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Which Demographic and Clinical Characteristics Can Better Predict the Length of Hospital Stay among Traumatic Patients? A Retrospective Single-Center, Registry-Based Study

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Abstract

Background: Lengthy hospitalization may lead to an increased hospital-acquired patient complication, including infections, as well as increased costs for both healthcare systems and patients. A few studies evaluated the impact of various clinical and demographic variables on patients' length of stay (LOS). Hence, in this study, we aimed to investigate the impact of various variables on traumatic patients' LOS.

Methods: This is a retrospective single-center, registry-based study of traumatic patients admitted to Taleqani, a major trauma center in Kermanshah, Iran. A Minimal Dataset (MDS) was developed to retrieve traumatic data on demographic and clinical aspects. We used univariable and multiple quantile regression models to evaluate the association between independent variables, including ISS, GCS, and SBP, with LOS. LOS is practically defined as the time interval between hospital admission and discharge. The LOS durations have been presented as median (Q1 to Q3) hours. A p-value of <0.05 was considered statistically significant.

Results: A total of 2708 cases were included in this study, with 1989 (73.4%) of them being male. The median LOS was 87.00 (48.00 to 144.00) hours. When adjusted for systolic blood pressure (SBP), Glasgow Coma Scale (GCS), Injury Severity Score (ISS), and cause of injury, the two characteristics of spine/back and multiple trauma were significantly associated with the higher LOS, with 43 (20.5 to 65.48) and 24 (10.39 to 37.60) hours more than extremities ($P < 0.001$ and $P = 0.005$). Besides, the patients admitted due to road traffic injuries (RTI) were discharged 16 and 41 hours later than falling and cutting/stabbing ($P = 0.008$ and < 0.001, respectively). Moreover, the patients with ISS≥16 and 9≤ISS≤15 had a median of 51 (21 to 80) and 34 (22 to 45) LOS hours more, compared to 1≤ISS≤8, respectively ($P < 0.001$). The trauma cases experiencing SBP ≤ 90 mmhg on admission had a median of 41 (20 to 62) hours more hospitalization period than those with SBP> 90 mmhg ($P < 0.001$). At last, the patients with GCS of 9 to 12 and GCS of 3 to 8 were hospitalized for 39 and 266 hours more than GCS of 13 to 15 ($P < 0.001$).

Conclusion: Determining independent determinants of prolonged LOS may lead to better identifying at-risk patients on admission. Trauma care providers should consider the following risk factors for increased LOS: higher ISS, Lower GCS, and SBP, multiple trauma or spine injury, and trauma resulting from falling or cutting/stabbing. As a result, the impact of extended LOS might be reduced by intervening in the related influencing factors.

Keywords: Length of stay, Wounds and injuries, Registries, Clinical and non-clinical factors, Classification, hospital

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Introduction

Prolonged hospitalization is determined as the amount of excessed days a patient resides in the hospital after being considered medically dischargeable from the hospital (1). Lengthy hospitalization may increase hospital-acquired patient complications, including infections and costs for healthcare systems and patients (2). Therefore,

↑What is "already known" in this topic:
Extended stays in the hospital can result in more complications for patients, such as infections, and can also lead to higher costs for both healthcare systems and patients. Some studies have examined how different factors, including clinical and demographic variables, can affect the length of a patient's stay (LOS). However, not too much effort was made to determine the effect of different factors on trauma patients' LOS.

→What this article adds:
Higher ISS, Lower GCS, and SBP, multiple trauma or spine injury, and trauma resulted from falling or cut/stab are the main risk factors for increased LOS.

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an index was defined as Lengths of Stay (LOS) as the time interval between hospital admission and discharge (3).

Prolonged hospitalization is associated with a remarkably high burden on healthcare systems; lengthy hospitalization may impact population productivity via spending time within healthcare facilities. Therefore, reducing LOS is an inseparable part of the quality of care (4-7). Despite not being a comprehensive indicator of hospital costs (8), LOS is a practical representative of hospital costs (9). Arguably, many factors are believed to impact the length of hospitalization; among them, ISS, age, and comorbidities are known to influence independently (10).

Trauma registry centers have been developed in many countries throughout the globe not only to expand trauma-related research but also to better plan for resource allocations and improve quality care (11). In this regard, the Iranian Ministry of Health and Medical Education (MOHME) established the National Trauma Registry of Iran (NTRI) in 2014, and its administrative responsibilities were appointed to the Sina Trauma and Surgery Research Center (STSRC). Many referral trauma centers within the country have joined the program since then. Details have been elaborately discussed elsewhere (12, 13).

So far, a multitude of studies has tried to determine the impact of patient's clinical and demographic findings at admission on death, ICU admission, and mechanical ventilation (14, 15). Some LOS calculators have been developed for non-trauma cases. Even for surgery cases, the National Surgical Quality Improvement Program (NSQIP) risk calculator has been developed for LOS prediction (16, 17). Although some demographic and clinical factors are known to impact the LOS in general admissions, including age, gender, marital status, occupation, method of payment, and history of admission (18), nonetheless, little effort has been made to investigate the influence of various clinical and demographic variables on LoS in trauma patients.

This study reviewed the trauma patients admitted to Taleghani Hospital in Kermanshah province, Iran, between November 2019 and March 2022, affiliated with the NTRI. We first aimed to identify the association between baseline demographic and clinical characteristics of trauma patients and LOS; afterward, we determined independent risk factors for protracted LOS.

Methods

Administration and participants

As discussed elsewhere (12, 13), to better respond to healthcare quality, the Iranian Ministry of Health and Medical Education (MOHME) granted the responsibility of the National Trauma Registry of Iran (NTRI) to the Sina Trauma and Surgery Research Center (STSRC) in 2014. The mission was not only to establish a base for the research objective but also to assess and improve the patients' quality of care. In this retrospective cohort study, we included each trauma patient consecutively admitted to Taleghani Hospital in Kermanshah province, Iran, between November 2019 and March 2022. Patients transferred from the ICU of other centers and imminent post-trauma deaths, i.e., in-hospital deceased cases within 24 hours after admission to trauma centers, were also included in this study. Patients discharged in healthy status in less than 24 hours were excluded from the study. Length of hospital stay (LOS) was considered as the primary outcome in this study. Data for each enrolled patient was retrieved from recorded documents. A trained registrar also performed another round of interviews with them or their next of kin, in case the patient was not able to perform a review, to check the accuracy of entered data for each patient.

Registry process

Three trained registrars majoring in medical sciences filled out questionnaires via direct face-to-face interviews. If the patient could not interview at the time, the interview was performed with an informed acquaintance of theirs. Further data were retrieved via the center's database, also known as the Health Information System (HIS). All data were consolidated and eventually uploaded to the NTRI web-based portal. An external assessor appraised data for its completeness and validity. Finally, according to guidelines developed by Advancement of Automotive Medicine (AAAM), a surgeon evaluated the injury severity-related data utilizing the Abbreviated Injury Scale (AIS), AIS predot code, and Injury Severity Score (ISS).

Variables

According to the NTRI protocol, the adopted MDS for this study encompassed 99 variables (12): emergency department information (n=23), prehospital data (n=22), injury characteristics (n=20), demographic data (n=18), outcomes (n = 6), injury severity indicators (n=3), financial points (n = 3), diagnosis (n=2), and procedures (n = 2).

Among the major injury causes, there were four main categories: road traffic injuries (RTIs), penetrating injuries from stabs and/or cuts, falling injuries, and others. Taking into account WHO definitions (19), a fall is an unintentional drop to the ground or lower level. In this study, several categories of injuries are listed under "others," including drowning, animal attacks, burns, heat injuries, and unknown causes. Patients' educational backgrounds were broken down into four categories: tertiary education for those with collegiate education, secondary education for those with high school degrees, primary education for those with primary school degrees, and no formal education for those without education.

The severity of injuries was graded using the abbreviated Injury Scale (AIS). The Injury Severity Score (ISS), which ranged from 1 to 75, was then determined using the AIS scores (20, 21). A patient with an injury in at least two body zones with AIS greater than two was deemed a case of multiple trauma (22, 23). GCS was divided into three categories based on the literature (24): mild injury (13–15), moderate (9–12), and severe (3–8).

Systolic blood pressure (SBP) less than 90 mmHg was established as the criterion for low SBP. HR higher than 100 beats per minute was considered tachycardia. A respiratory rate (RR) of 20 or higher was considered tachyp-

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nea, an SPO_2 of 90% indicated hypoxemia, and a temperature of 36 or less indicated hypothermia.

Statistical analysis

Frequency and percentage were used to describe nominal and categorical variables. Quantitative variables without normal distribution are presented as median (Q1 to Q3). Due to the abnormal distribution of LOS in this study, we utilized univariable and multiple quantile regression models to evaluate the association between independent variables with LOS. Histogram and Shapiro-Wilk test were used to confirm LOS did not follow a normal distribution pattern. A p-value of less than 0.05 was considered statistically significant. Statistical analyses were conducted using the STATA software version 15.0 (Stata Corp, College Station, TX, USA).

Results

In this study, the median LOS was 87.00 (48.00 to 144.00) hours. The mean (SD) for LOS was 143.13 (231.81) hours. A total of 2708 cases were included in this study. The male-to-female ratio was almost 3:1 (73.4%, n=1989 vs. 26.6%, n=719). The average age (mean±SD) was 38.69±20.16 in males and 50.39±23.93 years in females.

Educational level was negatively associated with LOS, as patients with tertiary and secondary education had a median of 27 and 14 hours shorter hospitalization duration ($P < 0.001$). Statistically significant, patients admitted with intentional injuries experienced 23 hours' of shorter hospitalization compared to unintentional injuries ($P < 0.001$). Besides, Trauma patients admitted due to RTI were discharged 12 and 49 hours later than falling and cut/stab trauma, respectively ($P = 0.009$ and $P < 0.001$). However, the fewest number of patients were admitted to the hospital at midnight shift, i.e., 00-06 (13.8%, n=374), the most statistically significant protracted hospitalization period attributed to this group ($P < 0.001$, median: 105

Table 1. Univariable quantile regression of association between demographic characteristics and patients' LOS . N=2708

Variable	N (%)	Median LOS (Q1 to Q3) hours	Coefficient (CI 95%)†	*P*-value
Gender				
Male	1989 (73.4)	86.00 (48.00 to 140.00)	1	
Female	719 (26.6)	91.50 (49.75 to 158.00)	6 (-1.20 to 13.20)	0.102
Age				
<18	345 (12.7)	66.50 (42.00 to 110.50)	1	
18-64	1876 (69.3)	87.00 (48.00 to 144.00)	20 (10.54 to 29.45)	<0.001
≥ 65	487 (18)	106.00 (66.00 to 166.00)	39 (27.65 to 50.34)	<0.001
Marital status				
Married	1594 (58.9)	92.00 (51.00 to 157.00)	1	
Single	962 (35.5)	71.00 (44.00 to 120.25)	-20 (-26.55 to -13.44)	<0.001
Divorced/widowed	146 (5.4)	114.00 (71.50 to 180.00)	22 (8.16 to 35.83)	0.008
The interval between Trauma and admission (min)				
≤ 100	1493 (55.1)	84.00 (4.00 to 138.00)	1	
> 100	1069 (39.5)	92.00 (58.00 to 155.00)	8 (1.24 to 14.75)	0.024
Education				
No formal education	618 (22.8)	98.00 (62.00 to 165.50)	1	
Primary education	490 (18.1)	91.00 (50.00 to 156.25)	-7 (-16.56 to 2.54)	0.151
Secondary education	1312 (48.4)	84.00 (46.00 to 137.00)	-14 (-21.71 to -6.28)	<0.001
Tertiary education	265 (9.8)	70.50 (43.25 to 112.00)	-27 (-38.61 to -15.38)	<0.001
Mechanism of trauma				
Unintentional	2478 (91.6)	89.00 (50.00 to 145.25)	1	
intentional	228 (8.4)	66.00 (42.00 to 113.00)	-23 (-33.71 to -12.28)	<0.001
Cause of Injury				
RTI	1054 (38.9)	98.00 (60.00 to 173.00)	1	
Falling	1267 (46.8)	86.00 (49.00 to 137.75)	-12 (-18.91 to -5.08)	0.009
Cut/stab	293 (10.8)	49.00 (36.00 to 87.25)	-49 (-59.99 to -38)	<0.001
Others	94 (3.5)	101.50 (60.25 to 186.75)	4 (-13.83 to 21.83)	0.439
Occurrence time				
00-06	374 (13.8)	105.00 (59.00 to 155.00)	1	
06-12	529 (19.5)	74.00 (47.00 to 124.00)	-31 (-42.16 to -19.83)	<0.001
12-18	927 (34.2)	91.00 (47.00 to 145.25)	-14 (-24.12 to -3.87)	0.006
18-24	877 (32.4)	87.00 (49.00 to 138.00)	-18 (-28.21 to -7.78)	<0.001
Hospital Transportation				
Ambulance	1208 (44.6)	108.00 (64.00 to 183.00)	1	
Private car	1444 (53.3)	71.50 (44.00 to 120.00)	-36 (-42.59 to -29.40)	<0.001
Others	55 (2)	81.00 (50.00 to 186.00)	-27 (-50.26 to -3.73)	0.022
Body Region				
Extremities	1722 (63.6)	80.00 (47.00 to 128.00)	1	
Head and neck	279 (10.3)	88.00 (45.00 to 190.00)	8 (-3.40 to 19.40)	0.169
Thorax	87 (3.2)	94.00 (46.00 to 142.00)	14 (-5.49 to 33.49)	0.159
Abdomen	32 (1.2)	89.50 (43.50 to 183.00)	13 (-18.47 to 44.47)	0.417
Spine and back	115 (4.2)	119.00 (86.00 to 189.00)	39 (22.00 to 59.90)	<0.001
Multiple Trauma	473 (17.5)	115.00 (65.00 to 208.00)	35 (25.83 to 44.16)	<0.001

RTI: Road Traffic Injuries

† Quantile regression was utilized to calculate coefficient (CI 95%).

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Table 2. Univariable quantile regression of association between clinical characteristics and LOS. N=2708

Variable	N (%)	Median LOS (Q1-Q3) hours	Coefficient (CI 95%)	*P*-value
SBP (ED)				
≤ 90	84 (3.1)	71.00 (42.00 to 140.00)	1	
≥ 91	2616 (96.6)	88.00 (49.00 to 144.00)	-17 (-35.78 to 1.78)	0.071
Heart rate (ED)				
<100	2621 (96.8)	88.00 (49.00 to 144.00)	1	
≥ 100	82 (3)	83.00 (45.00 to 137.75)	-5 (-23.77 to 13.77)	0.601
Respiratory rate (ED)				
<20	2035 (75.2)	91.00 (52.00 to 155.00)	1	
≥ 20	657 (24.2)	71.00 (42.00 to 123.00)	-20 (-27.40 to -12.59)	<0.001
O2 Saturation (ED) (%)				
≥ 90	1811 (66.9)	93.00 (61.00 to 157.75)	1	
<90	125 (4.6)	162.50 (92.25 to 341.50)	73 (56.29 to 89.70)	<0.001
Temperature (ED) (℃)				
≥ 36	2597 (95.9)	61.00 (47.50 to 119.00)	1	
<36	13 (0.5)	87.00 (48.00 to 141.00)	26 (-20.19 to 72.19)	0.273
GCS				
13-15	2437 (90)	84.00 (47.00 to 135.00)	1	
9-12	226 (8.3)	141.50 (83.75 to 308.75)	58 (46.29 to 69.70)	<0.001
3-8	37 (1.4)	422.00 (186.00 to 1002.00)	338 (309.34 to 366.65)	<0.001
ISS				
Mild (1-8)	1992 (73.6)	72.00 (44.00 to 126.00)	1	
Moderate (9-15)	626 (23.1)	117.00 (76.00 to 190.50)	45 (37.41 to 52.58)	<0.001
Severe (≥16)	67 (2.5)	185.00 (96.00 to 430.00)	113 (92.44 to 133.55)	<0.001

SBP: Systolic Blood Pressure; ED: Emergency Department; ICU: Intensive Care Unit; LOS: Length of Stay; ISS: Injury Severity Score; RTS: Revised Trauma Score; * Not/ Applicable due to small number

Tables 3. Multiple quantile regression of association between LOS and major demographic and clinical characteristics of patients

Variable	Adjusted coefficient (CI 95%)	*P*-value
Body Region		
Extremities	1	
Head and neck	0 (-16.28 to 16.28)	1.000
Thorax	5 (-22.14 to 32.14)	0.710
Abdomen	25 (-19.90 to 69.90)	0.274
Spine and back	43 (20.5 to 65.48)	<0.001
Multiple Trauma	24 (10.39 to 37.60)	0.005
SBP (mmhg)		
≥ 90	1	
<90	41 (20.26 to 61.73)	<0.001
GCS		
13 to 15	1	
9 to 12	39 (22.73 to 55.26)	<0.001
3 to 8	266 (223.06 to 308.93)	<0.001
ISS		
< 9	1	
9 to 15	34 (22.45 to 45.54)	<0.001
≥16	51 (21.46 to 80.53)	<0.001
Cause of injury		
Road traffic accident	1	
Fall	-16 (-26.70 to -5.29)	0.008
stab/cut	-41 (-58.57 to -23.42)	<0.001
others	16 (-11.30 to 43.30)	0.249

hours). Patients with a pre-hospital delay of more than 100 minutes had stayed, on average, 8 hours more than those with a pre-hospital delay of less than 100 minutes (P = 0.024). The median of patients' LOS was 39 (22.00 to 59.90) and 35 (25.83 to 44.16) hours more when the injury was located in the spine/back and multiple sites, respectively, than those in extremities (Table 1).

Patients experiencing hypoxemia stayed on 73 (56 to 90) hours more (median, Q1 to Q3) (P < 0.001). Based on the GCS category previously explained in methods, patients with severe and moderate injuries had significantly 338 (309 to 366) and 58 (46 to 70) hours more hospitalization, respectively, than mild injuries (median, Q1 to Q3) (P < 0.001). Foresightedly, patients with ISS≥16 and 9≤ISS≤15 had a median of 113 (92 to 134) and 45 (37 to 53) LOS hours more, compared to ISS≤8, respectively (P < 0.001) (Table 2).

When adjusted for other factors, including SBP, GCS, ISS, and cause of injury, spine/back, abdomen, and multiple trauma were the first three sites of injury associated with the highest LOS, with 43 (20.5, 65.48), 25 (-19.90, 69.90), and 24 (10.39 to 37.60) LOS hours more than those localized in extremities, respectively; nevertheless, the prolonged LOS in abdominal injuries was not statistically significant. Besides, after adjustment, the median LOS in patients with severe and moderate injuries, based on the GCS category, was 266 and 39 hours more than in mild injuries. Moreover, following adjustment for other factors, patients with ISS≥16 and 9≤ISS≤15 had a median of 51 (21 to 80) and 34 (22 to 45) LOS hours more, com-

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pared to ISS≤8, respectively (median, Q1 to Q3) (P < 0.001). Eventually, even after adjustment, RTIs had the significantly most prolonged LOS (Table 3).

Discussion

Prolonged hospitalization length burdens society and, more specifically, healthcare systems (7). In this single-center, registry-based study, we have investigated the association between 2708 patients' clinical and demographic findings and LOS, utilizing a univariable and multiple quantile regression.

The median LOS in this study was 87 hours, i.e., 3.6 days, much less than many previous studies. Length of hospitalization was investigated in a study of 241,268 patients from 82 Japanese hospitals of 19 major Diagnostic Categories (MDS), and overall mean LOS days was revealed as 22.15, which was almost 2-6 times longer than in other countries (25). The rationale behind this considerable difference is due to different strategies in patients' admission in Western and Eastern countries. Moreover, they did not limit their inclusion criteria to trauma patients. However, LOS in traumatic patients is believed to be almost 50% more compared to general admissions (26). More specifically, in trauma cases, the LOS was measured in a bulk of studies on trauma patients. In a study of 7,990 patients above 18 in the United States, the mean LOS was 6.23 days (27). Besides, nearly 180,000 Canadian trauma patients had a mean LOS of 9.4 days (26). The median LOS was seven days in a large Spanish study on 16,000 trauma cases (28). Altogether, the variability in trauma care organizations and injury patterns between countries makes it difficult to compare LOS between countries.

Despite the major difference in LOS duration with studies outside the country, most studies within the country showed similar results. In a five-year study of more than 22,000 trauma cases, the mean LOS was 84 hours (29). However, lower LOS was reported in some previous studies within the country. In a study of 849 traumatic cases published in 2017, 53% had a LOS > 48h, much less than ours (Q1=48) (30). Moreover, in a 588 pediatric trauma cases study, the mean LOS was 3.2 days, i.e., 77 hours (31). Previous local studies in Tehran, the capital of Iran, reported a LOS of 5 to 7.8 days in traumatic cases, which was a bit longer than our study (32-34). The remarkable difference in LOS time in studies within and outside the country might largely be due to distinct strategies for patient discharge in various countries. Furthermore, the lower age of trauma patients in Iran (13) compared to other countries may affect the results.

Although previous studies assessed the impact of patients' comorbidities on LOS (10, 35), not so many studies, have been found to evaluate the effects of patients' demographic and clinical characteristics in LOS. Our findings suggest that body region, SBP, GCS, ISS, and mechanism of injury were the major variables independently influencing patients' hospitalization. In line with our findings, a previous study in the Iranian population revealed that even after adjustment for other factors, higher ISS scores increased the odds of lengthy hospitalization (36).

Bergeron et al., specifically, implemented a study on 994 traumatic patients. With a mean LOS of 15.3 days, comorbidities, ISS, and age were the independent predictors of LOS (10). It was clearly postulated that trauma in senile cases yields an increased LOS compared to younger populations; besides, as elders encompassed a large proportion of admitted traumatic cases, imposing an excessive financial burden on hospitals and healthcare systems (37, 38). Furthermore, Loo et al. revealed that in traumatic cases older than 65, age was a significant risk factor for prolonged hospitalization (39). It was also concluded that patients older than 80 years stayed 5.5 days longer in the hospital (26).

Nevertheless, in one study, it was claimed that, when adjusted for other factors, age was not an independent factor significantly influencing patients' LOS (38). In a study of almost 82.000 trauma pediatric patients in the US, similar to our findings, the spine and back, thorax, and abdomen had significantly increased odds of prolonged LOS. However, on the opposite, they found that injuries in the head and neck did not have a higher risk of prolonged LOS (40). Moreover, in a large Canadian cohort study of over 126.000 trauma cases, injuries in the spine stayed on for 3.1 days longer (26). Correspondingly, spine and back injuries had the most protracted LOS significantly in this study. All in one, age, body region, and ISS were major factors affecting LOS.

In this study, we realized that patients with hypothermia on admission had a longer LOS. Similarly, in the multicentre study of over 80.000 cases, hypothermic cases experienced prolonged LOS two times more than others (OR=2) (40). Despite our findings, as GCS is a very reliable predictor of prolonged LOS, even after adjustment for other factors, the large Canadian cohort study dissimilarly did not find any association between LOS and GCS (26). However, similar to our findings, GCS was deemed as an independent factor influencing ICU LOS in TBI cases (15). Previous studies within NTRI also endorsed our findings regarding the significant association between higher ISS and extended LOS (13).

So many previous studies in large populations tried to develop a predictive index for LOS; some of them included not only clinical and demographic items but also utilized non-clinical variables, including insurance status and discharge destination (41-44). In this study, body region, ISS, GCS, SBP, and mechanism of injury were the independent variables affecting the LOS. In a study in Southwestern Iran of over 14,000 trauma cases, age, gender, mechanism of injury, infection, type of injury, survival, and ISS were determinants that extended the hospitalization duration. However, they claimed that the impact might be reduced by "eliminating modifiable risk factors" (45).

Conclusion

Finding independent determinants of extended LOS may help healthcare providers better identify at-risk patients on admission. In this study, body region, ISS, GCS, SBP, and mechanism of injury were the independent determinants of LOS. Notwithstanding the unalterable nature of ISS, GCS, SBP, and body region in trauma cases, by

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"eliminating the modifiable risk factors", the impact of extended LOS might be reduced.

Author contribution

P.S, Kh.N, and V.B contributed to the study design and methodology. V.R and M.Z supervised the whole process and modified it. A.Kh contributed to the manuscript provision, data analysis, and submission process. M.H and S.P contributed to writing the original draft. R.F helped in study coordination. All authors have read and approved the manuscript

Ethical Consideration

The study protocol was based on the tenets of the Declaration of Helsinki. This study was approved by the ethics committee of Tehran University of Medical Sciences (Approval ID: IR.TUMS.SINAHOSPITAL.REC.1399.090).

Abbreviations

NTRI: National Trauma Registry of Iran
SBP: Systolic Blood Pressure
ISS: Injury Severity Score
ICU: Intensive Care Unit
GCS: Glasgow Coma Scale
ED: Emergency Department
ICD-10: International Classification of Diseases, 10th version
MDS: Minimum Data Set
SD: Standard Deviation
OR: Odds Ratio
CI: Confidence Interval
STSRC: Sina Trauma Surgery and Research Center
HIS: Health Information System
AIS: Abbreviated Injury Scale
ISS: Injury Severity Score ISS
AAAM: Association for Advancement of Automotive Medicine
RTC: Road Traffic Crashes
WHO: World Health Organization
LMIC: Low- and –Middle-Income Countries
HIC: High-Income Countries
QI: Quality Improvement
DALY: Disability-Adjusted Life Years
MOHME: Ministry of Health and Medical Education
SD: Standard Deviation
EMS: Emergency Medical Service
HR: Heart Rate
LoS: Length of Stay

Conflict of Interests

The authors declare that they have no competing interests.

References

1. O'Keefe GE, Jurkovich GJ, Maier RV. Defining excess resource utilization and identifying associated factors for trauma victims. J Trauma Acute Care Surg. 1999;46(3):473-8.
2. Tipton K, Leas BF, Mull NK, Siddique SM, Greysen SR, Lane-Fall MB, et al. AHRQ Comparative Effectiveness Technical Briefs. Interventions To Decrease Hospital Length of Stay. Rockville (MD): Agency for Healthcare Research and Quality (US); 2021.
3. Ravangard R, Arab M, Zeraati H, Rashidian A, Akbarisari A, Mostaan F. Patients' length of stay in women hospital and its associated clinical and non-clinical factors, tehran, iran. Iran Red Crescent Med J. 2011;13(5):309-15.
4. Törő K, Hubay M, Sotonyi P, Keller E. Fatal traffic injuries among pedestrians, bicyclists and motor vehicle occupants. Forensic Sci Int. 2005;151(2-3):151-6.
5. Chalya PL, Mabula JB, Dass RM, Mbelenge N, Ngayomela IH, Chandika AB, et al. Injury characteristics and outcome of road traffic crash victims at Bugando Medical Centre in Northwestern Tanzania. Journal of trauma management & outcomes. 2012;6:1-8.
6. Olds K, Byard RW, Langlois NE. Injury patterns and features of cycling fatalities in South Australia. J Forensic Leg Med. 2015;34:99-103.
7. Beppu S, Hitosugi M, Ueda T, Koh M, Nishiyama K. Factors influencing the length of emergency room stay and hospital stay in non-fatal bicycle accidents: A retrospective analysis. Chin J Traumatol. 2021;24(03):148-52.
8. Brackstone M, Doig GS, Girotti MJ. Surgical case costing: trauma is underfunded according to resource intensity weights. Can J Surg. 2002;45(1):57-62.
9. Yates DW, Svoboda P, Kantorova I. The influence of medical care on the death rate from trauma in England and South Moravia. Eur J Trauma Emerg Surg. 2002;28(5):304.
10. Bergeron E, Lavoie A, Moore L, Clas D, Rossignol M. Comorbidity and age are both independent predictors of length of hospitalization in trauma patients. Can J Surg. 2005;48(5):361-6.
11. Librero J, Peiró S, Ordiñana R. Chronic comorbidity and outcomes of hospital care: length of stay, mortality, and readmission at 30 and 365 days. J Clin Epidemiol. 1999;52(3):171-9.
12. Ghodsi Z, Movaghar VR, Zafarghandi M, Saadat S, Mohammadzadeh M, Fazel M, et al. The minimum dataset and inclusion criteria for the national trauma registry of Iran: a qualitative study. Arch Trauma Res. 2017;6(2):7.
13. Sharif-Alhoseini M, Zafarghandi M, Rahimi-Movaghar V, Heidari Z, Naghdi K, Bahrami S, et al. National Trauma Registry of Iran: A Pilot Phase at a Major Trauma Center in Tehran. Arch Iran Med. 2019;22(6).
14. Jahantigh HR, Salamati P, Zafarghandi M, Rahimi‐Movaghar V, Fakharian E, Lotfi MS, et al. Epidemiology and Clinical Features of Injuries at the Shahid Beheshti Hospital, Kashan, Iran: A Report from the National Trauma Registry of Iran. Arch Trauma Res. Volume. 2022;11(4):200.
15. Khormali M, Payandemehr P, Zafarmandi S, Baigi V, Zafarghandi M, Sharif-Alhoseini M. Predictive Utility of the Glasgow Coma Scale and the Head Abbreviated Injury Scale in Traumatic Brain Injury: Results from the National Trauma Registry of Iran. Arch Iran Med. 2022;25(8).
16. Stocker B, Weiss HK, Weingarten N, Engelhardt K, Engoren M, Posluszny J. Predicting length of stay for trauma and emergency general surgery patients. Am J Surg. 2020;220(3):757-64.
17. Clark DE, Ostrander KR, Cushing BM. A multistate model predicting mortality, length of stay, and readmission for surgical patients. Health Serv Res. 2016;51(3):1074-94.
18. Khosravizadeh O, Vatankhah S, Bastani P, Kalhor R, Alirezaei S, Doosty F. Factors affecting length of stay in teaching hospitals of a middle-income country. Electro. Physician. 2016;8(10):3042-7.
19. Organization WH. Falls.
20. Safety CoMAoA. Rating the severity of tissue damage. I. The abbreviated scale. JAMA Netw Open. 1971;215(2):277-80.
21. Baker SP, o'Neill B, Haddon Jr W, Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. Journal of Trauma and Acute Care Surgery. 1974;14(3):187-96.
22. Butcher NE, Enninghorst N, Sisak K, Balogh ZJ. The definition of polytrauma: variable interrater versus intrarater agreement—a prospective international study among trauma surgeons. J Trauma Acute Care Surg. 2013;74(3):884-9.
23. Pape HC, Lefering R, Butcher N, Peitzman A, Leenen L, Marzi I, et al. The definition of polytrauma revisited: An international consensus process and proposal of the new 'Berlin definition'. J Trauma Acute Care Surg. 2014;77(5):780-6.
24. Naalt Jvd. Prediction of outcome in mild to moderate head injury: a review. J Clin Exp Neuropsychol. 2001;23(6):837-51.
25. Kuwabara K, Imanaka Y, Matsuda S, Fushimi K, Hashimoto H, Ishikawa KB, et al. The association of the number of comorbidities

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and complications with length of stay, hospital mortality and LOS high outlier, based on administrative data. Environ Health Prev Med. 2008;13:130-7.
26. Moore L, Stelfox HT, Turgeon AF, Nathens A, Bourgeois G, Lapointe J, et al. Hospital length of stay after admission for traumatic injury in Canada: a multicenter cohort study. Ann Surg. 2014;260(1):179-87.
27. Fakhry SM, Couillard D, Liddy CT, Adams D, Norcross ED. Trauma center finances and length of stay: identifying a profitability inflection point. J Am Coll Surg. 2010;210(5):817-21, 21-3.
28. Santolino M, Bolancé C, Alcañiz M. Factors affecting hospital admission and recovery stay duration of in-patient motor victims in Spain. Accid Anal Prev. 2012;49:512-9.
29. Fazel MR, Fakharian E, Mahdian M, Mohammadzadeh M, Salehfard L, Ramezani M. Demographic profiles of adult trauma during a 5 year period (2007-2011) in Kashan, IR Iran. Arch Iran Med. 2012;1(2):63.
30. Yadollahi M. A study of mortality risk factors among trauma referrals to trauma center, Shiraz, Iran, 2017. Chin J Traumatol. 2019;22(4):212-8.
31. Yousefzadeh Chabok S, Ranjbar Taklimie F, Malekpouri R, Razzaghi A. Predicting mortality, hospital length of stay and need for surgery in pediatric trauma patients. Chin J Traumatol. 2017;20(6):339-42.
32. Zargar M, Khaji A, Karbakhsh M. Pattern of motorcycle-related injuries in Tehran, 1999 to 2000: a study in 6 hospitals. East Mediterr Health J. 12 (1-2), 81-87, 2006. 2006.
33. Zargar M, Modaghegh M-HS, Rezaishiraz H. Urban injuries in Tehran: demography of trauma patients and evaluation of trauma care. Injury. 2001;32(8):613-7.
34. Moini M, Rezaishiraz H, Zafarghandi MR. Characteristics and outcome of injured patients treated in urban trauma centers in Iran. J Trauma Acute Care Surg. 2000;48(3):503-7.
35. Hong J, Lee W-K, Kim MK, Lee B-E, Shin SD, Park H. Effect of comorbidity on length of hospital stay and in-hospital mortality among unintentionally injured patients. Accid Anal Prev. 2013;52:44-50.
36. Haghparast-Bidgoli H, Saadat S, Bogg L, Yarmohammadian MH, Hasselberg M. Factors affecting hospital length of stay and hospital charges associated with road traffic-related injuries in Iran. BMC Health Serv Res. 2013;13:1-11.
37. MacKenzie EJ, Morris JA, Jr., Smith GS, Fahey M. Acute hospital costs of trauma in the United States: implications for regionalized systems of care. J Trauma Acute Care Surg. 1990;30(9):1096-101; discussion 101-3.
38. Pai CW, Lin HY, Tsai SH, Chen PL. Comparison of traffic-injury related hospitalisation between bicyclists and motorcyclists in Taiwan. PLoS One. 2018;13(1):e0191221.
39. Loo BP, Tsui KL. Pedestrian injuries in an ageing society: insights from hospital trauma registry. J Trauma Acute Care Surg. 2009;66(4):1196-201.
40. Gibbs D, Ehwerhemuepha L, Moreno T, Guner Y, Yu P, Schomberg J, et al. Prolonged hospital length of stay in pediatric trauma: a model for targeted interventions. Pediatr Res. 2021;90(2):464-71.
41. Shafi S, Barnes S, Nicewander D, Ballard D, Nathens AB, Ingraham AM, et al. Health care reform at trauma centers—mortality, complications, and length of stay. J Trauma Acute Care Surg. Surgery. 2010;69(6):1367-71.
42. Brasel KJ, Lim HJ, Nirula R, Weigelt JA. Length of stay: an appropriate quality measure? AMA Arch Surg. 2007;142(5):461-6.
43. Ciesla DJ, Sava JA, Kennedy SO, Levinson K, Jordan MH. Trauma patients: you can get them in, but you can't get them out. Am J Surg. 2008;195(1):78-83.
44. Thomas SN, McGwin Jr G, Rue III LW. The financial impact of delayed discharge at a level I trauma center. J Trauma Acute Care Surg. 2005;58(1):121-5.
45. Kashkooe A, Yadollahi M, Pazhuheian F. What factors affect length of hospital stay among trauma patients? A single-center study, Southwestern Iran. Chin J.Traumatol. 2020;23(3):176-80.

[DOI: 10.47176/mjiri.38.18]