Original Article

Bull Emerg Trauma 2023;11(4):190-195.

Bulletin of Emergency And Trauma

Demographics, Radiological Findings, and Predictors of Prolonged Hospitalization in Civilian Gunshot Wound Patients

***Seyed Hadi Aghili*[1,2,3], *Arshia Zardoui*[1], *Mehri Farhang Ranjbar*[4], *Alireza Baratloo*[1,5*]**

[1]*Research Center for Trauma in Police Operations, Directorate of Health, Rescue & Treatment, Police Headquarter, Tehran, Iran*
[2]*Neurosurgery Department, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Tehran, Iran*
[3]*Department of Neurosurgery, Valiasr Hospital, Tehran, Iran*
[4]*Department of Medical Surgical Nursing, School of Nursing and Midwifery, Tehran University of Medical Sciences, Tehran, Iran*
[5]*Department of Emergency Medicine, Sina Hospital, Tehran University of Medical Sciences, Tehran, Iran*

***Corresponding author:** *Alireza Baratloo*
Address: Research Center for Trauma in Police Operations, Directorate of Health, Rescue & Treatment, Police Headquarter, Tehran, Iran.
e-mail: alirezabaratloo@yahoo.com

Received: October 18, 2023
Revised: November 24, 2023
Accepted: December 3, 2023

ABSTRACT

Objective: This study aims to characterize the demographic, clinical, and radiological features of gunshot wound (GSW) patients as well as identify predictors of prolonged hospitalization.
Methods: In this retrospective study, a consecutive sampling method was used, including all patients with GSWs in any anatomical region. Data collection included demographic and clinical information, radiological findings, treatment specifics, and outcome variables, such as hospitalization length of stay (LOS) as the primary outcome. To identify predictive factors associated with prolonged LOS, logistic regression analysis was used.
Results: We studied 212 GSW cases, including 95.8% were men and 4.2% were women. The mean age of the studied group was 30.17±7.80 years. GSWs occurred in extremities (80.2%), abdomen (9.0%), thorax (4.7%), and head or neck (5.2%). Two patients (0.9%) had both abdominal and thoracic GSWs. The most prevalent radiological study was an X-ray (83.0%). Patients with head and neck GSWs had the longest emergency department stay, while patients with abdominal GSW patients had the shortest (p=0.068). The highest rates of blood product transfusion were observed in abdominal GSWs (63.2%), emergency surgery (63.2%), and ICU admission (42.1%). Head and neck GSWs had the longest hospitalization LOS (7.5 days). Longer LOS was significantly associated with abnormalities in radiological findings, receiving blood products, and ICU admission (p≤0.001). Significant predictors of prolonged LOS were major abnormalities in radiological findings [odds ratio (OR)=5.3; 95% confidence interval (CI):2.8-10.2], head and neck GSWs (OR=6.1; 95% CI:1.2-31.9), and blood product transfusion (OR=4.1; 95% CI: 1.0-16.3).
Conclusion: This study provides insights into factors influencing prolonged hospitalization in GSW patients, highlighting the importance of radiological findings, head and neck injuries, and blood product transfusion.

Keywords: Gunshot; Radiologic findings; Hospital length of stay; Trauma.

Please cite this paper as:
Aghili SH, Zardoui A, Farhang Ranjbar M, Baratloo A. Demographics, Radiological Findings, and Predictors of Prolonged Hospitalization in Civilian Gunshot Wound Patients. *Bull Emerg Trauma*. 2023;11(4):190-195. doi: 10.30476/BEAT.2023.100565.1473.

Introduction

Firearm violence is a major cause of death, disability, and economic loss worldwide [1]. Gunshot wounds (GSWs) are responsible for nearly 40,000 deaths in the United States each year, making them a major public health concern. What makes these injuries particularly noteworthy is their dual impact on substantial morbidity and disproportionately affecting a younger age group [2, 3]. GSWs account for a substantial portion of trauma cases, necessitating extensive healthcare resources and expertise for their management [2, 4].

While rates of firearm injuries differ around the world, numerous countries face the challenges presented by GSWs [1]. These challenges necessitate a comprehensive assessment of patient characteristics, clinical symptoms, and risk factors for longer hospital stays. Furthermore, in recent years, there has been an increasing recognition of the advantages of selective non-operative management for GSWs. This highlights the importance of accurate radiological assessments in treating GSW patients and indicates a shift toward a more detailed approach to managing these injuries [5, 6].

This study aims to shed light on GSW patients' demographic, clinical, and radiological features, as well as their impact on hospitalization outcomes. These kinds of studies are significant because they can assist healthcare providers, trauma centers, and policymakers in better understanding the specific needs of GSW patients. Moreover, by identifying factors that contribute to lengthier hospital stays, they can assist in developing targeted strategies to improve trauma care efficiency. Additionally, the findings might help in allocating resources such as blood products and critical care services to GSW patients who require them the most.

Materials and Methods

This retrospective cross-sectional study was conducted at Sina Hospital, Tehran, Iran, from 2020 to 2022. We obtained the required data from the hospital data bank, which covers data from multiple medical facilities and trauma centers. A consecutive sampling method was employed, and all the patients who were presented with civilian GSWs to any anatomical region of the body, and had complete data on radiological evaluation results, treatments administered, and the duration of hospitalization were enrolled. Based on a previous study [7], and with a 5% accuracy rate and a 95% confidence interval, a sample size of 174 patients was sufficient to meet the objectives of the study. However, to achieve better results, 212 patients were included in the present study.

We collected data on demographic information such as age and sex, clinical characteristics at admission (systolic blood pressure [SBP)], diastolic blood pressure [DBP], pulse rate [PR], respiratory rate [RR], Generalized Coma Score [GCS], and revised trauma score [RTS]). Besides, details on the diagnostic radiological modalities, radiological findings, and treatment characteristics such as Emergency department Length of stay (EDLOS), use of blood products, Intensive Care Unit (ICU) admission, ICU length of stay (LOS), ventilator use, days on ventilator, and outcome variables such as hospitalization LOS and death (pertains to fatalities resulting from injuries caused by GSW with a focus on occurrence exclusively during the hospital stay) were gathered. Pathologic findings were divided into two categories to improve statistical power and interpretability: "Normal or minor Abnormality", which included conditions such as soft tissue damage or normal, and "Significant Abnormality", which included conditions such as a bone fracture or vascular damage in extremities, intraperitoneal air or intraperitoneal fluid in the abdomen, hemothorax or pneumothorax in the chest, and cerebral hemorrhage in head and neck of the GSWs.

The quantitative data were expressed as mean±standard deviation (SD) and median [interquartile range (IQR)]. Categorical data were summarized using frequencies and percentages. Before analysis, the normality of continuous variables was assessed using the Shapiro-Wilk and Kolmogorov-Smirnov tests. The Mann-Whitney U test was used to compare quantitative variables between the two groups, and the Chi-square and Fisher exact tests were used for categorical variables. Hospital LOS, which was initially considered a continuous quantitative variable, was subsequently dichotomized into "short stay (0-3 days)" and "long stay (>3 days)" categories. A univariate logistic regression analysis was conducted to identify potential predictors of a prolonged LOS. Subsequently, a multivariate logistic regression analysis was performed using the stepwise method to determine the independent predictors of prolonged LOS. The results were presented as odds ratio (OR) and 95% confidence interval (CI). All statistical analyses were conducted using IBM SPSS Statistics, version 25.0. A p-value of less than 0.05 was considered statistically significant.

Results

In the present study, 212 individuals with GSWs were evaluated. The mean age of the participants was 30.17±7.80 years. Of these patients, 203 (95.8%) were male and 9 (4.2%) were female. 170 (80.2%) patients had a GSW on their extremities, 19 (9.0%) patients had abdominal GSW, 10 (4.7%) patients had thoracic GSW, and 11(5.2%) patients had GSW in their head and neck region. Two patients (0.9%) experienced both abdominal and thoracic GSWs. The mean RTS score for patients at the time of admission was 3.96±0.34. The median ED stay was 135 (IQR: 55-240) minutes (Table 1).

Table 1. Patients' characteristics and outcomes regarding the GSW location

Variables	Total N=212	Extremity N=170	Abdomen N=19	Thorax N=10	Head and Neck N=11
Demographics and admission characteristics					
Sex (male)	203 (95.8)	164 (96.5)	18 (94.7)	9 (90)	10 (90.9)
Age (years)	30.2±7.8 30 (25-36)	30.4±7.9 30 (24-35.25)	31.8±6.9 32 (25-36)	33.5±9.4 32.5 (26.75-42)	28.3±4.4 28 (25-31)
SBP (mmhg)	121.3±11.1 120 (112-129)	121.6±11.0 120 (111.5-129)	118.6±13.2 115 (110-120)	122.9±8.4 123 (115.25-130)	120.6±9.0 120 (110-130)
DBP (mmhg)	75.3±10.5 75 (70-80)	75.6±10.9 75 (70-80)	74.0±10.0 73 (70-80)	76.1±8.3 76.5 (69.75-80)	74.1±3.3 75 (70-75)
Heart rate	84.8±11.8 80 (78-90)	84.5±10.7 80 (78-90)	89.1±19.2 81 (78-100)	86.8±9.5 87 (80-95.5)	79.1±12.4 78 (70-89)
Respiratory rate	17.6±1.8 18 (16.25-18)	17.7±1.6 18 (17-18)	17.1±2.3 18 (16-18)	17.0±2.7 17 (15-20)	17.3±1.3 18 (17-18)
GCS	14.8±1.1 15 (15-15)	14.9±0.2 15 (15-15)	14.5±1.6 15 (15-15)	14.9±0.3 15 (15-15)	13.8±3.6 15 (15-15)
RTS	3.9±0.3 4 (4-4)	4.0±0.0 4 (4-4)	3.9±0.5 4 (4-4)	4.0±0.0 4 (4-4)	3.6±1.2 4 (4-4)
Diagnostic and treatment characteristics					
Imaging techniques					
X-ray	176 (83.0)	163 (95.9)	6 (31.6)	2 (20)	4 (36.4)
CT-scan	128 (60.4)	87 (51.2)	19 (100)	10 (100)	10 (90.9)
Ultrasonography	24 (11.3)	22 (12.9)	1 (5.3)	0 (0)	1 (9.1)
MRI	7 (3.3)	2 (1.2)	0 (0)	1 (10)	4 (36.4)
Radiological findings					
Minor abnormality	123 (58.0)	103 (60.6)	9 (47.4)	5 (50.0)	6 (54.5)
Significant abnormality	89 (42.0)	67 (39.4)	10 (52.6)	5 (50.0)	5 (45.5)
Receiving blood products	28 (13.2)	13 (7.6)	12 (63.2)	0 (0)	1 (9.1)
Emergency surgery	15 (7.1)	1 (0.6)	12 (63.2)	0 (0)	0(0)
EDLOS, minutes	181.9±195.8 135 (55-240)	189.4±199.7 135 (60-240)	100.8±102.8 60 (20-135)	166.5±127.8 120 (55-312.5)	185.5±253.4 150 (40-215)
Ventilator	5 (2.4)	1 (0.6)	2 (10.5)	0 (0)	1 (9.1)
Days on ventilator	2.8±3.0 1 (1-5.5)	One day	4.5±4.9	-	One day
ICU admission	18 (8.5)	5 (2.9)	8 (42.1)	3 (30)	1(9.1)
ICU LOS	6.0±5.7 3 (2-7.25)	6.0±7.1 2.0 (1.5-12.5)	4.8±4.2 3 (2.25-6.5)	5.7±3.2	20 Days
Outcomes					
Hospitalization LOS (days)	6.1±8.0 4 (2-7)	5.4±7.5 3 (2-6)	9.1±10.6 5 (3-14)	8.3±6.5 6.5 (2.75-13.25)	10.6±10.4 7 (5-15)
Hospitalization LOS					
Short	104 (49.1)	91 (53.5)	7 (36.8)	3 (30)	2 (18.2)
Long	108 (50.9)	79 (46.5)	12 (63.2)	7 (70)	9 (81.8)
Death	3 (1.4)	0 (0)	1 (5.3)	0 (0)	1 (9.1)

Quantitative data are presented as mean±standard deviation and median [Q1-Q3]; Categorical variables are presented as numbers (percentages). SBP: systolic blood pressure; DBP; diastolic blood pressure; GCS: Glasgow coma scale; RTS: revised trauma score; CT: computed tomography; MRI: magnetic resonance imaging; EDLOS: emergency department length of stay; LOS: length of stay; ICU: intensive care unit

Of the total population, X-rays were conducted on 176 (83.0%) patients, CT scans on 128 (60.4%) patients, and ultrasonography on 24 (11.3%) patients. At the same time, MRI was the least prevalent radiological study, conducted for only 7 (3.3%) patients. In patients with extremities GSWs, the most commonly performed radiological study was an X-ray (163 [95.9%]). A CT scan was the most commonly done radiological study in patients with abdominal, thoracic, and head and neck GSWs (Table 1). Unfortunately, three patients (1.4%) died, of which one had thoracoabdominal GSWs, one had head and neck GSW, and one had abdominal GSW.

Patients with head and neck GSW had the longest EDLOS, with a median stay of 150 minutes (IQR: 40-215). Patients with abdominal gunshot wounds, on the other hand, had the shortest EDLOS, with a median of 60 minutes (IQR: 20-135). Despite these variations, the GSW's location was not significantly associated with the EDLOS (p=0.068). Blood

Table 2. The association between radiological findings and treatment measures with hospitalization

Variables	Hospitalization LOS		
	Short (0-3days)	Long (>3days)	*p*-value
Radiological findings			
Minor abnormality	82 (66.7%)	41 (33.3%)	<0.001
Significant abnormality	22 (24.7%)	67 (75.3%)	
Receiving blood product			
Yes	5 (17.9%)	23 (82.1%)	<0.001
No	99 (53.8%)	85 (46.2%)	
Emergency surgery			
Yes	4 (26.7%)	11 (73.3%)	0.106
No	100 (50.8%)	97 (49.2%)	
ICU admission			
Yes	4 (22.2%)	14 (77.8%)	0.025
No	100 (51.5%)	94 (48.5%)	

Variables are presented as numbers (%); LOS: length of stay; ICU: intensive care unit

Table 3. Multivariate logistic regression results for predicting long hospitalization LOS

Variables	Odds ratio	95%CI	*p*-value
Radiological finding	5.4	[2.9-10.4]	<0.001
GSW location			0.086
Extremity	reference	reference	reference
Abdominal	0.8	[0.2-3.2]	0.757
Thoracic	2.9	[0.7-12.7]	0.164
Head and neck	6.2	[1.2-32.2]	0.029
Blood product transfusion	4.8	[1.3-18.7]	0.022

GSW: gunshot wound; ICU: intensive care unit; Nagelkerke R square=0.294

product transfusion was most commonly required in abdominal GSWs (63.2%), followed by extremity GSWs (7.6%), $p<0.001$. Emergency surgery was the most common (63.2%) in abdominal GSWs($p<0.001$). Moreover, as indicated in Table 1, patients with abdominal GSWs were more likely to be admitted to the ICU (42.1%), followed by those with thoracic GSWs (30%, $p<0.001$).

In radiological examinations, 123 (58%) of the total population revealed normal or mild abnormalities. For specific radiological observations associated with different GSW locations, please refer to Table 1.

The median of LOS in hospital for patients with gunshot wounds to the head and neck was 7.5 days (IQR: 5-14.75). In contrast, patients with gunshot wounds only to their extremities had the shortest hospitalization LOS, with a median of 3 days (IQR: 2-6).

Receiving blood products, having significant abnormalities in radiological findings, and ICU admission ($p\leq0.001$) were all associated with longer LOS in hospitals and long-term hospitalization (>3 days). Undergoing emergency surgery was also associated with longer hospitalization LOS ($p=0.002$), but not with lengthy hospitalization LOS as a categorical variable (>3 days), $p=0.106$ (Table 2).

To investigate potential determinants of prolonged LOS, univariate logistic regression analyses were conducted. A significant radiological abnormality (OR=6.1; 95% CI:3.3-11.2; $p<0.001$), a head and neck GSW (OR=5.2; 95% CI:1.1-24.7; $p=0.039$), blood product transfusion (OR=5.4; 95% CI:1.9-14.7; $p=0.001$), and ICU admission (OR=3.7; 95% CI:1.2-11.7; $p=0.025$) were all found to be significant predictors of long hospitalization LOS (>3days). According to Table 3, only radiological findings (OR=5.3; 95% CI:2.8-10.2), head and neck GSWs (OR=6.1; 95% CI:1.2-31.9), and blood product transfusion (OR=4.1; 95% CI:1.0-16.3) remained significant after performing a multivariate logistic regression. This means that patients with significant abnormalities in their radiological findings, patients with head and neck GSWs, and patients in need of blood product transfusions had 5.3 times, 6.1 times, and 4.1 times, higher odds of longer hospitalizations, respectively (Table 3).

Discussion

The present study evaluated 212 individuals with GSWs and aimed to investigate various factors influencing their clinical outcomes, focusing on the role of radiological findings, anatomical location of GSWs, and associated interventions. This study offered insights into the management of GSW patients and resource allocation.

The demographic characteristics of the present study revealed several notable trends. The majority of GSW patients were young men, which was consistent with previous research, indicating a higher incidence of GSWs among young men [1, 2, 8]. According to previous studies, the extremities were the most

frequently injured anatomical regions (80.2%) [9, 10]. The present reported mortality rate of 1.4% was notably lower than similar studies reporting rates ranging from 5% to 17%. This discrepancy could be attributed to the composition of the study population, with the majority of the individuals having solely extremity GSWs [7-11], as well as increased prehospital fatalities in GSWs [12]. In contrast, other studies included a higher percentage of patients with GSWs affecting more vital body regions [7-10].

The median EDLOS for all our patients was 135 minutes. No significant association between EDLOS and the location of GSW was found. However, patients with abdominal GSWs had the shortest EDLOS. This observation might be attributed to the higher demand for blood products, ICU admission, and the increased frequency of emergency surgeries among GSW patients. These variables suggested that their medical condition was more critical, necessitating expedited assignment and care, which likely contributed to the shorter EDLOS for this group. This finding was consistent with previous studies that reported a correlation between trauma severity and shorter EDLOS [13, 14]. Different studies suggested varied thresholds for determining short EDLOS in trauma patients, ranging from 2 to 4 hours [13, 15, 16]. This information is beneficial in managing the ED crowd dynamics and underscores the importance of prioritizing and allocating resources for trauma patients [17].

Following an X-ray, a CT scan was the most frequently used radiological modality. According to our findings, all patients with GSWs to the abdomen, chest, and head and neck regions, as well as nearly half of those with GSWs to their extremities, underwent a CT scan. We also found that patients with severe abnormalities in their radiological findings had almost five times higher rates of prolonged hospitalization. This underscores the critical role of CT scans in predicting outcomes in GSW patients and emphasizes the need for trauma centers that manage GSW cases to be equipped with CT scanning capabilities. The predictive value of radiological findings can help clinicians identify patients who are likely to require extended hospital stay early in their care, potentially allowing for more targeted resource allocation.

Several studies showed an increase in the use of selective nonoperative management (SNOM) for gunshot wound patients, emphasizing the significance of precise CT scans in identifying suitable candidates for this approach [5, 18].

The need for blood product transfusions, emergency surgeries, and ICU admissions varied significantly across various anatomical regions. Abdominal GSWs were associated with the highest rates of blood product transfusion, emergency surgeries, and ICU admissions. These findings emphasized the critical nature of abdominal injuries, which frequently necessitate prompt and extensive interventions. Although thoracic and head and neck injuries are as devastating as abdominal injuries [8, 19, 20], in the present study, the small number of patients with those affected body regions might contribute to this result.

The hospitalization LOS analysis revealed that patients with GSWs to the head and neck experienced the longest hospitalization LOS, with a median of 7.5 days. However, those with extremity GSWs had the shortest hospitalization LOS, with a median of 3 days. Multivariate logistic regression analysis demonstrated that radiological findings, head and neck GSWs, and blood product transfusions were independent predictors of extended hospitalization LOS, emphasizing their clinical importance and potential impact on patient outcomes. This finding was consistent with a recent study on more than 7000 trauma patients, which reported patients with head and neck injuries and patients requiring blood transfusion had a significantly higher mortality rate, resulting in a poor outcome for patients [13]. These findings might help trauma centers in prioritizing care for patients with head and neck GSWs and ensuring timely access to blood products, potentially contributing to improved patient outcomes.

Our study highlights the importance of recognizing significant radiological abnormalities in GSW patients as a key factor contributing to extended hospital stays beyond three days. This finding has practical implications for healthcare providers and institutions. It underlines the importance of allocating resources to meet the special needs of these patients, such as enough staffing and diagnostic equipment. Additionally, healthcare practitioners should tailor care plans to address the complexities presented by these abnormalities, enhancing the precision of treatment. Effective patient education is critical in communicating the importance of prolonged hospitalization. Finally, further research into these abnormalities, as well as the implementation of quality improvement initiatives, can contribute to improved patient outcomes and more efficient use of healthcare resources.

Conclusion

This study assessed GSW patients and also included information on demographic characteristics, radiological findings, clinical interventions, and hospitalization outcomes. The findings highlighted the critical nature of GSWs and the requirement for multidisciplinary approaches in their management. Significant radiological abnormalities, blood transfusion, and GSWs to the head and neck were found to be significant predictors of prolonged hospitalization LOS. These findings provided valuable insights that could guide clinical decision-making and resource allocation within trauma centers. Future research should focus on improving risk classification and treatment algorithms to further enhance the care and outcomes of GSW patients.

Declaration

Ethics approval and consent to participate: Patient confidentiality and data security were maintained throughout the study in accordance with relevant ethical guidelines and regulations. The Ethics Committees of the Directorate of Health, Rescue and Treatment of Police Headquarters of the Islamic Republic of Iran and Shahid Beheshti University of Medical Sciences approved the study protocol (IR.SBMU.TEB.POLICE.REC.1402.034).

Consent for publication: All authors have expressed their consent to the publication of this article.

Conflict of Interest: The authors declared that they had no conflict of interest.

Funding: The executive funded all project expenditures, and no other person or institution offered financial support for this study.

Authors' Contribution: The conception and design of the work by all the authors; Data acquisition by AZ and AB; Analysis and interpretation of data by AZ and AB; Drafting the work by AZ and MFR; Revising it critically for important intellectual content by SHA and AB; All the authors approved the final version to be published; AND agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work.

Acknowledgment: We would like to express our appreciation to Dr. Mahmoud Yousefi fard for his kind help.

References

1. Ou Z, Ren Y, Duan D, Tang S, Zhu S, Feng K, et al. Global burden and trends of firearm violence in 204 countries/territories from 1990 to 2019. *Front Public Health*. 2022;**10**:966507.
2. Hink AB, Bonne S, Levy M, Kuhls DA, Allee L, Burke PA, et al. Firearm injury research and epidemiology: A review of the data, their limitations, and how trauma centers can improve firearm injury research. *J Trauma Acute Care Surg*. 2019;**87**(3):678-89.
3. Cunningham RM, Walton MA, Carter PM. The major causes of death in children and adolescents in the United States. *N Engl J Med*. 2018;**379**(25):2468-75.
4. Gramlich J. What the data says about gun deaths in the US. Pew Research Center. https://www.pewresearch.org/short-reads/2023/04/26/what-the-data-says-about-gun-deaths-in-the-u-s/. Published [August 2019]. Updated [April 2023]. Accessed [September 2023].
5. Lee H, Kong V, Cheung C, Thirayan V, Rajaretnam N, Elsabagh A, et al. Trends in the management of abdominal gunshot wounds over the last decade: a South African experience. *World J Surg*. 2022;**46**(5):998-1005.
6. Al Rawahi AN, Al Hinai FA, Boyd JM, Doig CJ, Ball CG, Velmahos GC, et al. Outcomes of selective nonoperative management of civilian abdominal gunshot wounds: a systematic review and meta-analysis. *World J Emerg Surg*. 2018;**13**(1):1-16.
7. Schellenberg M, Inaba K, Heindel P, Forestiere MJ, Clark D, Matsushima K, et al. The diagnostic dilemma of shotgun injuries. *Eur J Trauma Emerg Surg*. 2020;**46**:1351-6.
8. Turgut K, Gür A, Güven T, Oğuztürk H. Evaluation of factors related to mortality caused by firearm injury: a retrospective analysis from Malatya, Turkey. *Arch Iran Med*. 2019;**22**(2):80-4.
9. Bäckman PB, Riddez L, Adamsson L, Wahlgren C-M. Epidemiology of firearm injuries in a Scandinavian trauma center. *Eur J Trauma Emerg Surg*. 2020;**46**:641-7.
10. Odatuwa-Omagbemi DO, Otene CI, Enemudo RET, Imonijevwe ES, Sefia TE. Gunshot injuries: experience in a tertiary health facility in the Niger Delta Region of Nigeria. *Pan Afr Med J*. 2022;**43**.
11. Omoke N. Firearm injuries received in emergency room of a Nigerian teaching hospital: Analysis of pattern, morbidity, and mortality. *Niger J Clin Pract*. 2017;**20**(5):587-94.
12. Crandall M, Sharp D, Unger E, Straus D, Brasel K, Hsia R, et al. Trauma Deserts: Distance From a Trauma Center, Transport Times, and Mortality From Gunshot Wounds in Chicago. *Am J Public Health*. 2013;**103**(6):1103-9. doi: 10.2105/ajph.2013.301223. PubMed PMID: 23597339.
13. Ramzee AF, El-Menyar A, Asim M, Kanbar A, Ahmed K, Daoud B, et al. The impact of emergency department length of stay on the outcomes of trauma patients requiring hospitalization: a retrospective observational study. *World J Emerg Med*. 2023;**14**(2):96.
14. Richardson JD, Franklin G, Santos A, Harbrecht B, Danzl D, Coleman R, et al. Effective triage can ameliorate the deleterious effects of delayed transfer of trauma patients from the emergency department to the ICU. *J Am Coll Surg*. 2009;**208**(5):671-8.
15. Singer AJ, Thode Jr HC, Viccellio P, Pines JM. The association between length of emergency department boarding and mortality. *Acad Emerg Med*. 2011;**18**(12):1324-9.
16. Kinney EP, Gursahani K, Armbrecht E, Dalawari P. Does emergency medicine length of stay predict trauma outcomes at a Level 1 Trauma Center. *J Hosp Adm*. 2015;**4**(5):1-7.
17. Talebpour M, Payandemehr P, Kalhor P, Abbasi N, Baratloo A. One-Year Analysis of the Emergency Department Input and Output; a Case Study of Sina Hospital, Iran. *J Police Med*. 2019;**8**(2):87-92. doi: 10.30505/8.2.87.
18. Navsaria PH, Nicol AJ, Edu S, Gandhi R, Ball CG. Selective nonoperative management in 1106 patients with abdominal gunshot wounds: conclusions on safety, efficacy, and the role of selective CT imaging in a prospective single-center study. *Ann Surg*. 2015;**261**(4):760-4.
19. Livingston DH, Lavery RF, Lopreiato MC, Lavery DF, Passannante MR. Unrelenting violence: an analysis of 6,322 gunshot wound patients at a Level I trauma center. *J Trauma Acute Care Surg*. 2014;**76**(1):2-11.
20. Berg RJ, Inaba K, Okoye O, Karamanos E, Strumwasser A, Chouliaras K, et al. The peril of thoracoabdominal firearm trauma: 984 civilian injuries reviewed. *J Trauma Acute Care Surg*. 2014;**77**(5):684-91.