Association Between Injury Severity Indices and Clinical Outcomes in Polytrauma Patients with Musculoskeletal Injuries: A Retrospective Study

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Abstract

Background: Polytrauma involving musculoskeletal injuries is associated with substantial morbidity and mortality. Injury severity indices are widely used to assess trauma severity; however, their relationship with clinical outcomes among patients with musculoskeletal polytrauma requires further evaluation. **Objective:** To determine the association between injury severity indices and clinical outcomes in polytrauma patients with musculoskeletal injuries. **Methods:** This retrospective cohort study was conducted at Sri Siddhartha Medical College and Hospital, Tumkur from Feb 2024 to Feb 2026 and included 250 adult polytrauma patients with musculoskeletal injuries. Injury severity was assessed using the Injury Severity Score (ISS), New Injury Severity Score (NISS), Revised Trauma Score (RTS), and Trauma and Injury Severity Score (TRISS). **Results:** The mean age of patients was 38.9 ± 15.7 years, and 182 (72.8%) were male. The mean ISS, NISS, RTS, and TRISS were 24.6 ± 8.9, 29.1 ± 10.2, 6.41 ± 1.22, and 84.8 ± 12.5%, respectively. Patients requiring ICU admission had significantly higher ISS (31.8 ± 7.6 vs. 20.1 ± 6.4), higher NISS (37.2 ± 8.9 vs. 24.1 ± 7.8), lower RTS (5.42 ± 1.11 vs. 7.03 ± 0.81), and lower TRISS (73.6 ± 13.4% vs. 91.8 ± 7.6%; all $p<0.001$). Patients hospitalized for more than 10 days demonstrated significantly higher injury severity scores, increased postoperative complications (42.6%), higher reoperation rates (25.9%), and poorer functional recovery. Multivariable analysis identified ISS >25 (AOR=3.82, $p<0.001$), RTS <6 (AOR=3.11, $p=0.001$), and associated head injury (AOR=2.64, $p=0.003$) as independent predictors of ICU admission. NISS >30 independently predicted postoperative complications (AOR=3.57, $p<0.001$), while TRISS <80% was the strongest predictor of in-hospital mortality (AOR=4.69, $p<0.001$). **Conclusion:** Injury severity indices are strong predictors of adverse clinical outcomes in polytrauma patients with musculoskeletal injuries. Higher ISS and NISS, together with lower RTS and TRISS, are associated with increased ICU admission, prolonged hospitalization, postoperative complications, and mortality.

Keywords: Polytrauma; musculoskeletal injuries; Injury Severity Score; New Injury Severity Score; Revised Trauma Score

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Introduction

Polytrauma accounts for a substantial proportion of morbidity and mortality globally, especially in young adults, and is a significant public health problem, because of the physical, psychological and socioeconomic effects of polytrauma [1]. Patients who have multiple traumatic injuries often present with musculoskeletal trauma associated with head, chest, abdominal or pelvic injuries, creating a complex clinical presentation that cannot be managed by a single physician [2]. The level of injury is a key determinant of patient outcome, with implications for survival, complications, functional status, length of hospital stay, and healthcare resource use, among others [3]. Extremities, pelvis, spine fractures with associated soft tissue injuries form a large part of polytrauma, and these are among the most common musculoskeletal injuries [4]. While these injuries do not usually result in fatalities, they can significantly increase the length of time that individuals are disabled, have delayed rehabilitations, experience chronic pain and a lower quality of life [5]. Early recognition of the severity of the injury is therefore key to determining treatment priorities, priorities in resource allocation and improved outcomes of patient care. There are several trauma scores that can be used to objectively measure the severity of trauma and to help predict clinical outcome in polytrauma patients [6]. The Injury Severity Score (ISS) is one of the most widely accepted anatomical scoring systems and has shown a high correlation with mortality, intensive care unit

admission, requirement for surgical intervention and hospital length of stay [7]. The New Injury Severity Score (NISS) is another attempt to better the ISS, allowing for the inclusion of the three most severe injuries across the whole body, rather than the body parts they were first applied to, therefore giving better predictive accuracy in patients who have multiple injuries in the same body part [8].

Physiological scoring systems also are crucial in the assessment of trauma. The Glasgow Coma Score (GCS), which is an indicator of the patient's physiological status at presentation, along with systolic blood pressure and respiratory rate, forms the Revised Trauma Score (RTS) which helps in predicting survival [9]. A well accepted model for predicting survival probability of severely injured patients is the Trauma and Injury Severity Score (TRISS) which combines the severity of the anatomical injury, the physiological status, the age of the patient and the mechanism of injury [10]. A number of studies have shown that injured patients with higher injury score require longer mechanical ventilation, more complications, more blood transfusion, intensive care admission, hospital stay longer and more mortal [11]. But the accuracy of each scoring system will be different based on patient-specific factors, injury types, and institution-specific trauma care practices [12]. Moreover, there is scarce information available about their prognostic value in particular in polytrauma patients with a predominant musculoskeletal injury. In addition to severity of the trauma, other factors including age, traumatic brain injury, hemorrhagic shock, the timing of definitive fracture fixation, comorbidities, and postoperative complications also affect clinical outcomes in patients with polytrauma [13]. Correct identification of high-risk patients in the initial evaluation can help ensure early intervention, prioritization of damage-control strategies, and better multidisciplinary decision making [14]. Despite significant improvements in the care of trauma patients, the number of patients with severe musculoskeletal polytrauma who die or develop long-term disabilities is still significant. Therefore, there is a need for reliable tools to be developed in order to provide early risk stratification and to best plan treatment [15]. The use of already available injury severity indices to assess the association with subsequent clinical outcomes can further enhance the management of trauma and resource utilization.

Objective

To determine the association between injury severity indices and clinical outcomes in polytrauma patients with musculoskeletal injuries.

Methodology

This was a retrospective cohort study conducted at Sri Siddhartha Medical College and Hospital, Tumkur from Feb 2024 to Feb 2026, including 250 polytrauma patients with musculoskeletal injuries to evaluate the association between injury severity indices and clinical outcomes. Patients aged 18 years and above who sustained polytrauma with at least one major musculoskeletal injury requiring hospital admission were included. Polytrauma was defined as injuries involving two or more body regions with an Injury Severity Score (ISS) ≥16. Patients with complete trauma registry data, documented injury severity indices, radiological investigations, operative records, and hospital outcome data were considered eligible. Patients with isolated musculoskeletal injuries without associated trauma, pathological fractures, burns, penetrating trauma without musculoskeletal involvement, dead-on-arrival cases, patients transferred after definitive surgical management at another institution, incomplete medical records, or missing injury severity scores were excluded.

Data Collection

Following ethical approval, data were retrieved from trauma registry databases, emergency department records, operative notes, radiological reports, intensive care unit records, and discharge summaries using a standardized data collection proforma. Demographic variables included age, gender, body mass index, smoking status, and comorbidities. Trauma-related variables included mechanism of injury, time from injury to hospital presentation, associated injuries (head, chest, abdominal, pelvic, spinal, and vascular injuries), type and location of musculoskeletal injuries, open or closed fractures, fracture classification, need for damage-control orthopedics, definitive fixation procedures, blood transfusion requirements, and duration of surgery. Injury severity was assessed using the Injury Severity Score (ISS), New Injury Severity Score (NISS), Revised Trauma Score (RTS), and Trauma and Injury Severity Score (TRISS) calculated from admission data. Clinical outcomes included intensive care unit admission, duration of mechanical ventilation, hospital length of stay, postoperative complications, need for reoperation, limb salvage, in-hospital mortality, and functional outcome at discharge assessed using standardized mobility and weight-bearing status.

Statistical Analysis

Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ±

standard deviation, while categorical variables were presented as frequencies and percentages. Independent *t*-tests or Mann–Whitney *U* tests were used to compare continuous variables between outcome groups, while Chi-square or Fisher's exact tests were used for categorical variables. Pearson or Spearman correlation analysis was performed to evaluate the relationship between injury severity indices and continuous clinical outcomes such as hospital stay and duration of mechanical ventilation. A p-value ≤0.05 was considered statistically significant.

Results

The mean age of patients was 38.9 ± 15.7 years, with male predominance (182, 72.8%). Road traffic accidents were the leading mechanism of injury (146, 58.4%), followed by falls from height (61, 24.4%). Open fractures were present in 84 (33.6%) patients, while head, chest, and abdominal injuries were seen in 88 (35.2%), 69 (27.6%), and 48 (19.2%), respectively. The mean ISS was 24.6 ± 8.9, NISS was 29.1 ± 10.2, RTS was 6.41 ± 1.22, and TRISS survival probability was 84.8 ± 12.5%.

Table 1: Baseline Demographic, Injury Characteristics, and Injury Severity Indices of Polytrauma Patients (N = 250)

Variable	n (%) / Mean ± SD
Age (years)	38.9 ± 15.7
Male	182 (72.8)
Female	68 (27.2)
Body Mass Index (kg/m²)	26.3 ± 4.7
Road Traffic Accidents	146 (58.4)
Fall from Height	61 (24.4)
Industrial Injuries	23 (9.2)
Assault/Sports Injuries	20 (8.0)
Open Fractures	84 (33.6)
Pelvic Fractures	46 (18.4)
Associated Head Injury	88 (35.2)
Associated Chest Injury	69 (27.6)
Associated Abdominal Injury	48 (19.2)
Injury Severity Score (ISS)	24.6 ± 8.9
New Injury Severity Score (NISS)	29.1 ± 10.2
Revised Trauma Score (RTS)	6.41 ± 1.22
Trauma and Injury Severity Score (TRISS) Probability of Survival (%)	84.8 ± 12.5

Patients requiring ICU admission had significantly higher ISS (31.8 ± 7.6 vs. 20.1 ± 6.4) and NISS (37.2 ± 8.9 vs. 24.1 ± 7.8), with lower RTS (5.42 ± 1.11 vs. 7.03 ± 0.81) and TRISS survival probability (73.6 ± 13.4% vs. 91.8 ± 7.6%; p<0.001). Mechanical ventilation and mortality were also markedly higher in ICU patients, occurring in 61 (63.5%) and 19 (19.8%) patients, respectively.

Table 2: Comparison of Injury Severity Indices According to Clinical Outcomes

Variable	ICU Admission (n=96)	No ICU Admission (n=154)	p-value
ISS, Mean ± SD	31.8 ± 7.6	20.1 ± 6.4	<0.001
NISS, Mean ± SD	37.2 ± 8.9	24.1 ± 7.8	<0.001
RTS, Mean ± SD	5.42 ± 1.11	7.03 ± 0.81	<0.001
TRISS (%), Mean ± SD	73.6 ± 13.4	91.8 ± 7.6	<0.001
Mechanical Ventilation Required, n (%)	61 (63.5)	18 (11.7)	<0.001
Mortality, n (%)	19 (19.8)	4 (2.6)	<0.001

Patients with hospital stay >10 days had higher ISS (30.4 ± 8.2 vs. 20.2 ± 6.3) and NISS (34.9 ± 9.1 vs. 24.7 ± 7.5), but lower RTS (5.66 ± 1.18 vs. 6.98 ± 0.89) and TRISS survival probability (77.2 ± 12.6% vs. 90.6 ± 8.8%; p<0.001). Prolonged stay was also associated with more postoperative complications (46, 42.6%), higher reoperation rate (28, 25.9%), and lower independent ambulation at discharge (54, 50.0%).

Table 3: Association Between Injury Severity Indices and Clinical Outcomes

Variable	Hospital Stay ≤10 Days (n=142)	Hospital Stay >10 Days (n=108)	p-value
ISS, Mean ± SD	20.2 ± 6.3	30.4 ± 8.2	<0.001
NISS, Mean ± SD	24.7 ± 7.5	34.9 ± 9.1	<0.001
RTS, Mean ± SD	6.98 ± 0.89	5.66 ± 1.18	<0.001
TRISS (%), Mean ± SD	90.6 ± 8.8	77.2 ± 12.6	<0.001
Postoperative Complications, n (%)	18 (12.7)	46 (42.6)	<0.001
Reoperation Required, n (%)	9 (6.3)	28 (25.9)	<0.001
Functional Independent	119 (83.8)	54 (50.0)	<0.001

Ambulation at Discharge, n (%)			

Multivariable analysis showed ISS >25 strongly predicted ICU admission (AOR=3.82, 95% CI: 2.01–7.26; p<0.001), while RTS <6 and head injury were also significant predictors. NISS >30 was the strongest predictor of postoperative complications (AOR=3.57, 95% CI: 1.89–6.74; p<0.001), followed by open fracture and hospital stay >10 days. Mortality was most strongly predicted by TRISS <80% (AOR=4.69), followed by ISS >30 and need for mechanical ventilation.

Table 4: Multivariable Logistic Regression Analysis of Predictors of Poor Clinical Outcomes

Outcome	Predictor	Adjusted OR	95% CI	p-value
ICU Admission	ISS >25	3.82	2.01–7.26	<0.001
	RTS <6	3.11	1.63–5.94	0.001
	Associated Head Injury	2.64	1.39–5.01	0.003
Postoperative Complications	NISS >30	3.57	1.89–6.74	<0.001
	Open Fracture	2.48	1.29–4.77	0.006
	Hospital Stay >10 Days	2.18	1.16–4.09	0.015
In-Hospital Mortality	TRISS <80%	4.69	2.03–10.84	<0.001
	ISS >30	3.96	1.69–9.25	0.002
	Mechanical Ventilation	3.28	1.36–7.90	0.008

1. **Discussion** This retrospective study aimed to assess if there was a correlation between the severity of injuries measured by injury severity indices and clinical outcome in 250 polytrauma patients with musculoskeletal injury. The results showed that increased ISS and NISS and decreased RTS and TRISS were significantly correlated with poor clinical outcomes such as admission to intensive care unit (ICU), long hospital stay, postoperative complications, reoperation, and mortality. The present results illustrate the critical role of indices of injury severity in early risk stratification and prognosis of polytrauma patients. The mean age of the study population was 38.9 ± 15.7 years, with a higher proportion of males (72.8%). The leading cause of injuries was road traffic accidents (58.4%) followed by falls from height (24.4%). One-third of patients had open fractures and 35.2% had a head injury with musculoskeletal injuries. In a similar study, the primary group reported had been young adult males, and road traffic accidents (RTA) continued to be the most common mechanism of injury as it had been found that there was increased exposure to high energy trauma [16]. Most patients were severely injured and needed multidisciplinary treatment as evidenced by the average ISS (24.6 ± 8.9) and NISS (29.1 ± 10.2) results. Previous studies have shown that the anatomical injury severity scores are consistent with resource utilisation, intensive care needs and mortality in polytrauma patients [17]. Patients requiring ICU admission had significantly higher ISS (31.8 ± 7.6) and NISS (37.2 ± 8.9) together with lower RTS (5.42 ± 1.11) and TRISS survival probability (73.6 ± 13.4%). Additionally, mechanical ventilation use was greater in the ICU setting (63.5%) and mortality was significantly higher (19.8%). Similar findings have been shown in previous studies that severely injured patients with high ISS and NISS scores are significantly more likely to require intensive care support, prolonged ventilation and advanced resuscitative measures due to the high degree of physiological compromise [18]. The severity of the injury was highly correlated with hospital stay. Patients admitted to the hospital for over 10 days showed significantly higher ISS (30.4 ± 8.2) and NISS (34.9 ± 9.1) values, whereas RTS and TRISS values were significantly lower than those of patients who were discharged within 10 days. These patients were also more likely to have postoperative complications (42.6%), reoperation

(25.9%), and less likely to be ambulatory at their discharge (50.0%). Other studies have shown similar results that higher severity of injuries leads to longer recovery, delays mobilization, and to higher post injury morbidity associated with more injury severity and systemic complications. This was especially true in this study, where there was a clear link between the level of injury and the level of functional recovery. A greater proportion of patients o had a prolonged hospital stay were able to walk independently on their own when discharged than those who had a shorter hospital stay. Previous studies have also demonstrated that severe musculoskeletal trauma can lead to a significantly longer rehabilitation period and functional recovery, especially in the case of patients with associated head trauma and/or pelvic fracture [19]. Multivariable analysis revealed that ISS>25 was a significant independent predictor of needing to be hospitalized in the ICU, as was RTS<6 and the presence of head injury, which resulted in almost four times more likelihood of needing an ICU. Past studies have consistently shown ISS as one of the strongest anatomical measures of critical care admission, while physiological scores like RTS offer valuable information about the early physiological deterioration after trauma. Open fracture and long duration of hospital stay were next in line as risk factors for post-operative complications, with NISS >30 being the strongest risk factor. Preliminary studies have also shown that NISS was superior to ISS in predicting complications due to its ability to capture multiple severe injuries in the same body region; especially for individuals with complex musculoskeletal trauma. TRISS was most closely associated with in-hospital mortality, with patients with TRISS <80% having almost five times greater odds of death in hospital. Higher ISS and mechanical ventilation were also independently associated with mortality. In previous studies, TRISS has been found to be a great predictor of mortality when it combines the anatomical severity of injury, physiological status, age of the patient, and the mechanism of injury into one model [20]. Limitations This study has several limitations. First, its retrospective design may have introduced selection and information bias because the analysis relied on previously recorded clinical data. Second, the study was conducted at a single tertiary care center, which may limit the generalizability of the findings to other trauma populations and healthcare settings. Variations in prehospital care, resuscitation protocols, surgical techniques, and rehabilitation services may also have influenced clinical outcomes. Future prospective multicenter studies with standardized trauma management protocols and extended follow-up are recommended to validate these findings and further refine prognostic models for polytrauma patients. Conclusion The present study demonstrated a strong association between injury severity indices and clinical outcomes among polytrauma patients with musculoskeletal injuries. Higher Injury Severity Score (ISS) and New Injury Severity Score (NISS), together with lower Revised Trauma Score (RTS) and Trauma and Injury Severity Score (TRISS), were significantly associated with increased intensive care unit admission, prolonged hospital stay, postoperative complications, reoperation, and in-hospital mortality. ISS >25, NISS >30, RTS <6, and TRISS <80% independently predicted poor clinical outcomes, highlighting their value in early risk stratification and clinical decision-making. References

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