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Research Article

Evaluation of Trauma Injury Patterns and Treatments of Urban Riots in Tehran

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Abstract

Introduction: Trauma is one of the leading causes of death and disability worldwide. This study aimed to investigate the severity and patterns of trauma, as well as to analyze the treatment outcomes for victims of urban riots who were referred to a general hospital in Tehran from October to December 2022.

Methods: This cohort study involved 1,032 individuals injured during urban riots, all of whom were referred to a Hospital in Tehran between October and December 2022. The severity of their injuries was assessed based on operational descriptions, CT scans of the brain and other organs, and ultrasound examinations, all of which were obtained from patient records. The likelihood of survival for each patient was calculated using the TRISS method.

Results: One thousand thirty-two individuals were injured, consisting of 1,030 males and two females. The patients ranged in age from 14 to 65, with an average age of 30.9 ± 9.9 years (median age of 30 years). Among the injured, two people (0.19%) were aged between 0 and 15, 1,008 people (97.7%) were between 15 and 55, and 22 people (2.1%) were over 55 years old. The average Injury Severity Score (ISS) was 1.8 ± 3, with a median score of 1. The average survival probability of patients using the TRISS model was 99.487 ± 2.7%. The overall average TRISS score was 0.513 ± 2.7%.

Conclusion: TRISS can be utilized to evaluate the quality of various programs, such as educational initiatives, the establishment of cardiopulmonary resuscitation teams, and trauma surgical teams. Given the potential for urban accidents, it is essential to develop trauma care protocols based on the severity of patients' injuries. Additionally, it is recommended to establish a trauma registration center that utilizes standard questionnaires and checklists.

Keywords: Trauma, treatment performance, urban riots.

Introduction

Mass casualties and incidents, such as mass transit accidents, terrorist attacks, and natural disasters, are rare events in which large numbers of people with urgent medical needs can quickly overwhelm existing healthcare capacities [1-3]. Events often happen unexpectedly, making disaster management crucial for policymakers. It- helps prevent incidents, minimize potential damage, and prepare for responses, ensuring the most effective action and swift recovery. Consequently, well-developed and effective emergency plans are essential in emergency healthcare [4-6].

The rebels use stones, sticks, and clubs as tools for riots. Also, projectile devices that utilize kinetic energy, such as plastic bullets, and chemical agents like tear gas are among the most commonly used tools for riot control, legally permitted to manage riots. Kinetic impact projectiles, including plastic, wooden, pellet, and foam batons, are considered non-lethal riot control agents due to their low velocity and sizeable cross-sectional area. These projectiles generally do not penetrate body tissues or pierce the skin. However, if they strike vulnerable regions such as the head, neck, or chest, they can lead to severe trauma, internal bleeding, or even death. In most cases, the injuries caused by these tools are limited to hematomas and bruising of the tissues [7]. When using live ammunition, several factors influence the extent of damage to the body. These include the speed and energy of the bullet, the size of the wound created, the depth of penetration, and the specific organs that are affected. In these incidents, blood vessels, muscles, and bones may be damaged. It is crucial to immobilize the limbs, care for soft tissue, apply proper wound dressings, and maintain organ function. These measures are among the most critical and challenging steps to reduce damage and prevent complications. However, the expertise of emergency and medical staff in managing and transporting the patient to the hospital and executing appropriate measures upon arrival are crucial factors for improving incident outcomes [6-8].

Trauma remains the leading cause of death among young people and has been among the top three causes of mortality overall in recent years. Recording accidents and injuries provide valuable information for monitoring and evaluating the care system. This information is collected in developed countries based on specific criteria, including trauma scoring and severity assessment. For many years, trauma scoring has been viewed as a crucial element in pre-hospital triage, helping to predict the severity of injuries, assess mortality risks following trauma, and assist physicians in evaluating patients to provide appropriate care [9]. A better understanding of trauma epidemiology allows for establishing relevant programs and strategies. This includes implementing preventive measures and organizing the delivery of medical services, which can ultimately enhance the quality of trauma care. For instance, in some countries, accidents are among the leading causes of death and injury. Their work programs have emphasized preventive measures to minimize injuries [9-11].

Given that no published information has been provided regarding the assessment of injury types and consequences for those injured during urban riots and incidents in Iran, examining this issue could enhance awareness and improve planning for treatment and care needs. This study aimed to evaluate the types of injuries and their consequences for both military personnel and civilians who were injured during urban incidents, specifically riots. The analysis focused on cases referred to one of the hospitals in Tehran from October to December 2022.

Methods

This study was conducted on injured patients from urban accidents referred to one of the general hospitals in Tehran between October and December 2022.

The study utilized a convenient sampling method to include all military and civilian casualties—1,032 individuals—who were referred to the emergency department of one of the hospitals in Tehran due to urban accidents between early October 2022 and the end of December 2022.

Exclusion criteria:

1. Individuals with injuries whose information was not entered correctly.
2. Injuries that are proven to be unrelated to the accident.

The desired information was collected in the form (containing personal Characteristics, age, gender, trauma mechanism, organ injury pattern, emergency surgery, and potential additional traumas) documented by the emergency department. The ISS and RTS values were calculated, and finally, TRISS was computed using the P(s) formula mentioned below for each injured individual. The study aimed to achieve several objectives: first, to determine the average severity of injuries sustained by accident victims based on the Injury Severity Score (ISS); second, to explore the relationship between the average injury severity and the patterns of injuries about the mortality rate; and third, to calculate the expected probability of mortality using the TRISS quantitative criterion. Finally, a comparison was made between these expected probabilities and the observed mortality rates in the patients referred to the study for analysis.

The ISS index assesses injury severity for each victim by dividing the body into the head, neck, face, chest, abdomen, pelvic contents, limbs, and pelvis. The calculation method is as follows: Each part of the specified organs is assigned the highest score based on the severity and type of injury, according to a table called the Abbreviated Injury Scale (AIS). The top three scores were identified, and their squares are added together. Additionally, the TRISS criterion will be calculated using the Revised Trauma Score (RTS) index, which takes into account the patient's respiratory rate (RR), blood pressure (BP), Glasgow Coma Scale (GCS), Injury Severity Score (ISS), and age to suggest the probability of survival (PS). To estimate the likelihood of patient survival using the TRISS method, scores from the Revised Trauma Score (RTS), the Injury Severity Score (ISS), and the patient's age (categorized into three groups: under 15 years, 15-55 years, and 55 years and older) are used. These scores were entered into specific formulas, which were then calculated based on the type of trauma. The age group coefficient in the model is the same for the age groups under 15 years and between 15 and 55 years. However, for individuals under 15 years, the probability of survival from penetrating traumas is also calculated using the model for blunt traumas.

P(s) = 1 / (1 + e-b) ؛ e = 2.718282 (base of natural logarithm)

b = b0 + b1*(RTS) + b2*(ISS) + b3*(Age index)

For patients under 55 years old, the age index is = 0, but for patient ≥ 55 years old, the age index is = 1.

In penetrating traumas:

$b_{0\,=\,-2.5355}$, $b1_{\,=\,0.9934}$, $b2_{\,=\,-0.0651}$, $b3_{\,=\,-1.1360}$

In blunt traumas:

$b_{0\,=\,-0.4499}$, $b1_{\,=\,0.8085}$, $b2_{\,=\,-0.0835}$, $b3_{\,=\,-1.7430}$

The probability of survival and death of patients was predicted based on the TRISS model. The number of predicted deaths was calculated from the product of the likelihood of death obtained with the total number of patients. The expected number of deaths in the study includes patients with a survival probability of less than 50 percent. To evaluate the status and performance of hospital services, the W statistic was calculated as follows:

To compare the results of this study with those of the Major Trauma Outcomes Study (MTOS), we calculated the Z statistic. If the Z statistic falls within the range of -1.96 to +1.96, it indicates no significant difference between the results of the two studies. The formula for calculating the Z statistic is as follows:

Statistical analysis

The study used SPSS-26 software for data analysis, employing descriptive statistics such as mean and standard deviation and appropriate statistical tests, including the t-test and Pearson Chi-square test. All tests were considered significant at 5%.

Results

This study included 1,032 military and civilian casualties resulting from urban riots. The patients were between 14 and 65 years, with a mean age of 30.9 ± 9.9 years and a median age of 30 years. Most of the traumas sustained were blunt. The average length of hospitalization was 1.38 days. Of all the referrals, 95 patients were admitted to the general ward, while four were transferred to the ICU (Table 1).

Table 1: Demographic characteristics of the participants

Items		N	%
Age, years	<15	2	0.19
	15-55	1008	97.7
	>55	22	2.1
Sex	Female	2	0.19
	Male	1030	99.8
Trauma mechanisms	Blast	26	2.5
	Combined	46	4.45
	Blunt	784	75.9
	Penetrating	176	17
Final outcomes	Discharge	1012	98
	Leaving the center	18	1.7
	Death	2	0.19
Occupation	Military	1009	97.7
	Non-military	23	2.2
Injury location	Head	179	17.3
	Neck	47	4.5
	Face	174	16.8
	Chest	65	6.3
	Abdominal	52	5
	Spine	50	4.8
	Upper limbs and shoulders	414	40.1
	Lower limbs and pelvis	465	45
	Exterior	75	7.2

The mean ISS was 1.8 ± 3 (median: 1). For deceased individuals, the mean ISS was 46 ± 41, while for survivors, it was 1.75 ± 2. This difference was statistically significant (P = 0.003).
The mean ISS for individuals under 15 was 1 ± 0.01, while the scores for those aged 15 to 55 and those 55 years and older were 1.8 ± 3.1 and 1.6 ± 0.7, respectively. The difference among these groups was insignificant (P = 0.74).
The frequency of injuries reported for the lower limbs and pelvis was 45%, for the upper limbs and shoulders was 40.1%, and for the head and face was 17.3% and 16.8%, respectively. Among civilians, the most common injuries were reported as follows: 52% of injuries affected the lower limbs and pelvis, 34% involved the upper limbs and shoulders, and 26% impacted the head. There was no statistically significant difference in the pattern of limb injuries when comparing soldiers and civilians (Table 2).

Table 2: The pattern of organ damage in casualties

Items		Occupation	N	%	P
Injury location	Head	Military	173	17.1	**0.26**
		Non-military	6	26	
	Neck	Military	46	4.5	**0.96**
		Non-military	1	4.3	
	Face	Military	1	17.1	**0.10**
		Non-military	173	4.3	
	Chest	Military	63	6.2	**0.63**
		Non-military	2	8.7	
	Abdominal	Military	50	4.9	**0.41**
		Non-military	2	8.7	
	Spine	Military	47	4.6	**0.06**
		Non-military	3	13	
	Upper limbs and shoulders	Military	406	40.2	**0.59**
		Non-military	8	34.7	
	Lower limbs and pelvis	Military	453	44.8	**0.48**
		Non-military	12	52.1	
	Exterior	Military	73	7.2	**0.78**
		Non-military	2	8.7	

The highest frequency of trauma mechanisms in blunt injuries was reported at 75.9%, while the lowest frequency of explosive injuries was noted at 2.5%.
Two patients (0.19%) died, 18 (1.8%) left the hospital, and 98% were discharged.
The military individual sustained injuries to the head, face, chest, upper limbs, shoulders, lower limbs, and pelvis. In contrast, the civilian individual exhibited injuries primarily to the upper limbs and shoulders, as well as external injuries, including skin damage and burns.
Eighty-two surgeries were performed on 74 patients, with orthopedic surgeries accounting for the highest frequency at 59.4%.
In this study, among 1032 patients, the TRISS model indicates that the probability of death for one person exceeds 50% (expected deaths). The average survival probability of patients using the TRISS model was 99.487 ± 2.7%. The overall average TRISS score was 0.513 ± 2.7%. Consequently, the expected number of deaths was calculated to be 26.5, leading to a predicted number of survivors of 1027. The estimated value of W was 0.29, and the computed value of z was -0.042. Based on the W obtained in this study, the mortality rate

was 0.29 per 100 individuals, which is lower than the Major Trauma Outcomes Study data. Additionally, the z value indicates no significant difference between the results of the two studies.

Discussion

The present study assessed the severity and pattern of injuries among urban accident victims referred to one of the hospitals in Tehran from October to December 2022. The findings revealed that the average injury severity score was 1.8 ± 3.

This study's results indicate a significant difference in the average injury severity index between survivors and deceased individuals. In this study, the most frequently reported injuries were to the lower limbs and pelvis, upper limbs and shoulders, and the head and face. Specifically, among civilians, the highest incidence of injuries also occurred in the lower limbs and pelvis, followed by the upper limbs, shoulders, and head. According to the study, two patients died.

The current study found that participants had an average injury severity score of 1.8 [3]. This score was significantly higher in deceased patients than survivors, and civilians also had a higher average injury severity score. Norouzi et al. conducted a study in Ardabil, indicating that the average injury severity score was 15.50 ± 11.31. In this study, the average ISS for patients with penetrating trauma was significantly higher compared to those with blunt trauma [11]. In a survey conducted in Ahvaz to examine the injury patterns and outcomes of victims of terrorist attacks, the average ISS was found to be 13 [12].

Additionally, there was a significant relationship between the ISS values and patient outcomes. Another study in Iran revealed that the ISS was substantial in both deceased patients and those who survived [11]. In a survey by Champion et al. involving 3,833 patients, mortality and complications of the disease were found to increase significantly with higher ISS severity [13]. Many researchers have studied the link between ISS score and mortality in trauma patients, consistently suggesting that greater injury severity correlates with higher death rates [14, 15]. In a survey conducted by Wan et al. at Saint Louis University involving 3,540 trauma patients, a significant relationship was found between patient death and an increased ISS [16].

Indurkar et al. demonstrated that the mean ISS was 4.27, and the average score was higher in patients who died [17]. The findings of this study align with previous research. The ISS can serve as a helpful index for assessing the quality of medical services provided to injured patients. However, a significant limitation of the ISS is that it accounts for only one score per body region. This means that if a patient sustains multiple injuries within the same body region, only the most severe injury is considered in the score. As a result, the score's ability to predict a patient's outcome is sometimes underestimated [18]. The results of the current study indicated that the average injury severity was more significant in individuals aged 15 to 55 compared to younger individuals. However, this difference was not statistically significant. Furthermore, a study involving 1,955 patients found that, at the same ISS, older patients had a higher risk of mortality than younger patients [19].

In the present study, injuries were most frequently reported in the lower limbs and pelvis, upper limbs and shoulders, and head and face. Among civilians, the most common injuries were reported in the lower limbs and pelvis, upper limbs and shoulders, and head, respectively. According to the findings of this study, a study conducted in Kermanshah indicated that individuals with trauma most commonly experienced injuries to their upper limbs [20]. Payne-Jame et al. found that individuals injured in riots were most affected in the head, eyes, and facial skin [21]. In a study conducted in the United States in 2022, 14% of individuals reported experiencing traumatic brain injuries and facial injuries [22]. A study from Iran found that 92.46% of trauma cases involved head and neck injuries or multiple traumas; however, a neck collar was applied in only 11.5% of these instances [23]. Choi's study found that most trauma mechanisms resulted in injuries to the head, neck, and chest, occurring with varying frequencies [24]. The most common body injuries noted in a study conducted in Somalia were to the head and limbs [25]. In a similar context, a longitudinal and prospective analysis of injuries sustained by a U.S. Army brigade combat team during the Iraq War revealed the following distribution of injuries: head/neck 36.2%, chest 7.5%, abdomen 6.9%, and extremities 49.4% [26].

Additionally, Dadashzadeh et al. reported that 85% of trauma cases involved blunt injuries in their investigation into the therapeutic interventions provided by pre-hospital emergency personnel for trauma patients [23]. According to Bijani et al., 20% of all patients experienced penetrating trauma, while 80% suffered from blunt injuries [27]. Furthermore, Arslan et al. demonstrated that multiple-body site injuries were more prevalent in blast injuries (75%) compared to gunshot wounds (48%). They also found that the relative frequency of internal injuries was higher in blast injury cases than in those resulting from gunshot wounds. Additionally, patients injured by explosions tended to have a greater incidence of severe and critical injuries than those injured by firearms [25].

According to the results of this study, two patients (0.19%) died, and 18 patients (1.8%) left the hospital, while the majority (98%) were discharged. In Ahvaz, 25% of patients died as a result of the aftermath of terrorist attacks [12]. In Somalia, the mortality rate among hospitalized patients with terror-related injuries was 11.6%. The findings of this study indicated that suicide bombings are linked to multiple bodily injuries, a higher incidence of severe and critical internal injuries, and an increased mortality rate [25]. The results of various studies indicate higher mortality rates than those reported in the Jazer study for trauma caused by different incidents [4]. The low mortality rate observed in this study may be attributed to several factors, including the low injury severity indices (ISS, TRISS), the inadequate performance of the medical staff at this center, or issues such as underreporting, incorrect documentation of referral reasons, pre-hospital deaths that were not recorded, or the lack of accurate access to relevant data.

We utilized the TRISS score to predict trauma outcomes in patients injured in accidents. The results of our study revealed that the average survival probability for these patients, based on the TRISS score, was 99.487 ± 2.7%. Additionally, the mean TRISS score (which indicates the predicted probability of death) for military casualties was 0.50 ± 2.7, while for civilian casualties, it was 0.79 ± 2.7. In total, the mean TRISS score was 0.513 ± 2.7. Consequently, the expected number of deaths was calculated to be 26.5, leading to a predicted number of survivors of 1,027.

Furthermore, W was estimated to be 0.29, and z was calculated to be -0.042. In a study conducted in India and Pakistan, the Z-statistics were estimated at -14.2 and 1.58, respectively [28-30]. In Utah, establishing a trauma team led to a W-statistic of 8, indicating that eight additional trauma patients survive per 100 compared to MTOS, while the Z-statistic was 1.2 [31]. Demetriades et al. found that TRISS effectively predicts survival in patients with mild injuries. Still, it is less effective for moderate to severe injuries due to a higher misclassification rate as injury severity increases [32]. Based on the findings of this study, we conclude that at a hospital in Tehran, there were 0.29 fewer deaths per 100 patients compared to the data from the Major Trauma Outcomes Study. Additionally, the z-value indicates no significant difference between the results of the two studies.

The present study encounters several significant limitations. Firstly, it employs a retrospective design, which can influence the reliability of the findings. Secondly, the data were not gathered during the critical prehospital and hospital phases, potentially compromising the accuracy of the results and the thoroughness of the information collected. Addressing these factors is essential for enhancing the validity of future research.

Conclusion

TRISS can be utilized to evaluate the quality of various programs, such as educational initiatives, the establishment of cardiopulmonary resuscitation teams, and trauma surgical teams. Given the potential for urban accidents, it is essential to develop trauma care protocols based on the severity of patients' injuries. Additionally, it is recommended to establish a trauma registration center that utilizes standard questionnaires and checklists.

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Conflict of Interest Disclosures

There is no conflict of interest.

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Authors' Contributions

All authors contributed equally in this study.

Ethical Statement

This study was approved by the Ethics Committee of Baqiyatallah University of Medical Sciences under the code: IR.BMSU.REC.1402.038

Declaration of Generative AI and AI-assisted

technologies

None.

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