

Factors Affecting Hospital Length of Stay in Trauma Patients Before and during the COVID-19 Pandemic: A Regional Trauma Center in Iran

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Abstract

Background and Objectives: Hospitals are often as an important goal focus on length of stay (LOS) for controlling the cost of trauma care. This study aimed to investigate the factors affecting hospital LOS in trauma patients before and during the COVID-19 pandemic in a regional trauma center in Iran. **Methods:** In this retrospective study, all trauma patients referred to Be'sat Hospital, the only regional trauma center in Hamadan, from 19 February to 20 November 2020 (during the COVID-19) were compared to the same date in 2019 (before the COVID-19). Data were collected using the recorded information in the Health Information Management Center of the Be'sat Hospital. Multivariate logistic regression was used to simultaneously evaluate the effect of covariates on LOS (≤ 3 days; > 3 days) in two periods. All statistical analyses were performed using SPSS version 24.0. **Results:** The mean values for LOS in trauma patients before and during the COVID-19 were 3.9 and 3.2 days, respectively. Before the COVID-19, the age of < 18 years old (odds ratio [OR] = 1.59; 95% confidence interval CI: 1.33–1.92, $P < 0.01$), winter season (OR = 1.33; 95% CI: 0.99–1.76, $P = 0.04$), and burn trauma (OR = 1.35; 95% CI = 1.02–1.79, $P = 0.03$) were significant. During the COVID-19, the age of < 18 years old (OR = 1.39; 95% CI: 1.04–1.90, $P = 0.04$), males (OR = 1.48; 95% CI: 1.10–1.99, $P = 0.01$), burn trauma (OR = 1.77; 95% CI: 1.15–2.73, $P = 0.01$), and history of hospitalization (OR = 1.77; 95% CI: 1.15–2.73, $P = 0.01$) were significant. **Conclusions:** According to the results, before the COVID-19, the factors such as age, season, and mechanism of trauma were predictors of LOS. Furthermore, age, sex, mechanism of trauma, and history of hospitalization were factors that affected LOS in trauma patients during the COVID-19. Thus, this study may be helpful in improving the discharge planning in trauma patients.

Keywords: COVID-19, Iran, length of stay, trauma

INTRODUCTION

Trauma as a public health problem is one of the leading causes of death and disability around the world^[1] that can be created by accident, fall, burn, drowning, sport, and so on.^[2] Each year, more than 5 million people lose their lives because of trauma, globally.^[3] In keeping with this trend, it is estimated that the global burden of injuries will increase in the next years, especially in low and middle-income countries.^[4] Iran,

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as a middle-income developing country, faces a high mortality and morbidity rate due to trauma.^[5] Trauma is identified as the second cause of death in all age groups in Iran.^[6] The results of a nationwide review in Iran showed that the most common cause of injury was an accident followed by a hit and fall.^[7] Apart from the cause of trauma, the economic burden of care in trauma patients is high.^[8] For example, in Iran, the treatment costs of a trauma patient who eventually dies are \$2,410 on average in 2009.^[9]

Nowadays, hospital quality improvement and cost reduction are really important for patients, health providers, and policymakers.^[10] Hospital length of stay (LOS) is one of the criteria which are usually used to assess a hospital's performance and functional costs.^[11] Furthermore, LOS is considered as an important indicator of the use of medical services that are used to determine the efficiency of hospital management and quality of patient care.^[12] LOS is defined as the number of days from hospital admission to discharge.^[13] The existing evidence indicates that shorter LOS decreases the risk of opportunistic infection, improves treatment outcome, reduces mortality rate and medical costs, and increases bed turnover rate. Therefore, decreasing LOS can be cost effective for hospitals.^[8]

As an important goal, hospitals often focus on decreasing LOS as a way of controlling the cost of care in trauma patients,^[8] especially in critical situations such as the recent pandemic, the coronavirus disease of 2019 (COVID-19). By knowing more about the factors affecting LOS in trauma patients, it is possible to reduce LOS and consequently to decrease the economic burden of caring for a trauma patient to control the costs of trauma centers.^[8] In the COVID-19 pandemic conditions and the whole world involvement with it, the effect of the pandemic on the length of hospital stay for trauma patients is not yet clear. There is this gap in the related literatures that given the high prevalence of trauma in different societies is there a difference between the factors affecting hospital LOS in trauma patients before and during the COVID-19 pandemic? Therefore, the current study aimed to investigate the factors affecting hospital LOS in trauma patients before and during the COVID-19 pandemic in a regional trauma center, Be'sat Hospital, Hamadan, Iran in 2020. To our knowledge, there are no published data about factors affecting hospital LOS in trauma patients before and during the COVID-19 pandemic. The results of this study can be useful to provide evidence for using medical services in trauma centers.

METHODS

In this retrospective study, all trauma patients referred to Be'sat Hospital, the only regional trauma center in Hamadan, from 19 February to 20 November 2020 (during the COVID-19 pandemic), were compared to the same date in 2019 (before the COVID-19 pandemic). The total number of studied trauma patients was 5063 (3508 patients before the pandemic/1555 patients during the pandemic). To extract

data, a checklist was developed based on the objectives of the study. The studied factors in this checklist were obtained using the previous studies.^[10,14,15] The characteristics of trauma patients such as age, sex, season, surgery, referral time, history of hospitalization, the final status of patients, mechanism of trauma, time of the week, and hospital LOS were collected using the recorded information in the Health Information Management (Center of the Be'sat Hospital). The inclusion criteria were all trauma patients referred to Be'sat Hospital (whether by direct transfer to this hospital or by referral from other medical centers). It is necessary to explain that given that the recorded information of all trauma patients was complete, so no patient was excluded. Chi-square test was used to compare the characteristics of patients in the two time periods. Moreover, multivariate logistic regression was used to simultaneously evaluate the effect of covariates on the hospital LOS during the COVID-19 pandemic compared to before it. The LOS was divided into ≤ 3 days (≤ 3 days) as a reference category and > 3 days. $P < 0.05$ was considered statistically significant. All statistical analyses were performed using SPSS software version 24.0 (IBM Corp, University of Chicago, Illinois, USA). It needs to be mentioned that in this study, "other" in the mechanism of trauma consisted of drowning, electrocution, suicide, homicide, poisoning, animal attacks, bites, and playing (sports) trauma. This study was approved by the Ethics committee of Hamadan University of Medical Sciences, Iran (No. IR.UMSHA.REC.1399.281).

RESULTS

The mean age of trauma patients was 36.4 (standard deviation [SD] = 22.5) years before the COVID-19 and 34.1 (SD = 21.4) years during the pandemic. During the COVID-19, 70.0% of trauma patients were males, the most common mechanism of trauma was fall (34.2%), the hospital LOS in about 71.0% of the patients was ≤ 3 days, and 31.4% of the traumatic accidents had occurred on the weekends. The characteristics of trauma patients before and during the pandemic are shown in Table 1.

The mean LOS in trauma patients before and during the pandemic is presented in Figure 1. Accordingly, during the

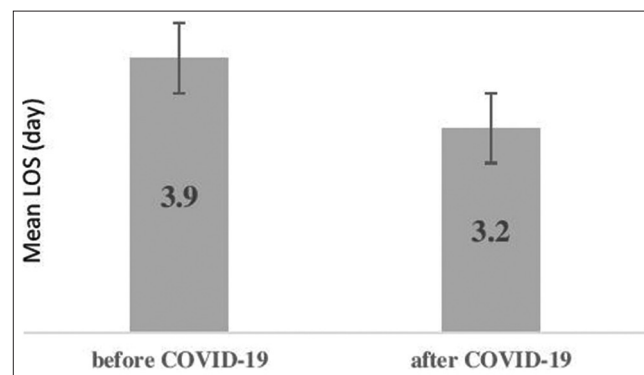


Figure 1: Mean length of stay in trauma patients before and during COVID-19

Table 1: Characteristics of trauma patients before (n=3508) and during (n=1555) the COVID-2019 pandemic

Variable	Before the COVID-19, n (%)	During the COVID-19, n (%)
Age (years)		
≤18	871 (24.8)	420 (27.0)
>18	2637 (75.2)	1135 (73.0)
Sex		
Male	2454 (70.0)	1170 (75.2)
Female	1052 (30.0)	385 (24.8)
Season		
Spring	1341 (38.2)	604 (38.8)
Summer	1267 (36.1)	658 (42.3)
Autumn	620 (17.7)	181 (11.6)
Winter	280 (8.0)	112 (7.2)
Time of week		
Weekdays	2405 (68.6)	1143 (73.5)
Weekends	1103 (31.4)	412 (26.5)
Referral time		
Morning	377 (10.7)	152 (9.8)
Evening	1631 (46.5)	650 (41.8)
Night	1500 (42.8)	753 (48.4)
Mechanism of trauma		
Accident	1093 (31.1)	437 (31.8)
Falls	1199 (34.2)	545 (39.7)
Violence	195 (5.6)	121 (8.8)
Burn	253 (7.2)	159 (11.6)
Other	768 (21.9)	111 (8.1)
History of hospitalization		
Yes	887 (25.3)	318 (20.5)
No	2621 (74.7)	1237 (79.5)
Surgery		
Yes	2877 (82.0)	1302 (83.7)
No	631 (18.0)	253 (16.3)
Hospital LOS (days)		
≤3	2491 (71.0)	1173 (75.4)
>3	1017 (29.0)	382 (24.6)
The final status of patients		
Discharged	3348 (95.4)	1480 (95.2)
Escaped	68 (1.9)	23 (1.5)
Expired	92 (2.6)	52 (3.3)

LOS: Length of stay

COVID-19, the mean LOS in trauma patients decreased 0.7 days compared to before the pandemic. Figure 2 shows the mean LOS in trauma patients based on the mechanism of trauma before and during the pandemic. Based on the results of this figure, the mean LOS increased in burn trauma (0.3 days) during the COVID-19 compared to before it.

The results of the multivariate logistic regression model indicated that the effect of age, season, and mechanism of trauma on the odds of LOS was significant in trauma patients before the pandemic. Hence, the odds of >3 days LOS in trauma patients over 18 years old was 1.62 times more than those of ≤18 years (odds ratio [OR] = 1.59; 95% confidence

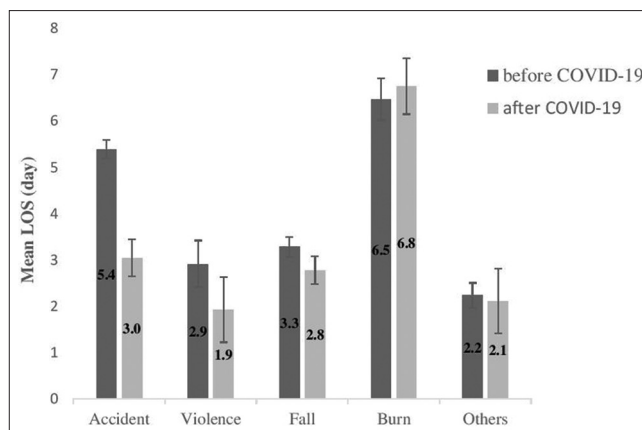


Figure 2: Mean length of stay in trauma patients based on mechanism of trauma before and during COVID-19

interval [CI]: 1.33–1.92, $P < 0.01$). In winter, the odds of >3 days LOS in trauma patients were 1.33 times more than those of spring (OR = 1.33; 95% CI: 0.99–1.76, $P = 0.04$) and patients with burn trauma were more likely to be hospitalized for more than 3 days compared to those with other traumatic accidents (OR = 1.35; 95% CI: 1.02–1.79, $P = 0.03$).

Furthermore, the effect of age, sex, mechanism of trauma, and history of hospitalization on the odds of LOS in trauma patients was significant, during the COVID-19. Therefore, the odds of >3 days LOS in trauma patients over 18 years were 1.39 times more than that ≤18 years (OR = 1.39; 95% CI: 1.04–1.90, $P = 0.04$). Males were 1.48 times more likely to be hospitalized for more than 3 days than females (OR = 1.48; 95% CI: 1.10–1.99, $P = 0.01$). Patients with burn trauma were more likely to be hospitalized for more than 3 days compared to those with other traumatic accidents (OR = 1.77; 95% CI: 1.15–2.73, $P = 0.01$), and the odds of >3 days LOS in trauma patients who had a history of hospitalization was 1.66 times more than that with no history of hospitalization (OR = 1.77; 95% CI: 1.15–2.73, $P = 0.01$) [Table 2].

Finally, to assess the effect of the period of study (before and after the pandemic period) on LOS, the result of multivariate logistic regression model showed that the odds of >3 days LOS in the pandemic period decrease about 22% compared to before the pandemic period (OR = 0.78; 95% CI: 0.70–0.92, $P = 0.001$).

DISCUSSION

This study aimed to investigate the factors affecting hospital LOS in trauma patients before and during the COVID-19 pandemic in a regional trauma center in Be'sat Hospital, Hamadan, Iran. Our finding revealed that during COVID-19, the overall mean LOS decreased in trauma patients compared to the same date before the pandemic. This result was in line with the results of other studies in Italy^[16] and in the United States.^[17] This finding could be the result of that according to the instructions of the National Headquarters of Administrating the COVID-19 in Iran, all public hospitals should avoid admitting nonemergency patients during the peak

Table 2: The results of the multivariate logistic regression model to determine the factors affecting length of stay

Variables	Before the COVID-19		During the COVID-19	
	OR (95% CI)	P	OR (95% CI)	P
Age (years)				
≤18	1.00	<0.01	1.00	0.04
>18	1.59 (1.33-1.92)		1.39 (1.04-1.90)	
Sex				
Male	1.16 (0.97-1.37)	0.16	1.48 (1.10-1.99)	0.01
Female	1.00		1.00	
Seasons				
Spring	1.00		1.00	
Summer	1.20 (1.02-1.45)	0.04	1.28 (0.96-1.70)	0.09
Autumn	1.15 (0.92-1.41)	0.36	0.95 (0.62-1.46)	0.83
Winter	1.33 (0.99-1.76)	0.04	1.54 (0.96-2.49)	0.07
Time of week				
Weekdays	1.00	0.26	1.00	0.24
Weekends	0.92 (0.77-1.12)		0.81 (0.63-1.14)	
Referral time				
Morning	1.00		1.00	
Evening	0.95 (0.75-1.27)	0.86	0.94 (0.59-1.50)	0.80
Night	1.03 (0.79-1.35)	0.81	0.98 (0.62-1.55)	0.94
Mechanism of trauma				
Accident	1.00		1.00	
Falls	0.42 (0.44-1.64)	<0.01	0.27 (0.14-0.49)	<0.01
Violence	0.53 (0.29-0.60)	<0.01	0.65 (0.49-0.87)	<0.01
Burn	1.35 (1.02-1.79)	0.03	1.77 (1.15-2.73)	0.01
Other	0.26 (0.20-0.33)	<0.01	0.35 (0.19-0.65)	<0.01
Hospitalization history				
Yes	1.12 (0.94-1.34)	0.21	1.66 (1.22-2.28)	<0.01
No	1.00		1.00	
Surgery				
Yes	1.00	0.24	1.00	0.12
No	0.88 (0.72-1.09)		0.72 (0.50-1.04)	
The final status of patients				
Discharged	1.00		1.00	
Expired	1.14 (0.67-1.92)	0.63	2.27 (0.95-5.44)	0.07
Escaped	0.65 (0.39-1.10)	0.11	0.77 (0.34-1.75)	0.53

OR: Odds ratio, CI: Confidence interval

of the COVID-19 in each region and allocate their capacity to the COVID-19 patients at the peak of the pandemic. Furthermore, it is possible that some patients and families have desired to be discharged as soon as possible due to being safe from the COVID-19 during the hospital stay.

An interesting finding in our study was that during the COVID-19, the number of the trauma patients decreased 44% in trauma patients compared to the same date before the pandemic. This finding is also supported by two other studies.^[16,18] The results of a scoping review revealed that the COVID-19 pandemic has caused a reduction in the volume of trauma patients in the worldwide (ranged from 20.3% to 84.6%). This reduction was seen in road traffic accidents, sports injuries, and trauma occurring outdoors.^[19]

In the current study, trauma patients over 18 years had a higher chance of being hospitalized for more than 3 days

both before and during the COVID-19 compared to other accidents. Age is known as an important factor to affect LOS and discharge status; usually older patients are more susceptible to have a longer LOS.^[15] The finding of the present study is in line with a study conducted by Hu *et al.*, which showed that with increasing age, the number of hospitalization days has increased. In the present study, among the three age groups (0–17, 18–64, and ≥65), the elderly had the highest LOS compared to the other age groups.^[20] The evidence indicates that average LOS in a trauma patient older than 17 years with comorbidities was 3 more days compared to a trauma patient with no comorbidities.^[21]

Before the COVID-19, trauma patients injured in winter had a longer LOS than in spring. Hopkins *et al.* found that in winter, trauma patients had a higher hospitalization rate and longer hospital LOS, especially older people.^[22]

We found that patients with burn trauma were more likely to be hospitalized for more than 3 days compared to those with other accidents, both before and during the COVID-19. Furthermore, among trauma patients, the longest mean LOS was related to burn patients during COVID-19. In contrast to our findings, Farroha found that LOS 68% decreased in burn patients during the COVID-19. This was achieved by increasing the use of outpatient care and considered a nurse team for follow-up and dressing at home. Furthermore, if surgery was needed for a small burn, the patient was operated on the same day and discharged.^[23] In fact, the main reason for decreasing the LOS has mentioned to prevent unnecessary risk of the COVID-19 infection to burned patients during hospital stay and save hospital resources during the pandemic.^[23] Burn patients may require extensive treatment and monitoring. Thus, it is reasonable to be a higher risk for a longer LOS.^[10] Some previous studies have reported different reasons for predicting the duration of hospitalization in burn patients. For example, in the study of AbdelWahab *et al.*, some reasons such as incidence of infection, inhalation injury, total body surface area (TBSA)%, and wound depth have reported as different reasons for predicting the duration of hospitalization.^[24] Furthermore, the finding of the Khaliq *et al.* study has revealed that age and sex of the patient, inhalation injury, the cause of burn, the region of burn, and TBSA% were important factors in determining LOS in burn victims.^[25] Given the nature of burn and the specific susceptibility of this trauma to infections, it seems that one of the reasons for the increase of LOS in these patients during the COVID-19 could be getting COVID-19 during the hospital stay. It has been proved that burn wards as one of the sensitive wards are known particularly affected by the COVID-19 due to the larger risk of contamination in burn patients.^[26]

Our results also indicated that during the COVID-19, males were more likely to be hospitalized for more than 3 days than females. This finding has also been confirmed by the study of Kashkooe *et al.*^[15] The fact should not be ignored that males are more likely to engage in risky activities compared to females.^[18] The results of a meta-analysis in trauma patients pointed out that male sex was associated with higher incidence of complications, longer hospital LOS, and higher risk of mortality.^[27]

In our study, trauma patients with a history of hospitalization were more likely to be hospitalized for more than 3 days than trauma patients without a history of hospitalization, during COVID-19. No similar study was found for this finding. Therefore, there is a need for further studies in this field. The possible reason for the hospitalization history of these patients may be the presence of underlying diseases that can predispose them to COVID-19, which increases the LOS. Our study also had two limitations. First, we were not able to investigate the injury severity score. This is because this score was not recorded in the Health Information Management Center of the studied hospital. Second, the results of the current study may not be generalized well to all trauma centers. This is because mean LOS varies from one trauma center to another.

CONCLUSIONS

The results indicated that before the COVID-19, the factors such as age, season, and mechanism of trauma were predictors of LOS. Furthermore, age, sex, mechanism of trauma, and history of hospitalization were factors affecting LOS in trauma patients during the COVID-19. Therefore, this study may be useful in improving the discharge planning in trauma patients.

Ethical approval

This study was approved by the Ethics Committee of Hamadan University of Medical Sciences, Iran (No. IR.UMSHA.REC.1399.281).

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Conflicts of interest

There are no conflicts of interest.

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