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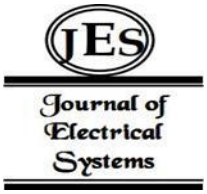
A Cohort Retrospective Study on Factors Associated with Mortality in Multiple Trauma



Abstract: - Trauma is one of the major causes of death and disability worldwide, and a high percentage (50-60%) of trauma patients die from injuries before reaching the hospital. The aim of this study is to investigate the relation of some pre-hospital factors related to the mortality of multi-trauma patients. In this retrospective cross-sectional study, multiple trauma patients referred to the emergency department of our center (a trauma center in the west of Iran) from 2021 to 2022 were included. Demographic and clinical information was collected and recorded using hospital registry information. The collected data were statistically analyzed using SPSS version 25 software. Of 2876 trauma patients included, 2119 cases (73.7%) were men and 757 cases (26.3%) were women. The mean and standard deviation of the age of patients, by gender, in men and women were 20.23 ± 38.63 and 24.01 ± 49.97, respectively. 25 women and 22 men died due to trauma. The most common mode of transportation to the hospital was by private vehicle and ground ambulance with a frequency of 1517 and 1302 respectively. Also, 342 people were injured due to overturning ,748 people were injured due to collision and 1786 people were injured due to other types of trauma. The most common cause was road traffic accidents and falling was the most common second cause of trauma. Based on multivariable logistic regression, the variables of gender, mechanism of Injury and ISS (Injury severity score) had a significant effect on the mortality rate of patients. The most rate of mortality was in elderly women and in vehicle collisions. It seems necessary to conduct focused investigations on how to provide preventive measures in this group of society. Also, in addition to trying to modify factors causing collisions, conducting studies on initial advanced treatment interventions in high-risk patients in the field may reduce the death rate of trauma patients and it's burden on the health system.

Keywords: Multiple trauma, Trauma mortality, Motor vehicle collision.

I. INTRODUCTION

Trauma is one of the most important public health challenges in the world. With the progress of science and technology and the industrialization of societies in the last century, changes in lifestyle and increase in life expectancy have led to changes in the type of diseases in countries (1). Although a decline in trauma-related mortality in adults has been observed over time, trauma is still a leading cause of death worldwide (2). According to the Iranian Society of Surgeons, trauma is the third leading cause of death, after cardiovascular diseases and cancer in Iran (3).

Mechanism of injury is important, as it is helpful in determining the next course of action. Considerable injury mechanisms include: ejection from the vehicle, passenger death, falling, high-speed, motorcycle, auto-pedestrian collisions and penetrating injuries such as stab and gunshot (4).

Most of the deaths usually happen before the patient reaches the hospital or in the first hours after the injury (5). A high rate (50-60%) of the victims of fatal MVC do not survive enough to reach the hospital (6).

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Despite the high prevalence of traumatic injuries and its socio-economic consequences in Iran and the importance of the initial interventions in the field, few studies have been conducted in this regard. Studying the pre-hospital measures and identifying the intervening and influencing factors on the mortality of trauma patients would be the first step to modify them and make improvements. The aim of this study is to investigate factors associated with mortality in multiple trauma patients referred to our center in 2021.

II. Methods

This descriptive-analytical retrospective study was conducted at a trauma center in the west of Iran to determine factors associated with mortality in multiple trauma patients during January 2021–December 2021. All the patients who died in the emergency room, needed at least 24 hours of hospitalization or who had been referred to this hospital from the ICU of another hospital were included. In case of transferring to other hospitals patients were excluded from the study.

The information was obtained based on the completed patient transfer form by the EMS and the information available in the hospital registry system and documented in a questionnaire by trained research assistant. This questionnaire was approved by the first executor of the project as an expert. In case of incomplete file, the patient was removed from the study.

The data was computerized and statistically analyzed using SPSS v25. In the descriptive analysis, the frequency of clinical findings were presented as the main variables in different groups and all demographic and clinical data of patients were reported based on descriptive criteria. For analytical analysis, Chi-square test was used for qualitative data and independent t-test was used to compare quantitative data. If the initial assumptions were not met as normal, Mann-Whitney parametric test was used. P value < 0.05 was considered to be statistically significant.

The design was approved by the Ethics Committee of the University of Medical Sciences.

III. RESULTS

Of 2876 trauma patients included,2119 cases (73.7%) were men and 757 cases (26.3%) were women. 25 women and 22 men died, Fig 1. There was a significant difference between genders(P<0.001) (table 1).

Table 1 . Characteristics of patients by mortality

variables		**outcome**						**P value**
		discharge		**death**		**Total**		P<0.001
		number	percent	number	percent	number	percent	
gender	male	2097	72.9	22	0.76	2119	73.6	
	female	732	25.4	25	0.86	757	26.3	
age	<40	1551	53.9	22	0.76	1573	54.7	0.27
	>40	1278	44.4	25	0.86	1303	45.3	
Transfer method	ambulance	1281	44.5	21	0.73	1302	45.30	0.80
	helicopter	6	0.20	0	0	6	0.20	
	Private vehicle	1492	51.8	25	0.86	1517	52.70	
	Public transportation	14	0.50	1	2.10	15	0.50	
	On foot	3	0.10	0	0	3	0.10	
	police	10	0.40	0	0	10	0.30	
	other	23	0.80	0	0	23	0.80	

Mechanism of trauma	Road traffic accidents	1112	38.66	11	0.38	1123	39	0.13
	Other transport accidents (	12	0.4	1	2.10	13	0.50	
	Blunt injuries	196	6.90	3	0.10	199	6.90	
	falling	1082	37.6	24	0.83	1106	38.50	
	Penetrating injuries	305	10.80	4	0.13	309	10.7	
	Animal bite	13	0.50	1	0.03	14	0.50	
	burn	3	0.10	0	0	3	0.10	
	Suffocation	4	0.10	0	0	4	0.10	
	Electrical injury	3	0.10	0	0	3	0.10	
	gunshot	64	2.30	1	0.03	65	2.30	
	Blast wave injury	8	0.30	0	0	8	0.30	
	unknown	27	1	2	0.06	29	1	
Interfacility transfer	Unknown	1545	54.60	26	0.90	1571	54.60	0.84
	Yes	355	12.50	7	0.24	362	12.6	
	No	929	32.80	14	0.48	943	32.80	
ISS	< 16	2744	97	39	1.3	2783	96.8	P<0.001
	>16	85	3	8	o.2	93	3.2	
AIS	Minor	676	23.50	8	0.27	684	23.80	0.036
	Moderate	1387	49	18	0.62	1405	48.90	
	Severe	576	20.40	14	0.48	590	20.50	
	Unknown	190	6.70	7	0.24	197	6.80	

The total mean and standard deviation of the age of patients was 41.61 ± 21.86. The mean and standard deviation of the age by gender were 38.63 ± 20.23 and 49.97 ± 24.01 in men and women, respectively. 22 patients under 40 years old and 25 patients over 40 years old died, Fig 2. There was not a significant difference between age groups (P=0.27),(table 1).

The most common mechanism of trauma was road accidents followed by falls. The highest frequency of death was due to falls,Fig 3.There was no significant difference among mechanisms of trauma (P=0.13).(table 1).

The most common mode of transportation to the hospital was by private vehicle and ground ambulance with a frequency of 1517 and 1302, respectively. The lowest way of transportation was on foot with a frequency of 3 patients. 25 people who were taken to the hospital by private vehicle and 21 people who were taken to the hospital by ground ambulance died, Fig 4. 943 people were transported directly to our hospital and 362 people were transported by ambulance from another acute care facility. The status of 1571 patients was uncertain, among them 26 died, Fig 5. There was no significant difference among the methods or interfacility transferring.(table 1).

In this study, out of 2876 trauma patients, 85 had an ISS greater than 16, and 8 of these patients died, Fig 6. 676 people had minor trauma, 1387 people had moderate trauma, 576 people had severe, critical and serious trauma, and the status of 190 people was unknown. 18 people with moderate trauma and 14 people with severe trauma died,Fig 7.There was significant difference between ISS groups(P< 0.001) and AIS as well(P=0.36).(table 1).

The mean and standard deviation of the initial systolic blood pressure in discharged and deceased patients were 114.19 ± 14.86 and 113.46 ± 13.77 respectively. The blood pressure of deceased persons was one mmHg lower than discharged persons, but this difference was not significant (P=0.73). (Table 2).

Table 2. Individual characteristics of patients by final outcome (death/discharge) based on t-test

variable	outcome	Mean ± standard deviation	Rank average	The significance level	Significant level for normality test
Primary systolic blood pressure	discharge	114.19 ± 14.86	1434.89	0.73	P<0.001
	death	113.46 ± 13.77	1410.81		
Initial oxygen saturation percentage	discharge	70.44 ±41.89	1418.54	0.54	P<0.001
	death	66.56 ±43.69	1254.83		
Initial GCS	discharge	14.28 ±1.53	1435.03	0.83	P<0.001
	death	14.23 ±1.5	1402.83		

The mean and standard deviation of the initial oxygen saturation percentage in discharged and deceased patients were 70.38 ± 48.91 and 66.56 ± 43.69 respectively. Although the percentage of initial oxygen saturation was slightly lower in trauma patients who died, this difference was not significant (P=0.54). (Table 2).

And the mean and standard deviation of the initial GCS in discharged and deceased trauma patients were 14.28 ± 1.53 and 14.23 ± 1.50 respectively. Although the initial GCS was a little lower in deceased trauma patients, this difference was not significant (P=0.83). (Table 2).

IV. DISCUSSION

In the present study, gender had a significant effect on the mortality of trauma patients, although the majority of trauma patients (73.7%) were men, but the mortality rate was higher in elderly women. In the study of Sadeghi Mohammadi et al the results were similar to our study[8]. In Amini et al.'s study [9] 395 patients (72.6%) were male and the rest were female and there was no statistically significant difference between the deceased and surviving groups in terms of gender. In Costa et al.'s study [10] most of the studied population was men (82%), but gender did not have a significant effect on the mortality rate. In Chiang et al.'s study [11] although 67.5 percent of the samples were men, there was no significant difference in the mortality rate between men and women. The reason that men were more frequent in traumatized people can be due to the fact that mainly men are involved with more occupational and risky jobs and the risk of being exposed to injuries and traumas is more than women. Also, men are inherently more daring and risk-taking than women, so they are more at risk of facing various injuries. But on the other hand, the death rate of elderly women in this study was higher which was mainly caused by falls and traffic and road accidents. This can be due to age and physical conditions and underlying medical diseases.

In the present study, age did not have a significant effect on the mortality rate of trauma patients, which was consistent with the results of Costa et al.'s study [10]. In the study of Amini et al. [9],which was conducted on 544 multi-trauma patients,the average age of the patients was 35.45 years, and the average age of the deceased was 45 years, and age had a significant effect on mortality. In Chiang et al.'s study [11],the average age of people who suffered major trauma was 53.7 years with the predominance of men, and age greater than 45 years was related to the rate of mortality. Also, previous studies have confirmed that mortality and complications are higher in elderly trauma patients, so that falls are the main cause of death in elderly people, and this risk increases rapidly after the age of 60 [12-14].This difference can be caused by some confounding variables such as having an

underlying disease, osteoporosis and other conditions which have caused an increase in vulnerability and mortality in these group of people.

In this study, a negative relationship between the initial GCS and mortality was observed, but this difference was not significant. In Soltani et al.'s study [15], A negative and significant relationship was observed between the GCS and mortality, which was just consistent with our results in terms of having a negative relationship. In the study of Yazdi Onji and colleagues [16] on 95 patients, they showed that there was a significant difference in GCS in deceased and recovered trauma patients. GCS 6 hours after admitting to ICU was a significant determinant of outcome, but initial GCS had no significant relationship with the outcome. Medical interventions used in the treatment of mild and moderate trauma may complicate the assessment of GCS. Prescription of sedatives or paralyzing drugs, as well as poisoning and facial injuries and many other factors may limit the accuracy and usefulness of initial GCS [17].

In our study, although the percentage of initial oxygen saturation was slightly lower in deceased patients, this difference was not significant (P=0.54) (Table 2). In the study of Janmohammadi et al.[18] on 334 hospitalized patients, 155 patients were hospitalized due to multiple trauma or head trauma,no significant relationship was found between the level of consciousness and intubation with mortality. The difference in the results of different studies can be caused by the difference in the sample size and characteristics of the studies.

In our study the blood pressure of deceased persons was one mmHg lower than discharged persons, but this difference was not significant (P=0.73). (Table 2). In the study of Soltani et al.[15] on 1541 trauma patients,there was a significant difference in the blood pressure of recovered and deceased people, so that SBP of less than 60 mm Hg was associated with significantly higher mortality. The results of the studies by Ahun et al. [19],Farhoud et al. [20] and Sartorius et al. [21] also showed that there is an increase in mortality when the systolic blood pressure is less than 60 mm Hg.

In this study, motor vehicle collisions and falls contributed greatly to the mortality of trauma patients, which was consistent with the results of other studies. In Costa et al.'s study [10], pedestrian accidents (38.5%) were predominant, followed by motorcycle accidents (25.5%) and falls (14%). According to the study by Sis et al. [14], in the United States, death from falls increased by 46% from 2002 to 2010, and death from falls was associated with increasing age. In the study of Sadeghi Mohammadi et al. [8], all age groups were at the same risk for motor vehicle accidents on non-urban roads.

In general, the mortality rate in this study was 1.6%. Based on trauma severity, mortality rate in mild, moderate and severe injury groups was 0.27% , 0.62% and 0.48% respectively (Table 1). Also, ISI more than 16 and less than was associated with 0.2% and 1.3% respectively. In the study of Amini et al. [9] the mortality rate was 5.6% which was higher than the result of our study. The mortality rate in the study by Wafaei et al. [7] was 0.71%, which was lower than our results. In the study by Costa et al.[10], which was a longitudinal prospective observational study conducted between 2010 and 2013 in São Paulo, Brazil, the mortality rate of trauma patients during the follow-up period was 26%, and in the study by Chiang et al.[11],the 8-year mortality rate of trauma patients was 13.4%, which was much higher than the mortality rate in our study. In Costa et al.'s study [10] , ISI had a significant effect on the mortality rate.In Chiang et al.'s study [11],the variables most associated with mortality were age older than 45 years, ISS between 16 and 24, GCS score less than 8, road accidents, falls, trauma team call(trauma code), pre-existing co-morbidities including cardiovascular disease, renal failure and hypotension. In our study, higher ISI was associated with higher mortality rate, which was consistent with other studies. This may be because, in general, higher ISI values are related to severe and multiple traumas and these patients are generally in serious and critical conditions, so the mortality rate in this group of patients is higher.

V. CONCLUSION

Road traffic injuries are a major public health problem, especially in low- and middle-income countries, with significant socioeconomic effects and major adverse clinical outcomes. This study was designed to identify early predictors of mortality in multiple trauma patients. According to our results, a significant percentage of traumatized people were under 40 years of age as well as old women and the most common causes of trauma were collisions and falls, so it is necessary to make policies to improve the quality of vehicles, roads and measures to

prevent driving offences in order to reduce preventable injuries. Public education about trauma prevention in the group of elderly women and their families can be effective in reducing its incidence.

In our study, private vehicle with 53.2% of cases followed by ambulance with 44.7% was the most common method of transferring trauma patients. They might be a result of unfavorable pre-hospital emergency systems or people's lack of knowledge about its proper use therefore planning for improvement of emergency systems and public education in this matter seems necessary.

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Ethical approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Author contribution

Dr. Reza Farahmandrad: conceptualized and designed the study

Dr. Shahrouz Tabrizi: drafted the initial manuscript and revised the manuscript, and critically reviewed the manuscript for important intellectual content.

Dr. Akram Zolfaghari: Coordinated and supervised data collection

Dr.Amir Hossein meisami: Coordinated and supervised data collection

Dr. Mohammad Reza Rezaei: Coordinated and supervised data collection

Dr.Bar Reza Rezaei: : Coordinated and supervised data collection

Declaration of competing interest

The authors deny any conflict of interest in any terms or by any means during the study.

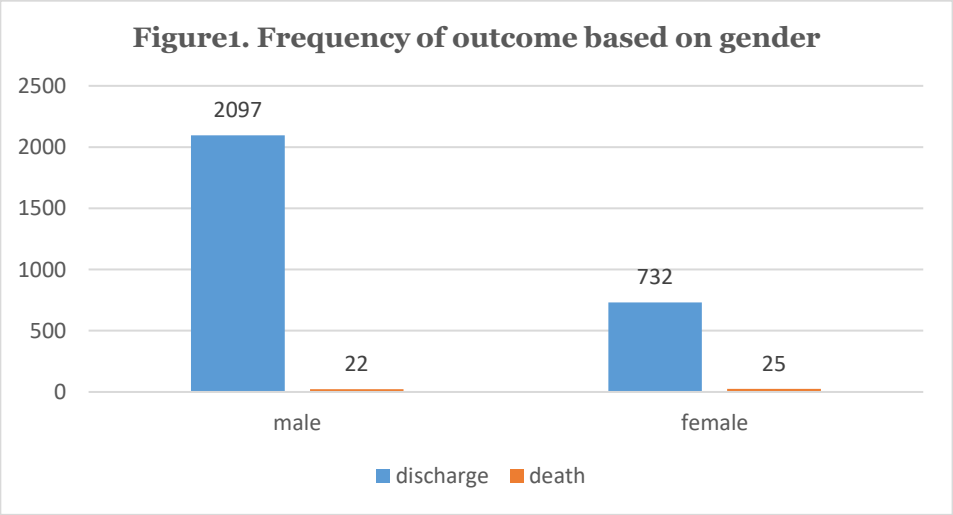


Figure 2. Frequency of the final outcome based on age groups

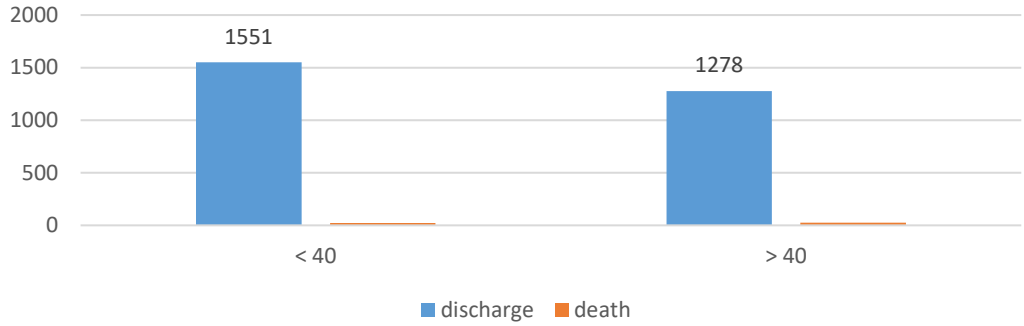


Figure3.frequency of outcome based on mechanism

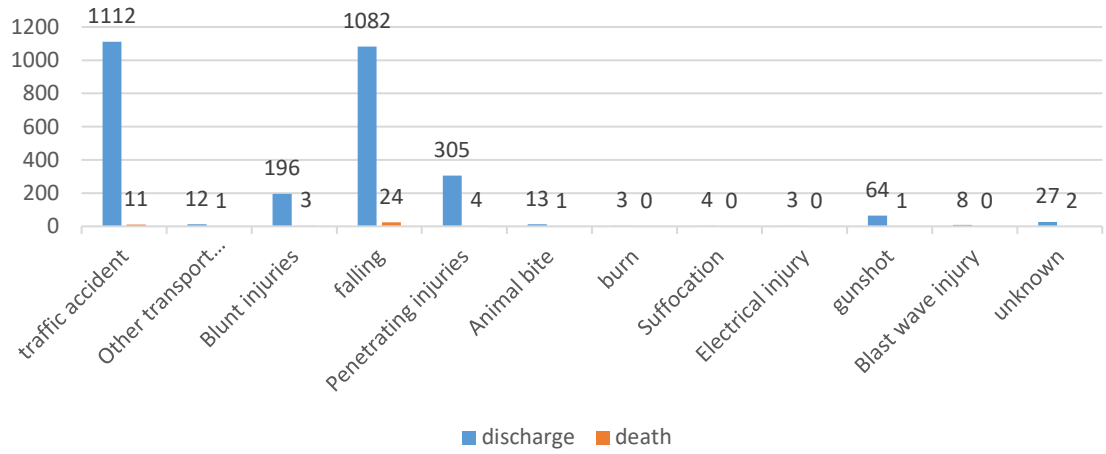


Fig 4.Frequency of outcome based on method of transfer

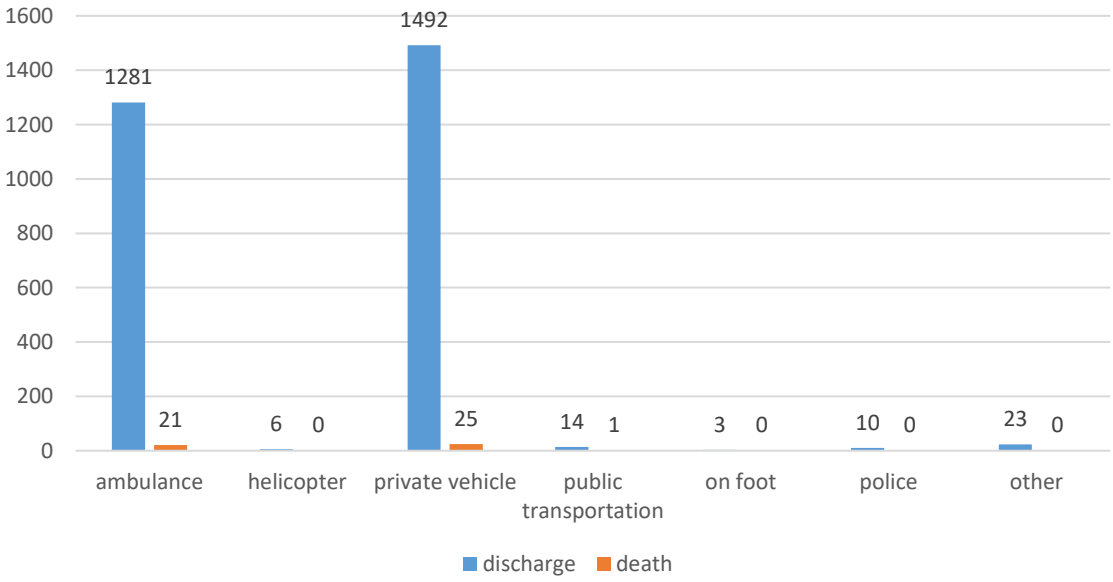


Fig 5. Frequency of outcome based on interfacility transfer

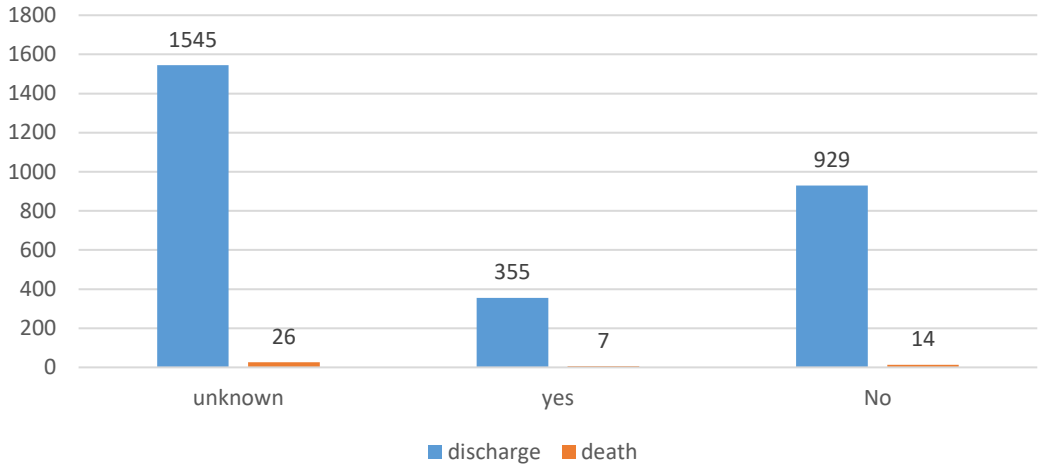


Fig 6.Frequency of final outcome based on ISI

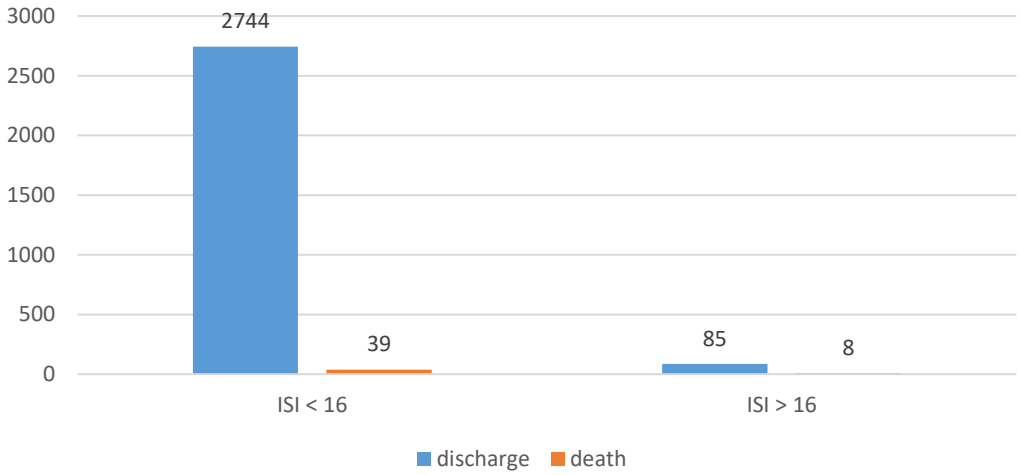
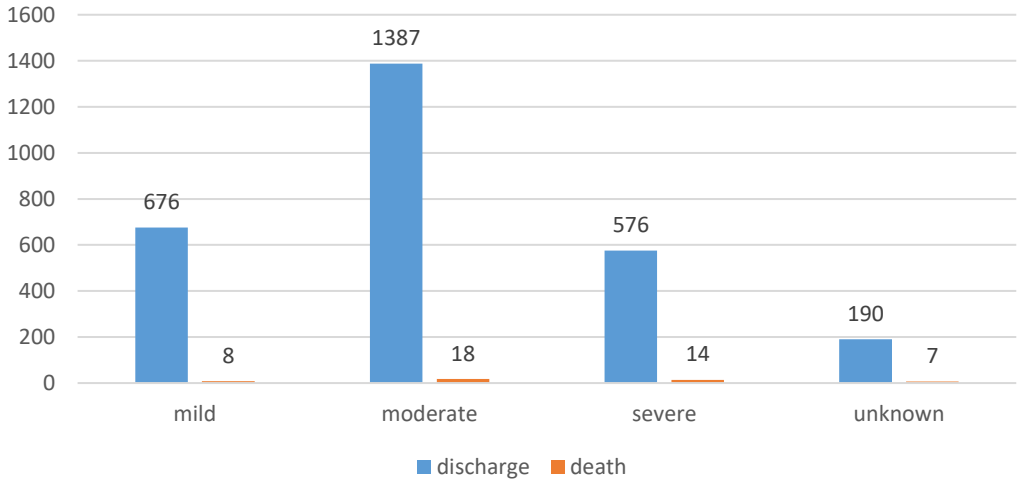


Fig 7. Frequency of outcome based on trauma severity(AIS)



References:

[1] 1.Naghavi M, Shahraz S, Bhalla K, Jafari N, Pourmalek F, Bartels D, et al. Adverse health outcomes of road traffic injuries in Iran after rapid motorization. 2009.

[2] 2.Johnson NB, Hayes LD, Brown K, Hoo EC, Ethier KA. CDC National Health Report: leading causes of morbidity and mortality and associated behavioral risk and protective factors—United States, 2005–2013. 2014.

[3] 3.Pur SN, Rassouli M, Pur AM, Kavousi A. Auditing of preventive nursing care regarding neonatal hypothermia at Shahid Beheshti Medical Sciences University selected hospitals in 2011. Modern Care Journal. 2012;9:104-13.

[4] 4.Gulli B, Ciatolla JA, Barnes L. Emergency care and transportation of the sick and injured: Jones & Bartlett Learning; 2011.

[5] 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 Monthly. 2017;22(3).

[6] 6.Pfeifer R, Tarkin IS, Rocos B, Pape H-C. Patterns of mortality and causes of death in polytrauma patients—has anything changed? Injury. 2009;40(9):907-11.

[7] 7.Vafaee R, Vafaei A, Forouzanfar MM, Asadollahi S, Kashani P, Heidari K, et al. Epidemiology of traumatic brain injury in Iranian population: the results of a multicenter study. Wulfenia. 2013;20(9):257-63.

[8] 8.mohammadi SS, Dinmohammadi M. Demographic characteristics of patients with trauma and its related factors in patients referred to emergency departments of Ayatollah Mousavi, teaching hospital affiliated to Zanjan University Of Medical Sciences, 2017. Iranian Journal of Emergency Care. 2017;1(3):11-7.

[9] 9.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 Monthly. 2021;26(5):252-7.

[10] 10.da Costa LGV, Carmona MJC, Malbouisson LM, Rizoli S, Rocha-Filho JA, Cardoso RG, et al. Independent early predictors of mortality in polytrauma patients: a prospective, observational, longitudinal study. Clinics. 2017;72:461-8.

[11] 11.Chiang Y-T, Lin T-H, Hu R-H, Lee P-C, Shih H-C. Predicting factors for major trauma patient mortality analyzed from trauma registry system. Asian journal of surgery. 2021;44(1):262-8.

[12] 12.Champion HR, Copes WS, Buyer D, Flanagan ME, Bain L, Sacco WJ. Major trauma in geriatric patients. American journal of public health. 1989;79(9):1278-82.

[13] 13.Perdue PW, Watts DD, Kaufmann CR, Trask AL. Differences in mortality between elderly and younger adult trauma patients: geriatric status increases risk of delayed death. Journal of Trauma and Acute Care Surgery. 1998;45(4):805-10.

[14] 14.Sise RG, Calvo RY, Spain DA, Weiser TG, Staudenmayer KL. The epidemiology of trauma-related mortality in the United States from 2002 to 2010. Journal of trauma and acute care surgery. 2014;76(4):913-20.

[15] 15.Soltani Y, Khaleghdoost Mohamadi T, Adib M, Kazemnejad E, Aghaei I, Ghanbari A. Comparing the predictive ability for mortality rates by GAP and MGAP scoring systems in multiple-trauma patients. Journal of Mazandaran University of Medical Sciences. 2018;27(157):118-32.

[16] 16.Izadi avanji FS, Fakharian E, Masoodi Alavi N. Outcome of factors related to traumatic brain injuries among the patients hospitalized in intensive care unit. Feyz Journal of Kashan University of Medical Sciences. 2010;14(2):112-9.

[17] 17.Andrews PJ, Sleeman DH, Statham PF, McQuatt A, Corruble V, Jones PA, et al. Predicting recovery in patients suffering from traumatic brain injury by using admission variables and physiological data: a comparison between decision tree analysis and logistic regression. Journal of neurosurgery. 2002;97(2):326-36.

[18] 18.Janmohammadi N, Alijanpour E, Bahrami M, Taheri M, Hosseni F. Outcome of the Patients Admitted to the Surgical Intensive Care Unit of Shahid Beheshti Hospital (Babol, Iran). Journal of Babol University of Medical Sciences. 2014;16(6):72-7.

[19] 19.Ahun E, Köksal Ö, Sığırlı D, Torun G, Dönmez SS, Armağan E. Value of the Glasgow Coma Scale, age, and arterial blood pressure (GAP) score for predicting the mortality of major trauma patients presenting to the emergency department. Turkish Journal of Trauma and Emergency Surgery. 2014;20(4):241-7.

[20] 20.Farhoud AH. Accuracy of mechanism, glasgow coma scale, age and arterial pressure (MGAP) score in predicting mortality in Polytrauma patients.

[21] 21.Sartorius D, Le Manach Y, David J-S, Rancurel E, Smail N, Thicoïpé M, et al. Mechanism, glasgow coma scale, age, and arterial pressure (MGAP): a new simple prehospital triage score to predict mortality in trauma patients. Critical care medicine. 2010;38(3):831-7.