusions: Based on the results of this study, regions 7, 4, and 6 are among the Road Traffic Accident Black Regions (RTABRs) in the Tabriz metropolis; therefore, it is necessary to review and investigate the causes of traffic accidents and carry out interventions to increase road safety.
Keywords: Trauma, Traffic accident, Safety, Aged population

Introduction

Trauma is one of the main causes of death and disability in the world. Road traffic accidents (RTAs) death has the highest rate of death due to unintentional injuries in the world.[1-3] Injuries caused by vehicles are one of the biggest health problems, and prevention of them requires effective and sustainable measures.[4,5] Trauma-related injuries are a threat to health in the world and cause 9% of global deaths.[6]

Studies showed that RTAs are not only limited to developing countries but are also a global phenomenon. Since the current cities of the world have a high level of motor vehicles and are threatened due to the lack of development of sustainable transportation, serious attention should be paid to the issues of reforming the urban transportation system, especially considering the increase in the average age of the population.[7] Introducing road hotspot points is the first step in the road safety management process. Accident hotspots are sometimes referred to as dangerous road situations, high-risk places, accident-prone places, places in need of improvement, and the like. Accident hotspot identification leads to a list of sites prioritized for detailed engineering studies that can identify accident patterns, contributing factors, and possible countermeasures. A crash hotspot can be theoretically defined as any location that has a higher number of crashes than other similar locations as a result of local risk factors.[8]

In Iran, the burden of RTAs decreased by 61.1% from 1990 to 2019. The burden of RTAs was mainly related to injuries to drivers or passengers of vehicles and pedestrians. RTAs mostly affected males aged 15-29 years and people over 70 years old.[9,10] Planning the sustainable development of transportation requires the efforts of all relevant bodies, including transportation authorities and society.[7]

Samson[11] tried to identify the major causes of traffic accidents. He concluded that there are increasing problems in road accidents and proposed a traffic simulation model for the solution. Several studies have been conducted on Road Traffic Accident Black Region (RTABR) identification methods.[12-14] Identifying and determining RTABR for each city is one of the important steps in urban planning for RTA countermeasures and control.

The increase in the average age of the population is an obvious fact all over the world, and the use of safety measures to maintain the safety of people is one of the goals of all governments. The present study aimed to determine the main RTABRs for Tabriz metropolitan areas based on the available data obtained from the Tabriz pre-hospital emergency center to propose correct practical recommendations as a remedy for the road safety problem. Determining the high-risk areas causes the authorities to conduct more detailed investigations in the desired areas to make effective decisions in the city's traffic safety commission to reduce accidents. This study may provide at least basic information about the current situation of traffic accidents in Tabriz, which may enable the relevant bodies to re-examine the overall system of urban transportation networks and traffic flow.

Methods
Study Setting
RTA information recorded in Tabriz's pre-hospital emergency system was extracted during a retrospective descriptive-analytical study in Tabriz during 2020-2021. The inclusion criteria included RTAs in Tabriz, and the exclusion criteria included incomplete documentation and traffic accidents outside Tabriz.

Sample Size and Sampling Method
The sample size included all RTA information recorded in the pre-hospital emergency system, and the whole census was used in this study during the study period.

Place of Study
Tabriz is the capital of East Azarbaijan province in the northwest of Iran. It is divided into 10 municipal regions (Figure 1). The Tabriz area is about 244.51 square kilometers, and it is the fourth largest city in Iran. The sixth municipal region (in the northwest of Tabriz) is the largest region of this city in terms of area, and there are 140 main streets in Tabriz.[15]
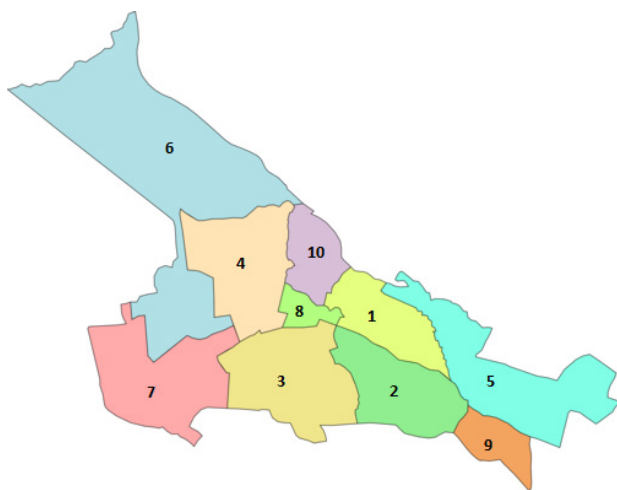

Figure 1. Tabriz Municipal Regions. Source. Wikipedia.[15]

Data Gathering
The studied variables were the age and gender of the patients, the patients' vital signs at the scene, the type of vehicle in the accident, and the location of the accident. The required information was collected using the pre-hospital emergency files, and the areas where the most accidents occurred were identified and compared over two years. The severity of the injuries caused by the injured registered in the system was compared based on the Glasgow Coma Scale, Age, Pressure (GAP), Revised-GAP (R-GAP), and new trauma score (NTS) indices[1-3] during two years.

Statistical Analysis
The information was entered into SPSS 17.0 software. To describe quantitative and qualitative data, descriptive statistical methods were used in the form of frequency (percentage) and mean ± standard deviation (median and interquartile range: 25-75). The Shapiro-Wilk test was used to determine the normal distribution of data. If the P value of this test is greater than 0.05, the data distribution is normal. In addition, an independent sample's t-test was used to compare quantitative variables between two groups, and the chi-square test (and Fisher exact test in necessary cases) was used for qualitative variables. In the case of non-normally distributed variables, the Mann-Whitney U test was employed to compare the quantitative variables. A P value below 0.05 was considered statistically significant.

Results
In this study, 5423 RTAs were registered in Tabriz's pre-hospital emergency system in 2020. In terms of gender distribution, 4069 patients (75%) were male, and 1354 patients (25%) were female, of which 10 persons (0.2%) died at the scene, and 761 people (14%) were treated at the scene. In terms of the cause of the accident, 3783 (69.76%) accidents were due to light vehicle accidents, 1308 (24.12%) were caused by motorcycles, 185 (3.41%) were due to bicycle accidents, and 147 (2.71%) were caused by trucks. The highest number of missions related to pre-hospital emergency stations in 2020 was done by 2073 (Rizvanshahr area), 2053 (central railway station area), and 2143 (Andisheh town area) stations, with a frequency of 502 (3.9%), 325 (6%), and 312 (5.8%), respectively. The lowest number of missions carried out by pre-hospital emergency stations were done by 2273 (El Goli area), 2153 (Khosroshahr), and 2283 (Nesferah) stations, with a frequency of 35 (0.6%), 38 (0.7%), and 48 (9 0.0%), respectively.

On the other hand, 6611 RTAs were registered in Tabriz's pre-hospital emergency system in 2021. In terms of gender distribution, 4887 patients (73.9%) were male, and 1724 patients (26.1%) were female. Moreover, 15 of these injured people (0.2%) died at the scene, and 822 people (12.4%) were treated at the scene. In terms of the cause of the accident, 4696 (71.03%) accidents were caused

by cars, 1535 (23.23%) by motorcycles, 214 (3.24%) by bicycle, and 165 (2.50%) by truck. The highest number of missions in 2021 related to RTA by pre-hospital emergency stations was done by 2073 (Rezvanshahr), 2023 (Tehran Gate region), and 2183 (Hojjati Street) stations, with a frequency of 442 (6.7%), 362 (5.5%), and 332 (5%), respectively. The lowest number of missions by the pre-hospital emergency stations was done by 2153 (Khosroshahr), 2313 (Rahnemayi area), and 2243 (Spiran village road) stations, with a frequency of 64 (1%), 77 (1.2%), and 90 (1.4%), respectively.

Table 1 presents a comparison of demographic variables, vital signs, and injury severity of RTA victims under investigation during the two years. The severity of injuries in 2021 was slightly higher than that in 2020. Table 2 illustrates the classifications of injury severity in two years. In terms of the classification of injury severity in GAP and R-GAP indices, the frequency of moderate and higher injury severity increased in 2021. Moreover, the classification of injury severity in the NTS index was not different in two years. Furthermore, the statistical differences between the two groups of patients were not significant due to the great sample size.

To determine RTABRs, RTA addresses were checked and matched based on the regions of Tabriz municipality. In 2020, the most incidents occurred in regions 7 (southwest), 4 (west), and 6 (northwest) with a frequency of 17.6%, 16.9%, and 12.2%, respectively. Likewise, in 2021, most RTAs occurred in the same regions 7 (southwest), 4 (west), and 6 (northwest) with a frequency of 16.6%, 16.6%, and 12.6%, respectively. This statistic suggests that about 45% of the incidents happened in these three mentioned municipality regions in the west of Tabriz. Table 3 compares the main variables of RTA in two years

in the regions with a high prevalence of accidents.

We divided the injured people into two groups based on age: under 60 and over. In 2020, the most RTAs in the group over 60 occurred in residential regions 4 (west), 3 (south), and 1 (north), with a frequency of 17.6%, 13.4%, and 13.4%, respectively. In the group under 60, the most RTAs occurred in industrial regions 7 (southwest), 4 (west), and 6 (northwest) with a frequency of 18.1%, 16.8%, and 12.2%, respectively.

In 2021, the most RTAs in the group over 60 occurred in regions 4 (west), 7 (southwest), and 1 (north), with a frequency of 16.4%, 15.1%, and 12.2%, respectively. In the group under 60, the most RTAs occurred in regions 4 (west), 7 (southwest), and 6 (northwest), with a frequency of 16.5%, 16.1%, and 13%, respectively. Moreover, the most RTAs in two groups of injured patients occurred in industrial regions.

Discussion

This study investigated and compared the traffic accidents in Tabriz that led to the activation of the pre-hospital emergency system during the period 2020-2021. Based on the obtained results, region 7 of Tabriz municipality had the highest number of traffic accidents in two years.

To understand the distance between the management of traffic accidents and the existing transportation systems in the world, it is enough to pay attention to the example of the iceberg. Statistics showed that the prevalence of traffic accidents in the world is extremely high[16], and it is the third cause of death among the Iranian population.[5] RTAs are considered among the main causes of unnatural death in humans and are the third major cause of preventable death among all deaths in the world.[17] Important reform measures to reduce RTAs in many countries include adopting a multi-pronged approach to road safety such as traffic management, design and quality improvement

Table 1. Comparison of the Demographic Variables, Vital Signs, and Injury Severity of Victims during 2020-2021

Variable	2020	2021	P Value
Age (y)	32 (22-44)	32 (22-46)	0.083
Gender			
Male	4069 (75%)	4887 (73.9%)	
Female	1354 (25%)	1724 (26.1%)	0.001
Vital sign			
Heart rate (/minute)	85 (80-90)	85 (80-90)	0.831
Respiratory rate (/minute)	16 (14-17)	16 (14-17)	0.002
SBP (mm Hg)	120 (110-125)	120 (110-125)	<0.001
DBP(mm Hg)	80 (70-80)	80 (70-80)	0.003
GCS	15 (15-15)	15 (15-15)	0.125
Saturation of oxygen (%)	97 (96-98)	97 (96-98)	0.664
Severity of trauma			
GAP	24 (22-24)	24 (22-24)	0.002
R-GAP	22 (22-24)	22 (22-24)	<0.001
NTS	22 (21-22)	22 (21-22)	0.015

Note. SBP: Systolic blood pressure; DBP: Diastolic blood pressure; GAP: Glasgow coma scale, age, pressure; R- GAP: Revised GAP; NTS: New trauma score.

Table 2. Comparison of the Injury Severity Classification During 2020-2021

Variable	2020	2021	P Value
GAP severity			<0.001
Mild	5374 (99.1%)	6486 (98.1%)	
Moderate	34 (0.6%)	103 (1.6%)	
Severe	15 (0.3%)	24 (0.4%)	
R-GAP severity			<0.001
Mild	5112 (94.3%)	6067 (91.8%)	
Moderate	288 (5.3%)	509 (7.7%)	
Severe	9 (0.2%)	16 (0.2%)	
Very severe	14 (0.3%)	19 (0.3%)	
NTS severity			0.084
Mild	5380 (99.2%)	6531 (98.8%)	
Moderate	26 (0.5%)	51 (0.8%)	
Severe	3 (0.1%)	10 (0.2%)	
Very severe	14 (0.3%)	19 (0.3%)	

Note. GAP: Glasgow coma scale, age, pressure; R- GAP: Revised GAP; NTS: New trauma score.

Table 3. Comparison of the RTA-Related Variables During 2020-2021 in the Municipality Districts

Variable	Regions					
	7th Municipality region		6th Municipality District		4th Municipality District	
Year	2020	2021	2020	2021	2020	2021
Number of injured patients	957	1059	664	843	917	1092
Mission result						
Transfer to hospital	792 (82.8%)	921 (87%)	576 (86.7%)	748 (88.7%)	788 (85.9%)	961 (88%)
Treat at the scene	164 (18.1%)	134 (12.7%)	85 (12.8%)	92 (10.9%)	127 (13.8%)	129 (11.8%)
Death	1 (0.1%)	4 (0.3%)	3 (0.5%)	3 (0.4%)	2 (0.2%)	2 (0.2%)
Mechanism						
Vehicle	725 (75.8%)	747 (70.5%)	485 (73%)	676 (80.2%)	541 (59%)	650 (59.5%)
Motorcycle	204 (21.2%)	250 (23.6%)	118 (17.8%)	123 (14.6%)	314 (34.2%)	372 (34.1%)
Truck	16 (1.7%)	32 (3%)	47 (7.1%)	35 (4.1%)	9 (1%)	13 (1.2%)
Bicycle	12 (1.3%)	30 (2.8%)	14 (2.1%)	9 (1.1%)	53 (5.8%)	57 (5.2%)

Note. RTA: Road traffic accident.

of road infrastructure, the use of intelligent transport systems, safe vehicles, law enforcement, effective and rapid response to accidents, and effective treatments. To carry out these measures, all stakeholders should help the government to improve the interventions and implement road safety measures.[18] The existence of a traffic accident registry system can help better understand the causes of accidents and apply appropriate and effective corrective measures.[19]

One of the important factors in preventing RTAs is designing and improving the quality of road infrastructure. The effective elements in road safety include road geometry, road surface quality, risks on the side of the road, additional road structures, and road equipment. The implementation of safe road infrastructure should start at every stage of the road life cycle, which can be done using audit tools in planning, design, construction, and road safety inspection. A comprehensive strategy for dealing with traffic accidents and close cooperation between traffic police, health system, law, and transport authorities has played a significant role in preventing and reducing RTAs and increased the level of traffic safety in a country.[20] International studies in the field of investment to improve road safety showed that the costs incurred in improving road infrastructure are recovered in a reasonable period of time.[21]

This study was carried out for two consecutive years regarding the determination of accident-prone areas in Tabriz, and its results indicated that in both years, region 7 of Tabriz municipality is the most accident-prone urban area in Tabriz. In terms of the number of RTAs in two years, the figure in 2021 was higher than that in 2020, and the severity of the injury was also higher in 2021. The results of Ala and colleagues' study indicated that the most of injured patients are male.[22] These results are similar to our study results. The results of Moradi's study showed that the most RTAs in the Tehran metropolis occur around major leisure and business centers, bus terminals, and shopping centers,[23] while in the present study, most

RTAs occurred in the west side of Tabriz, in which most business centers, companies, and factories are located.

Study Limitations
One of the limitations of this study is related to the collected variables, including the exact address of the scene of the traffic accident, the brand of the car involved in the accident, and the outcome of hospitalization of the injured patients.

Conclusions
According to the results of this study, during the two investigated years, regions 7, 6, and 4 were among the RTABRs in the Tabriz metropolis. All of these regions are on the west side of the city, and most of the factories, companies, and business centers are located in the west of Tabriz. In addition, the main connection road between the north and south of the province is in this area. This causes an increase in the traffic load. Accordingly, there is a need to review and investigate the causes of traffic accidents and carry out necessary interventions to increase road safety. The reasons can be the type of urban structure, population density, compliance with driving rules and regulations, and the like.

Considering the increase in the average age of the population, it is recommended that the authorities take necessary measures to increase the safety of this age group of the population when using the streets, public transport vehicles, overpass bridges, urban furniture, and other related equipment. It is suggested that in the road safety commission related to Tabriz, the desired issues should be evaluated in terms of road construction engineering, and the important processes should be corrected.

Author contributions

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Validation: Ali Ahmadinia.
Visualization: Mahsa Fathi.
Writing–original draft: Haniyeh Ebrahimi Bakhtavar.
Writing–review & editing: Farzad Rahmani.

Data availability statement

Data gathered for the study are available from the corresponding author upon reasonable request.

Ethical approval

This study has been approved by the Ethics Committee of the Tabriz University of Medical Sciences with the ethics code IR.TBZMED.REC.1399.1182.

Consent for publication

Not applicable

Conflict of interests

The authors declare no conflict of interests.

References

1. Amini K, Abolghasemi Fakhri S, Salehi H, Ebrahimi Bakhtavar H, Rahmani F. Mortality prediction in multiple trauma patients using GAP, RTS and NTS models. Trauma Mon. 2021;26(5):252-7. doi: 10.30491/tm.2021.262592.1212.
2. Ghahremanzadeh Anigh S, Hajiloo Z, Ebrahimi Bakhtavar H, Paknejad SP, Rahmani F. Helmet: a device to reduce mortality and severity of trauma. Int J Life Sci Res Arch. 2022;3(1):93-100. doi: 10.53771/ijlsra.2022.3.1.0077.
3. Sepehri Majd P, Alimohammadi Siyabani A, Ebrahimi Bakhtavar H, Rahmani F. A new method to predict the in-hospital outcome of multi-trauma patients: R-GAP. J. Emerg Pract Trauma. 2022;8(2):128-33. doi: 10.34172/jept.2022.15.
4. Ghaffarzad A, Rahmani F, Parsian Z, Arefikia M, Abdollahi F, Morteza Bagi HR. Pain management in trauma patients referred to the emergency department of Imam Reza General Hospital, Tabriz, Iran. Int J Drug Res Clin. 2023;1(1):e3. doi: 10.34172/ijdrc.2023.e3.
5. Rahmani F, Ebrahimi Bakhtavar H, Shams Vahdati S, Hosseini M, Mehdizadeh Esfanjani R. Evaluation of MGAP and gap trauma scores to predict prognosis of multiple-trauma patients. Trauma Mon. 2017;22(3):e33249. doi: 10.5812/traumamon.33249.
6. Wui LW, Shaun GE, Ramalingam G, Wai KM. Epidemiology of trauma in an acute care hospital in Singapore. J Emerg Trauma Shock. 2014;7(3):174-9. doi: 10.4103/0974-2700.136860.
7. Kennedy C, Miller E, Shalaby A, Maclean H, Coleman J. The four pillars of sustainable urban transportation. Transp Rev. 2005;25(4):393-414. doi: 10.1080/01441640500115835.
8. Montella A. A comparative analysis of hotspot identification methods. Accid Anal Prev. 2010;42(2):571-81. doi: 10.1016/j.aap.2009.09.025.
9. Sadeghian Tafti MR, Ostovar A, Saeedi Moghaddam S, Shobeiri P, Ehrampoush MH, Salmani I, et al. Burden of road traffic injuries in Iran: a national and subnational perspective, 1990-2019. Inj Prev. 2023;29(2):101-10. doi: 10.1136/ip-2022-044677.
10. Bazargan-Hejazi S, Ahmadi A, Shirazi A, Ainy E, Djalalinia S, Fereshtehnejad SM, et al. The burden of road traffic injuries in Iran and 15 surrounding countries: 1990-2016. Arch Iran Med. 2018;21(12):556-65.
11. Samson F. Analysis of Traffic Accident in Addis Ababa: Traffic Simulation. Ethiopia: Addis Ababa University (AAU); 2006.
12. Ahmad AU, Hossain KT, Hossain MA. Identification of urban traffic accident hotspot zones using GIS: a case study of Dhaka Metropolitan Area. J Geogr Stud. 2020;3(1):36-42. doi: 10.21523/gcj5.19030104.
13. Amou E, Ghanbari A, Poorebrahim k. Investigating the effect of urban furniture on urban accidents (case study: accident hotspots in Tabriz). Journal of East Azerbaijan Police Science. 2022;11(41):131-73. [Persian].
14. Khan IU, Vachal K, Ebrahimi S, Wadhwa SS. Hotspot analysis of single-vehicle lane departure crashes in North Dakota. IATSS Res. 2023;47(1):25-34. doi: 10.1016/j.iatssr.2022.12.003.
15. Tabriz. Wikipedia website. https://en.wikipedia.org/wiki/Tabriz. Updated July 12, 2023.
16. Soehodho S. Public transportation development and traffic accident prevention in Indonesia. IATSS Res. 2017;40(2):76-80. doi: 10.1016/j.iatssr.2016.05.001.
17. Prabhakar S, Venkatesh VT, Viswakanth B, Ramesh C, Sujatha PL, Dominic IR. Analysis of fatal road traffic accidents in a metropolitan city of South India. J Indian Acad Forensic Med. 2013;35(4):317-20.
18. Deshpande P. Road safety and accident prevention in India: a review. Int J Adv Eng Technol. 2014;5(2):64-8.
19. Sadeghi-Bazargani H, Sadeghpour A, Lowery Wilson M, Ala A, Rahmani F. Developing a national integrated road traffic injury registry system: a conceptual model for a multidiscipline setting. J Multidiscip Healthc. 2020;13:983-96. doi: 10.2147/jmdh.s262555.
20. Pembuain A, Priyanto S, Suparma L. The effect of road infrastructure on traffic accidents. Paper presented at: Proceedings of the 11th Asia Pacific Transportation and the Environment Conference (APTE 2018). Atlantis Press; 2019. doi: 10.2991/apte-18.2019.27.
21. Ahmed I. Road infrastructure and road safety. Transport and Communications Bulletin for Asia and the Pacific. 2013;(83):19-25.
22. Ala A, Aghili A, Ghorbanian S, Hejazian SS, Nahvi A, Mousavi Aghdas SA. Epidemiology of road traffic accidents in Tabriz municipality: a crosssectional study. J Anal Res Clin Med. 2018;6(3):134-8. doi: 10.15171/jarcm.2018.021.
23. Moradi A, Soori H, Kavousi A, Eshghabadi F, Zainni S. The spatial distribution of high and low risk points leading to pedestrians-related injury in the central area of Tehran. Payesh. 2017;16(1):27-37. [Persian].