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The diagnostic accuracy of injury severity score and revised trauma score to predict mortality and hospital stay in polytrauma patients: A prospective cohort study.

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Abstract

Background
Trauma continues to be a significant global health concern, ranking as one of the leading causes of death and long-term disability worldwide. Each year, nearly 5 million individuals succumb to trauma-related injuries stemming from incidents such as road traffic accidents (RTAs), falls from height, violence, warfare, fires, and occupational hazards. Polytrauma is a leading cause of emergency admissions and mortality worldwide. Accurate trauma scoring systems like the Injury Severity Score (ISS) and Revised Trauma Score (RTS) help predict outcomes.
Objectives- This study compares ISS and RTS in assessing mortality and hospital stay in polytrauma patients.

Methods
A prospective observational, cohort study was conducted from March 2023 to February 2025 at KIMS, Bhubaneswar, including 147 patients aged 18–60 with injuries to two or more body regions. ISS and RTS were calculated, and patients were grouped accordingly. Outcomes such as mortality and hospital stay were recorded. Statistical analysis was done using SPSS and GraphPad Prism with a significance level of $p \leq 0.05$.

Results
Most patients were males (85.7%) aged 21–30 years, with road traffic accidents being the main cause (85.7%). Mean ISS was 25.07, and RTS was 10.59. Higher ISS and lower RTS were significantly associated with mortality ($p < 0.0001$). Age was also a significant predictor ($p = 0.0053$), while hospital stay did not differ significantly.

Conclusion
This prospective observational study highlights the clinical utility of the RTS and ISS as effective tools for predicting mortality and assessing injury severity among polytrauma patients.

Recommendations
It has been recommended that patients with RTS < 10 or ISS ≥ 20 should trigger senior review, expedited imaging, and ICU preparedness. Older patients, particularly those above 50 years, warrant heightened monitoring.

Keywords: *Polytrauma, Injury Severity Score, Revised Trauma Score, Mortality, Emergency Medicine*
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Introduction

Trauma continues to be a significant global health concern, ranking as one of the leading causes of death and long-term disability worldwide. Each year, nearly 5 million individuals succumb to trauma-related injuries stemming from incidents such as road traffic accidents (RTAs), falls from height, violence, warfare, fires, and occupational hazards [1]. RTAs, in particular, are the predominant cause of polytrauma, followed by assaults, falls, and work-related injuries [2]. In many industrialized nations, trauma stands as the third most common cause of mortality after cardiovascular diseases and cancer, with its incidence expected to rise further due to increasing urbanization and vehicular traffic [3]. Addressing this health crisis requires the implementation of a robust trauma care system—an organized, region-specific framework that encompasses prehospital care, emergency services, and hospital-based interventions guided by protocols like the Advanced Trauma Life Support (ATLS) guidelines [4].

Polytrauma refers to injuries affecting two or more body regions, with at least one injury severe enough to be potentially fatal. These cases often demand intensive care and surgical intervention, and they carry a high risk of mortality [5]. Among all trauma-related fatalities, thoracic injuries account for the highest proportion, followed by traumatic brain and spinal cord injuries, with chest trauma alone exhibiting a mortality rate ranging from 10% to 60% [6]. To predict clinical outcomes in such critical cases, several trauma scoring systems have been developed. These include anatomical scoring systems such as the Injury Severity Score (ISS) and physiological systems like the Revised Trauma Score (RTS), which are often used in emergency settings for prognosis and triage. The ISS, derived from the Abbreviated Injury Scale (AIS), calculates trauma severity by evaluating the most critically affected body regions, while the RTS incorporates parameters such as Glasgow Coma Scale (GCS), systolic blood pressure (SBP), and respiratory rate (RR) to forecast outcomes like mortality and length of hospital stay [7][8].

Effective trauma triage in both prehospital and hospital settings is crucial for improving patient survival, particularly in resource-limited environments. Inaccurate triage can lead to either under-triage, delaying care for severely injured patients, or over-triage, burdening tertiary facilities with minor cases and compromising care for others [9]. To improve accuracy, newer tools such as the New Trauma Score (NTS) have been developed. NTS modifies RTS by incorporating actual GCS values, replacing RR with oxygen saturation (SpO2), and adjusting SBP coding, which enhances both sensitivity and specificity [10]. This study was conducted to evaluate the diagnostic accuracy of RTS and ISS in predicting mortality and hospital stay among polytrauma patients admitted to KIMS Hospital, Patia, Bhubaneswar. Additionally, a related aim was to assess the relevance and reliability of these scores within the local population, contributing data to regions like Pakistan, where limited research exists on trauma scoring in emergency departments [11] [12].

Methods

Study design and setting

This prospective observational, cohort study was conducted in the Department of Emergency Medicine at Kalinga Institute of Medical Sciences (KIMS), PBMH, KIIT Deemed to be University, Bhubaneswar, Odisha.

Study duration and sample size

The study was conducted over two years from March 2023 to February 2025. Based on the study by Yadollahi et al. (2020), using an odds ratio of 6.04 for RTS in predicting mortality, a minimum sample size of 126 was calculated with 80% power and 95% confidence at a 5% significance level. Using the single population proportion formula, the sample size was established. The p-value was set at 0.5, and the margin of error was set at 0.05 because no prior comparable research had been conducted in India. The non-response rate was set at 10%.

Inclusion and exclusion criteria

Inclusion criteria included trauma patients aged 18–60 years, of either sex, presenting with injuries to two or more body regions.

Exclusion criteria included those discharged against medical advice and individuals with comorbidities such as COPD, CHF, CKD, CLD, diabetes, or hypertension.

Patient allocation and assessment

All eligible polytrauma patients underwent evaluation using both the Injury Severity Score (ISS) and Revised Trauma Score (RTS). Patients were categorized into two groups based on these scores:

Group A: ISS-based assessment (ISS <20 and ≥20)
Group B: RTS-based assessment (RTS <10 and ≥10)

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Efforts to reduce bias

This study may be subject to selection bias, as it included only patients who presented to a single tertiary care centre within the specified age range and met predefined inclusion criteria, excluding those with significant comorbidities or outside the 18–60-year range.

Data collection and scoring

Demographics, injury mechanism, and admission vitals (GCS, SBP, RR) were noted, ISS was calculated from clinical and radiological findings, and RTS from physiological parameters. Patients were monitored from admission until discharge or death to record mortality and hospital stay.

Outcome measures and analysis

The study aimed to compare the sensitivity and specificity of ISS and RTS in predicting mortality and length of hospital stay. Graphical representations and Area Under Curve (AUC) analyses were performed to assess diagnostic accuracy.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS v27.0 and GraphPad Prism v5. Descriptive statistics included means and standard deviations for continuous variables. A p-value ≤ 0.05 was considered statistically significant.

Ethical clearance

Ethical clearance was obtained from the Institutional Ethics Committee (IEC), KIMS, Bhubaneshwar, Odisha, India.

Informed consent

Written informed consent was obtained from all participants before their enrolment in the study.

Results

182 individuals who were suspected of having polytrauma showed up at the ED during the study period. 161 of these underwent eligibility testing following initial stabilization. Fourteen individuals had substantial pre-existing comorbidities, two had missing clinical data, and eight were eliminated because their ages did not fall within the 18–60 age range. The remaining 147 patients were enrolled after meeting the inclusion requirements. Every participant was tracked until they were released or passed away, and all outcome data was accessible. All 147 patients' data were incorporated into the final study.

The study involved 147 polytrauma patients, predominantly male (85.7%), with the majority aged between 21–30 years (40.1%). Road traffic accidents were the leading cause of injury (85.7%), and 86.4% of patients were successfully discharged, while the mortality rate was 13.6%. The most frequently involved trauma regions included the head, face, extremities, and external areas (11.56%) (Table 1).

Table 1: Demographic characteristics, injury profile, trauma regions, and score distribution among polytrauma patients (N = 147)

Parameter	Category/Value	Frequency (n)	Percentage (%) / Value
Age Group (Years)	≤ 20	7	4.8%
	21–30	59	40.1%
	31–40	38	25.9%
	41–50	31	21.1%
	51–60	12	8.2%
Gender	Male	126	85.7%
	Female	21	14.3%
Mode of Injury	Road Traffic Accident (RTA)	126	85.7%
	Fall from Height	16	10.9%
	Assault	5	3.4%
Outcome	Discharged	127	86.4%
	Mortality	20	13.6%

Among the 147 polytrauma patients, the mean RTS score was 10.59 ± 1.44, suggesting that most patients had moderate physiological impairment. The mean ISS score was 25.07 ± 7.69, indicating significant anatomical injury across the cohort. The average hospital stay was 9.47 ± 7.09 days, with a wide range from 1 to 38 days and a

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median of 8 days. These findings demonstrate that both trauma scores are valuable for assessing injury severity and predicting hospital stay duration, with higher ISS and lower RTS generally correlating with prolonged hospitalization and increased risk of mortality (Table 2).

Table 2: Summary of Revised Trauma Score (RTS), Injury Severity Score (ISS), and hospital stay among polytrauma patients (N = 147)

Parameter	Mean	Standard Deviation (SD)	Minimum	Maximum	Median
RTS Score	10.59	1.44	7.00	12.00	11.00
ISS Score	25.07	7.69	6.00	50.00	26.00
Hospital Stay (days)	9.47	7.09	1.00	38.00	8.00

Among the variables analyzed, age group showed a statistically significant association with outcome ($p = 0.0025$), indicating that mortality varied meaningfully across age brackets, with patients aged 51–60 years showing the highest mortality rate (50%). Gender and mode of injury were not significantly associated with outcomes, suggesting that mortality was relatively independent of these factors in this sample. The region of trauma approached statistical significance ($p = 0.0590$), implying that injury location may influence mortality, but did not meet the conventional cutoff for significance. These findings highlight age as a critical factor in outcome prediction among polytrauma patients (Table 3).

Table 3: Association of age, gender, mode of injury, and region of trauma with outcome in polytrauma patients (N = 147)

Variable	Chi-square Value	Degrees of Freedom (df)	p-value	Statistical Significance
Age Group vs Outcome	16.4396	4	0.0025	Significant
Gender vs Outcome	0.3472	1	0.5556	Not Significant
Mode of Injury vs Outcome	2.6429	2	0.2667	Not Significant
Region of Trauma vs Outcome	31.9670	21	0.0590	Borderline Significant

Significant differences were observed between discharged and mortality groups in terms of age, RTS score, and ISS score. Patients who died were older on average (mean age 40.7 vs. 33.4 years, $p = 0.0053$), had significantly lower RTS scores (8.35 vs. 10.94, $p < 0.0001$), and higher ISS scores (34.1 vs. 23.65, $p < 0.0001$), indicating more severe injuries and worse physiological profiles. Although the mean hospital stay was shorter in the mortality group (7.2 days) compared to discharged patients (9.83 days), this difference was not statistically significant ($p = 0.1240$). These findings support the predictive value of RTS and ISS scores for mortality in polytrauma patients (Table 4).

Table 4: Comparison of mean age, RTS score, ISS score, and hospital stay by outcome in polytrauma patients (N = 147)

Variable	Outcome	Mean	SD	Min	Max	Median	p-value	Statistical Significance
Age (years)	Discharged	33.40	10.44	19.00	58.00	32.00	0.0053	Significant
	Mortality	40.70	12.37	21.00	57.00	42.00		
RTS Score	Discharged	10.94	1.09	7.00	12.00	11.00	< 0.0001	Highly Significant
	Mortality	8.35	1.42	7.00	12.00	8.00		
ISS Score	Discharged	23.65	6.28	6.00	36.00	24.00	< 0.0001	Highly Significant
	Mortality	34.10	9.69	14.00	50.00	36.00		
Hospital Stay (days)	Discharged	9.83	7.21	2.00	38.00	8.00	0.1240	Not Significant
	Mortality	7.20	5.94	1.00	19.00	5.00		

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Discussion

The present prospective observational study was carried out from March 2023 to February 2025 in the Emergency Department of KIMS, PBMH, KIIT University, Bhubaneswar, including 147 polytrauma patients. The majority of the patients belonged to the 21–30 years age group (40.1%), which was statistically significant ($p = 0.0025$). The mean age was notably higher among patients who succumbed to their injuries (40.7 years) than those who were discharged (33.4 years), indicating age as a predictor of mortality ($p = 0.0053$). These findings align with the GAP scoring system used in a study, where age was considered a prognostic factor in trauma outcomes [13].

Gender distribution in this study revealed a predominance of male patients (85.7%), with a male-to-female ratio of nearly 6:1, though this difference was not statistically significant ($p = 0.5556$), consistent with results from Besra et al. [14]. Road traffic accidents (RTA) were the leading cause of polytrauma, accounting for 85.7% of all cases, but the association between mode of injury and outcome was not significant ($p = 0.2667$). This supports earlier findings by Wong et al., where RTA was the most common cause, and both RTS and ISS scores significantly predicted mortality and hospital stay [15]. Similarly, while patients with injuries involving the head, face, abdomen, and extremities showed higher mortality (35%) than those discharged (12.6%), the regional trauma distribution was only borderline significant ($p = 0.0590$), echoing trends reported by Ciechanowicz et al. [16].

Crucially, the study confirmed that lower RTS scores were significantly associated with higher mortality (mean RTS of 8.35 in mortality vs. 10.94 in discharged; $p < 0.0001$), reinforcing previous conclusions that RTS is a valuable physiological marker for trauma severity [17]. Similarly, higher ISS scores were significantly linked to poor outcomes (mean ISS of 34.1 in mortality vs. 23.65 in discharged; $p < 0.0001$). Although discharged patients had a slightly longer hospital stay on average (9.83 days) than those who died (7.2 days), this difference was not statistically significant ($p = 0.1240$), in contrast to findings in a study that reported RTS as a strong predictor of extended hospitalization [18]. Overall, both ISS and RTS proved to be effective tools in mortality prediction and trauma assessment.

Generalizability

The findings of this study are most applicable to similar tertiary care emergency settings in regions with comparable trauma patterns, particularly where road traffic accidents are a predominant cause of polytrauma.

Conclusion

This prospective observational study highlights the clinical utility of the Revised Trauma Score (RTS) and Injury Severity Score (ISS) as effective tools for predicting mortality and assessing injury severity among polytrauma patients. The findings demonstrate that older age, higher ISS, and lower RTS are significantly associated with increased mortality risk, while gender and mode of injury showed no significant impact on outcomes. Although longer hospital stays were observed in discharged patients, the difference was not statistically significant. Overall, RTS and ISS scores can serve as reliable prognostic indicators in the emergency setting, aiding in early risk stratification and informed clinical decision-making.

Limitations

Since this study was conducted in a single urban tertiary care facility, it may not be feasible to extrapolate the findings to the broader population. Additionally, the study's sample size was too small to draw conclusions and extrapolate findings.

Recommendations

It has been recommended that patients with RTS < 10 or ISS ≥ 20 should trigger senior review, expedited imaging, and ICU preparedness. Older patients, particularly those above 50 years, warrant heightened monitoring. Embedding score calculators into triage systems, linking them to trauma activation protocols, and ensuring regular staff training can improve timely interventions.

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List of abbreviations

ISS- Injury Severity Score
RTS- Revised Trauma Score
RTA- Road Traffic Accident
GCS- Glasgow Coma Scale
SBP- Systolic Blood Pressure

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RR- Respiratory Rate
ICU- Intensive Care Unit
MTP- Massive Transfusion Protocol
AUC- Area Under the Curve
KIMS- Kalinga Institute of Medical Sciences

Source of funding

There was no external funding; the study was self-funded by the department.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

All authors contributed to the study design, data collection, analysis, and manuscript preparation.

Data availability

The data generated during this study are available from the corresponding author upon reasonable request.

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