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Original Article

Factors Influencing Injury Severity Scores Among War Casualties along the Thai Myanmar Border: Experience from Maesot Hospital (2020–2024)

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ABSTRACT

Background: In the context of ongoing armed conflicts and political instability in Southeast Asia, particularly along the Thai-Myanmar border, war-related injuries pose a significant public health challenge. These injuries are complex and have a profound impact on emergency medical care. Assessing the severity of war-related trauma is crucial for prioritizing treatment and guiding decision-making in trauma and emergency surgery. Therefore, this study aims to identify factors influencing injury severity scores (ISS) in war casualties admitted to Maesot Hospital, a major referral center along the Thai–Myanmar border.

Methods: A retrospective study was conducted using medical records of war-injured patients treated at Maesot Hospital between 2020 and 2024. A total of 212 patients were included and categorized into two groups based on their ISS scores: ISS <16 (n = 53) and ISS ≥16 (n = 169). Descriptive statistics and multiple logistic regression analysis were performed to identify factors associated with higher ISS.

Results: There was no significant association between sex and ISS severity (p = 0.79). However, age was a significant factor, with patients aged 35–44 years being more likely to sustain severe injuries (p = 0.04). Additionally, inpatient status was strongly associated with higher ISS (p < 0.01), indicating that patients requiring hospitalization had more severe injuries.Regarding injury location, multiple trauma involving multiple body regions was the strongest predictor of higher ISS (Adjusted OR = 9.95, 95% CI: 1.03–95.45, p = 0.04) Conversely, head and neck injuries, abdominal and pelvic injuries, and upper limb injuries did not show significant associations with ISS severity.

Conclusions: Age, inpatient status, and multiple body region trauma were key predictors of higher ISS. These findings highlight the need for ISS-based triage protocols and resource prioritization in conflict-affected areas.

Keywords: Injury Severity Score, War Trauma, Emergency Surgery, Border Hospital, Trauma Triage, Maesot Hospital

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Introduction

In the context of war and political conflict in Southeast Asia, particularly in Myanmar, the impact of armed conflict has resulted in a significant public health burden. War-related injuries often exhibit distinct pathological characteristics, which range from penetrating injuries and blunt trauma to polytrauma, and are frequently the result of explosive weapons and gunfire[1]. Patients injured in war commonly present with multiple types of injuries, such as lacerations, organ penetration injuries, and blast injuries, which are complex and cause anatomical damage across multiple systems. For instance, the central nervous system is often affected, with traumatic brain injury (TBI) being strongly associated with high mortality rates[2]. Injuries to the respiratory and thoracic systems, including lung lacerations or hemothorax (the accumulation of blood in the chest cavity), are also critically important for prognosis. About the gastrointestinal system, injuries to the liver and small intestine often lead to rapid blood loss and require emergency surgical intervention[3].

The Injury Severity Score (ISS) is a critical tool in trauma surgery and emergency care1. It quantifies injury severity based on the Abbreviated Injury Scale (AIS), calculated by summing the squares of the three most severe injuries in different body regions[4]. The ISS enables clinicians to evaluate trauma impact, prioritize care, and predict outcomes such as mortality and the need for surgical intervention. In addition to anatomical injury, factors like age and mechanism (e.g., blast or gunshot) influence outcomes. Previous studies in Thailand have shown blast injuries to be the most common cause of trauma and identified age as a key factor in severity[5].

In the context of the armed conflict along the Thai–Myanmar border, particularly in the Maesot District of Tak Province, clashes between the anti-junta forces and the Myanmar military have led to a large number of people fleeing into the safe zones on the Thai side. Many of the injured from both sides have crossed the border to receive treatment in Thai hospitals[6]. One such hospital is Maesot Hospital, which is located near the Thai–Myanmar border. This medical facility is vital in providing medical care to war casualties from the border area. Medical services in this wartime context must operate within the frameworks of medical ethics and international humanitarian law, both of which provide essential principles for ensuring effective and equitable care for patients, particularly under constraints related to resources and security risks[7].

Given these challenges, the ISS is essential for trauma triage, allowing efficient resource allocation in emergencies involving large patient volumes. However, limited data exist on factors influencing ISS in this setting. This study aims to identify predictors of severe injury among war casualties treated at Maesot Hospital from 2020 to

2024. The findings are expected to inform clinical protocols, improve trauma system preparedness, and guide resource management in conflict-affected border regions.

Method

This study employed a retrospective study design. The population studied consisted of war casualties who had received treatment at Maesot Hospital between 2020 and 2024 (B.E. 2563–2567). These were patients whose injuries had been caused by armed conflict along the Thai–Myanmar border and who had been registered in the hospital's patient registry or medical records during the specified period. The sample included patients selected from the population, based on specific criteria, such as having sufficient data to calculate the ISS.

The Inclusion Criteria were as follows:

1. War casualties from armed conflicts along the Thai–Myanmar border.
2. Patients who received treatment at Maesot Hospital between 2020 and 2024 (B.E. 2563–2567).
3. Patients with complete medical records that were sufficient and could be used to calculate the ISS.

The Exclusion Criteria were as follows:

1. Patients for whom the medical data could not be obtained.
2. Patients who had died before reaching the hospital.

Sample Size Determination

Given the nature of this study as a population-based study involving a specific group, namely, war casualties along the Thai–Myanmar border, the research included all patients who had received treatment at Maesot Hospital during the defined study period (2020–2024). There was no need to generalize the findings to a broader population. The estimated number of cases was approximately 200 patients[8].

Patients were categorized into two groups based on their Injury Severity Score (ISS) those with ISS < 16 and those with ISS ≥ 16.An ISS of 16 or greater is widely used in trauma research to define major trauma, as it is associated with increased risk of mortality and need for intensive care. This cutoff is supported by established trauma literature and is commonly applied in emergency surgery and trauma triage protocols[9].

Age groups were categorized based on common operational age ranges found in military and humanitarian settings. Previous studies on combat injuries have shown that individuals aged 25–44 years are more likely to be involved in frontline or tactical roles, thus at greater risk of high-energy trauma. This classification aligns with age-grouping standards used in conflict-related trauma research (e.g., Boonthep et al., 2012)[8].

Ethics Approval

This study was approved by the Institutional Review Board (IRB) of Maesot Hospital, Tak Province, Thailand (Approval No. MSHP 11/2568). All patient data were anonymized, and the study was conducted in accordance with the Declaration of Helsinki.

Data Analysis

The data was analyzed using the statistical software STATA version 10.1. Descriptive and inferential statistical analyses were employed to examine the study sample's typical characteristics. The descriptive data is presented in tables showing frequencies, percentages, means, and standard deviations. The following tests were employed to make comparisons between groups. The Independent *t*-test was used for continuous variables with normal distribution, while the Mann-Whitney U test was applied for continuous variables with non-normal distribution. The Chi-square test was used for categorical variables. In cases with small, expected frequencies (less than 5), Fisher's Exact Test was applied. In addition, logistic regression was used to examine the association between each independent variable (risk factor) and the outcomes. Univariate logistic regression was first applied to estimate the odds ratio (OR), and a 95% confidence interval (CI) was used for each independent variable. Subsequently, stepwise forward selection logistic regression was performed to identify significant predictors. In the final model, a p-value < 0.05 was determined to be statistically significant.

Results

From the analysis of the data from those patients injured in the armed conflict along the Thai–Myanmar border, in which those with a low injury severity (ISS < 16) and those with a high injury severity (ISS ≥ 16) were compared, it was found that both groups had shown a high proportion of male patients (92.45% and 93.49%, respectively). Meanwhile, the female patients accounted for only 7.55% and 6.51%, respectively. The p-value was 0.79. Regarding the patient age groups, the 25–34 age group had the highest number of patients in both ISS categories (33.96% in ISS < 16 and 36.09% in ISS ≥ 16). However, there was a statistically significant difference in the 35–44 and the patients aged 45 years and older groups. For the 35–44 age group, 18.93% had been in the ISS ≥ 16 group compared to 7.55% in the ISS < 16 group. Meanwhile, the patients aged 45 years and older group had shown a lower proportion of severe injuries (12.43%). The p-value was 0.04. In terms of healthcare service utilization, the proportion of inpatients had been much higher in the ISS ≥ 16 group (81.07%) compared to the ISS < 16 group (43.40%), with a p-value of less than 0.01. This indicated a significant association between inpatient status and the severity of injuries since

patients with more severe injuries had required hospitalization. Considering the anatomical sites of injury, lower limb injuries were the most common in both groups (43.40% in ISS < 16 and 31.95% in ISS ≥ 16) , as shown in (Table 1) and illustrated in (Figure 4). which was followed by head and neck injuries, and abdominal and pelvic injuries. However, the *p*-value was 0.16.

Analysis using multiple logistic regression revealed the factors influencing the severity of injuries by calculating the adjusted odds ratio (OR), which helps assess the likelihood of patients

Figure 1 A 52-year-old female patient with facial blast injury presenting with multiple complex and extensive avulsion and laceration wounds, accompanied by an open comminuted fracture of the mandible.

Figure 2 A 30-year-old male patient with inhalation injury and flame burns. Sustained second- and third-degree burns to the face, neck, trunk, both forearms, thighs, and legs, covering 37% of total body surface area (TBSA).

Figure 3 A 27-year-old male patient injured by bomb shrapnel, presenting with subdural hematoma and a bamboo fragment impaled into the right orbit, resulting in traumatic rupture of the right eye globe with retained foreign body.

Table 1 General characteristics of patients

Characteristics of patients	ISS score < 16 (n = 53)	ISS score ≥ 16 (n = 169)	*p*-value
Sex			0.79
Male	49 (92.45)	158 (93.49)	
Female	4 (7.55)	11 (6.51)	
Age group (years)			0.04
Below 25	17 (32.08)	55 (32.54)	
25-34	18 (33.96)	61 (36.09)	
35-44	4 (7.55)	32 (18.93)	
45 and older	14 (26.42)	21 (12.43)	
Service type			< 0.01
Inpatient	23 (43.40)	137 (81.07)	
Outpatient	30 (56.60)	32 (18.93)	
Affected Body Structures by PDX			0.16
Head & Neck Injuries	8 (15.09)	40 (23.67)	
Thoracic Injuries	7 (13.21)	13 (7.69)	
Abdominal & Pelvic Injuries	8 (15.09)	26 (15.38)	
Upper extremities Injuries	6 (11.32)	18 (10.65)	
Lower extremities Injuries	23 (43.40)	54 (31.95)	
Multiple Trauma & Other Injuries	1 (1.89)	18 (10.65)	

"PDX" = Primary Diagnosis

having an ISS ≥ 16 compared to a reference group. The results, as summarized in Table 2, showed that head and neck injuries had an adjusted OR of 2.79 (95% CI: 0.80–9.75, p = 0.10), suggesting an increased–but not statistically significant–likelihood of severe injuries compared to the reference group (thoracic injuries).

For abdominal and pelvic injuries, the adjusted OR was 1.98 (95% CI: 0.56–6.96, p = 0.28), and for upper limb injuries, it was 1.76 (95% CI: 0.44–6.95, p = 0.41). Lower limb injuries had an adjusted OR of 1.27 (95% CI: 0.42–3.79, p = 0.66). None of these associations reached statistical significance.

In contrast, multiple trauma and other injuries were strongly associated with severe injury, showing the highest adjusted OR of 9.95 (95% CI: 1.03–95.45, p = 0.04), indicating that patients

with injuries affecting multiple body regions were nearly 10 times more likely to have an ISS ≥ 16 than those with thoracic injuries alone. , as shown in (Table 2)

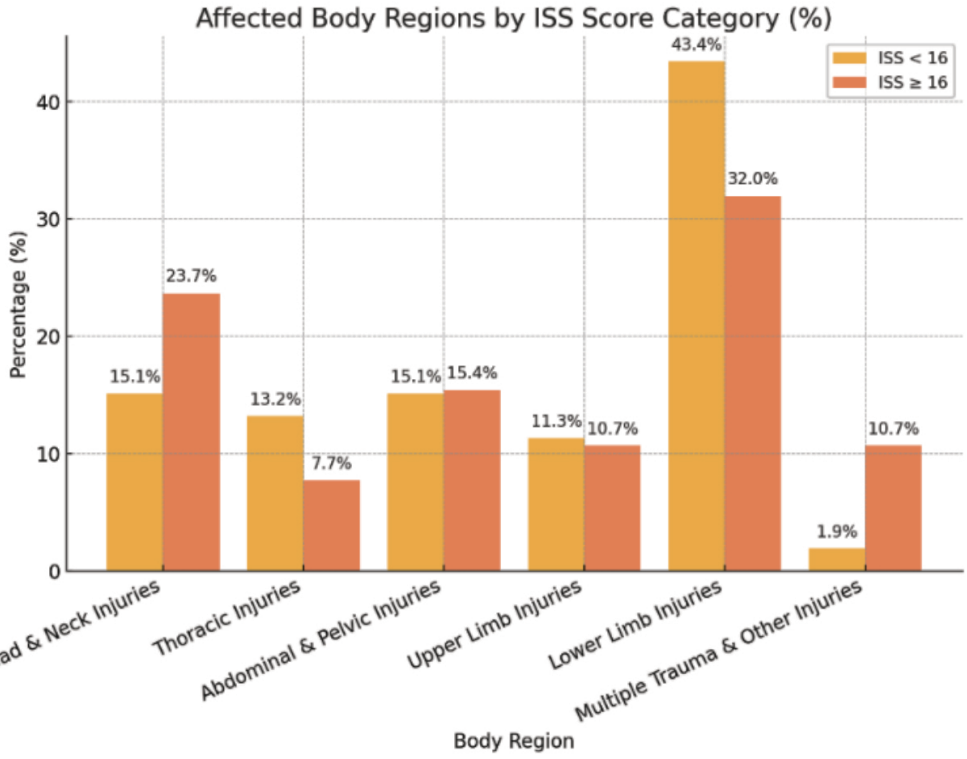

Figure 4 Affected body structures comparing ISS <16 and ISS ≥16 groups, illustrating injury type trends within each group.

Table 2 Factors associated with injury severity levels in war-related patients

Factor	Adjust OR	95%CI	*p*-value
Affected Body Structures by PDX			
Head & Neck Injuries	2.79	0.80-9.75	0.10
Thoracic Injuries	Ref		
Abdominal & Pelvic Injuries	1.98	0.56-6.96	0.28
Upper extremities Injuries	1.76	0.44-6.95	0.41
Lower extremities Injuries	1.27	0.42-3.79	0.66
Multiple Trauma & Other Injuries	9.95	1.03-95.45	0.04

*adjust age sex, “PDX” = Primary Diagnosis

Discussion

This study analyzed the factors influencing the ISS among the casualties from the armed conflict along the Thai–Myanmar border, using data from Maesot Hospital from 2020 to 2024. The armed conflict in this border area is a major factor that impacts medical care and patient triage. Injuries sustained during these events have distinct characteristics that differ from those seen as a result of peacetime accidents. For example, blast injuries and penetrating injuries from gunshots are commonly encountered on the battlefield.

The study highlighted the key factors influencing ISS levels, including a patient's age, inpatient status, multiple traumata, and other injuries. The findings revealed that the sex of the patient had not been associated with the severity of the injuries (p = 0.79), which aligned with the research by Anderson et al. (2017)[10], who studied the relationship between sex and injury risk in a military context. Their study found that, after controlling for confounding variables, such as age, body composition, and physical fitness, sex did not affect the likelihood of injury. However, age was significantly associated with ISS levels (p = 0.04), particularly in the 35–44 age group, in which there had been a higher tendency for severe injuries. This may be attributable to the fact that individuals in this age group are more likely to be active combatants or frontline personnel, thereby increasing their exposure to high-energy trauma mechanisms such as blasts or gunfire. Their role in conflict zones may involve direct engagement in combat operations, placing them at greater risk of sustaining complex injuries.Research by Kim et al. (2024)[11], which examined the impact of ISS on treatment approaches and survival rates among elderly patients, found that older adults exhibited lower survival rates than younger individuals, especially in cases with ISS ≥ 16. This was attributed to slower tissue regeneration and a reduction in the efficiency of the circulatory system in older patients.

In terms of inpatient status and injury severity, the results showed that inpatients had significantly higher ISS levels than outpatients ($p < 0.01$). This finding is consistent with research by MacGregor et al. (2021)[2], who reported that patients requiring hospitalization were more likely to have complex injuries, such as thoracoabdominal trauma or injuries involving vital organs.

This study found that patients with multiple injuries across different body regions had the highest risk of having an ISS ≥ 16, with the highest adjusted OR of 9.95 (95% CI: 1.03–95.45, p = 0.04). Chest (thoracic) injuries were selected as the reference category because they represented a clinically significant anatomical region and had a moderate frequency in both ISS subgroups, allowing for stable comparison. Moreover, thoracic injuries have been frequently used as a baseline category in trauma studies due to their

intermediate severity in both prognosis and surgical complexity[2]. This meant that these patients were almost 10 times more likely to suffer from severe injuries when compared to the reference group. Research by Machaku et al. (2023)[12] reported that blast injuries can affect multiple organ systems, including penetrating wounds and blast force trauma, which complicate the treatment process and require a comprehensive care approach. Although head and neck injuries had an adjusted OR of 2.69 (95% CI: 0.81–8.86, p = 0.10), the association was not statistically significant. This contrasted with the findings of Lueckel et al. (2019)[13], who studied traumatic brain injuries (TBI) and clinical outcomes and reported that TBI was a major cause of trauma-related deaths, accounting for 30% of all trauma-related fatalities. However, This discrepancy may be attributed to several factors, including the heterogeneity of injury mechanisms, sample size limitations, or the timely intervention available at the referral hospital. Moreover, some patients with potentially critical head injuries may have died before reaching the hospital, leading to underrepresentation in the dataset. The present study also found that abdominal and pelvic injuries had not been significantly associated with higher ISS (p = 0.36), which may have been attributed to rapid emergency intervention and modern Damage Control Surgery (DCS) techniques, which can help reduce complications[14]. Although Injuries to the extremities were the most frequently observed, they were not significantly associated with ISS levels. This aligned with research by Boonthep et al. (2012)[5], who stated that limb injuries are typically not a major factor in determining injury severity, unless they involve excessive bleeding or major vascular damage.

The findings of this study have significant practical implications for trauma care systems operating in conflict-affected settings, particularly in resource-constrained environments. By identifying key determinants of injury severity–such as patient age and polytrauma–border hospitals can refine trauma triage protocols and optimize resource allocation based on clinical urgency. Furthermore, the framework proposed by this research may be adapted for use in other conflict zones with similar operational challenges. It serves as a foundational reference for developing clinical practice guidelines, structuring surgical team training programs, and enhancing disaster preparedness and humanitarian response strategies at the policy level.

Limitations

Although this study has provided important insights into the factors influencing ISS levels, several limitations must be considered. First, it was a retrospective study, which may be subject to errors or incompleteness in medical record documentation. Second, the study did not include an analysis of long-term patient outcomes after

treatment, such as survival rates, functional recovery, or quality of life after hospital discharge. Third, the wide confidence interval observed for the "multiple trauma" variable in the logistic regression model suggests a small sample size and statistical imprecision for this subgroup. This may affect the stability of the model and the generalizability of the findings related to complex, multi-region injuries. Future prospective studies with larger sample sizes and follow-up data are warranted to validate and expand upon these findings.

Conclusion

This study found that a patient's age, inpatient status, and multiple injuries across body regions were the key factors that influenced ISS levels. The findings can be used to help develop treatment protocols and optimize medical resource management for war-related trauma patients, particularly within the context of border hospitals where resources are limited.

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