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Predictive Accuracy of RTS, ISS And TRISS for In-Hospital Mortality in Trauma Patients: A Prospective Observational Study

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Abstract

Background:
Trauma remains a major cause of morbidity and mortality worldwide, particularly among young adults. Trauma scoring systems such as the Revised Trauma Score (RTS), Injury Severity Score (ISS), and Trauma and Injury Severity Score (TRISS) are widely used to assess injury severity and predict outcomes. However, their comparative performance in predicting mortality varies across populations, and data from Indian trauma cohorts remain limited.

Methods:
This prospective observational cohort study was conducted at a tertiary care teaching hospital—MGM Medical College and Hospital, Navi Mumbai, India—from August 2022 to January 2024. A total of 150 adult trauma patients presenting to the emergency department were included. RTS, ISS, and TRISS were calculated using standard published methods. The primary outcome was in-hospital mortality. Predictive accuracy of the scoring systems was assessed using receiver operating characteristic (ROC) curve analysis.

Results:
Of the 150 patients studied, 69 (46%) died during the hospital stay. All three trauma scoring systems demonstrated a statistically significant association with in-hospital mortality ($p < 0.001$). On ROC curve analysis, TRISS demonstrated the highest discriminatory ability for predicting mortality, with an area under the curve (AUC) of 0.919, followed by RTS (AUC 0.892) and ISS (AUC 0.854).

Conclusion:
RTS, ISS, and TRISS are useful tools for predicting in-hospital mortality in trauma patients. Among the three scoring systems, TRISS showed the highest predictive accuracy in the present study, highlighting the advantage of combining physiological and anatomical parameters. These findings support the continued use of trauma scoring systems for outcome prediction and risk stratification in trauma care settings.

Keywords: Trauma, Injury Severity Score, Revised Trauma Score, Trauma and Injury Severity Score, In-Hospital Mortality, Trauma Scoring Systems, Trauma Surgery

Introduction

Traumatic injury is defined as damage to the body caused by an exchange with environmental energy that exceeds the body's physiological resilience [1]. Trauma is a global public health problem and a major cause of morbidity and mortality worldwide. It predominantly affects young individuals and is the

leading cause of death in the first four decades of life [2]. This results in a substantial societal burden due to both direct healthcare costs and indirect socioeconomic losses [2]. Various mechanisms of trauma, including road and railway traffic incidents, falls, interpersonal violence, self-inflicted injuries, and burns, account for approximately five million deaths globally each year, contributing to nearly 9% of worldwide mortality [3].

India bears a disproportionate share of this burden and reports one of the highest rates of road traffic accidents globally [3]. Mortality rates among severely injured patients have been reported to range from 7% to 45% [4]. Such wide variation may be attributed to differences in injury severity, patient demographics, availability of trauma care facilities, and variability in therapeutic interventions. In view of these differences in prognostic factors, there is a need for reliable and objective tools to assess injury severity and predict patient outcomes [5]. Road traffic accidents remain the most common cause of trauma-related mortality in India, placing a significant strain on the healthcare system [4].

Quantitative assessment of trauma severity has several important applications, including patient triage, standardized communication of injury severity, prognostication, trauma care audit, and epidemiological research [6]. Trauma scoring systems enable objective quantification of injury burden and outcome probability, thereby facilitating identification of gaps between initial presentation and definitive management [7]. The development of nearly 50 trauma scoring systems reflects both the clinical importance of such tools and their inherent limitations in fulfilling all clinical requirements.

To standardize assessment of trauma severity, various scoring systems have been developed based on physiological parameters, anatomical injury patterns, or a combination of both. Trauma scores may broadly be classified as anatomical, physiological, or combined scoring systems. Anatomical scores such as the Abbreviated Injury Scale and Injury Severity Score quantify injury burden based on lesion severity, while physiological scores such as the Revised Trauma Score are derived from parameters recorded during initial clinical evaluation. Combined scores, notably the Trauma and Injury Severity Score, integrate physiological variables, anatomical injury severity, and age to estimate survival probability [8].

The Revised Trauma Score is based on systolic blood pressure, respiratory rate, and Glasgow Coma Scale and is widely employed for early triage and initial assessment [9]. The Abbreviated Injury Scale provides a standardized description of anatomical injuries and forms the basis for calculation of the Injury Severity Score, which is commonly used to classify trauma severity [10]. The Trauma and Injury Severity Score, introduced in 1981, combines physiological and anatomical indices with age to predict survival probability and has been demonstrated to be a powerful predictor of outcomes in trauma patients [11].

Despite the widespread use of RTS, ISS, and TRISS, their predictive accuracy varies across populations and healthcare systems. In the Indian context, limited studies have evaluated and compared these scoring systems, particularly the performance of TRISS in predicting mortality [8,10,12]. Given the importance of early and accurate prognostication in trauma care, the present study was undertaken to compare the predictive accuracy of Revised Trauma Score, Injury Severity Score, and Trauma and Injury Severity Score in estimating in-hospital mortality among trauma patients presenting to a tertiary care centre in India.

Aim & Objectives

Aim:

To compare the predictive accuracy of the Revised Trauma Score (RTS), Injury Severity Score (ISS), and Trauma and Injury Severity Score (TRISS) in predicting in-hospital mortality among trauma patients presenting to a tertiary care centre in India.

Objectives:

1. To calculate RTS, ISS, and TRISS for trauma patients at presentation.
2. To determine the association between each trauma scoring system and in-hospital mortality.
3. To compare the discriminative ability of RTS, ISS, and TRISS in predicting mortality using receiver operating characteristic (ROC) curve analysis.
4. To identify the trauma scoring system with the highest predictive accuracy for mortality in the study population.

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Materials & Methods

Study design:

Prospective observational cohort study

Study setting:

The study was carried out in the Department of General Surgery, MGM Medical College and Hospital, Navi Mumbai, a tertiary care teaching hospital.

Study duration:

The study was conducted over a period of 18 months, from August 2022 to January 2024.

Ethical considerations:

Approval was obtained from the Institutional Ethics Committee of MGM Medical College and Hospital prior to the commencement of the study. Written informed consent was obtained from all patients or their legally authorized representatives after explaining the nature and purpose of the study in a language understood by them.

Study population:

All adult patients presenting to the emergency department of MGM Medical College and Hospital with a history of traumatic injury during the study period were assessed for eligibility.

Sample size and sampling method:

A total of 150 patients were included in the study. Patients were enrolled using a convenience sampling method based on predefined inclusion and exclusion criteria.

Inclusion criteria:

1. Patients aged 18 years and above
2. Patients presenting with trauma due to:
3. Road traffic accidents
4. Falls from height
5. Assault causing blunt or penetrating injury
6. Crush injuries

Exclusion criteria:

1. Patients aged below 18 years
2. Patients declared dead on arrival
3. Patients who did not complete the course of treatment
4. Pregnant women
5. Patients with burn injuries
6. Patients who did not provide informed consent

Data collection:

Demographic data, mechanism of injury, clinical findings, and investigation results were recorded using a structured case record proforma.

Physiological parameters:

1. The following physiological variables were recorded at the time of admission:
2. Systolic blood pressure, measured using a manual sphygmomanometer
3. Respiratory rate, measured manually or using an automated monitor
4. Glasgow Coma Scale (GCS) score, assessed according to standard criteria

Anatomical injury assessment:

All injuries were classified according to the Abbreviated Injury Scale (AIS). The Injury Severity Score (ISS) was calculated by summing the squares of the highest AIS scores in the three most severely injured body regions.

Trauma scoring systems:

Revised Trauma Score (RTS):

RTS was calculated using Glasgow Coma Scale, systolic blood pressure, and respiratory rate according to the standard weighted formula:

RTS = (0.9368 × GCS code) + (0.7326 × SBP code) + (0.2908 × RR code)

Injury Severity Score (ISS):

ISS was calculated as the sum of squares of the highest AIS scores in the three most severely injured body regions, with scores ranging from 1 to 75.

Trauma and Injury Severity Score (TRISS):

TRISS was calculated to estimate the probability of survival using RTS, ISS, age index, and mechanism of injury (blunt or penetrating), based on the standard logistic regression equations.

Standardized electronic calculators were used for the computation of all trauma scores.

Outcome measure:

The primary outcome of the study was in-hospital mortality.

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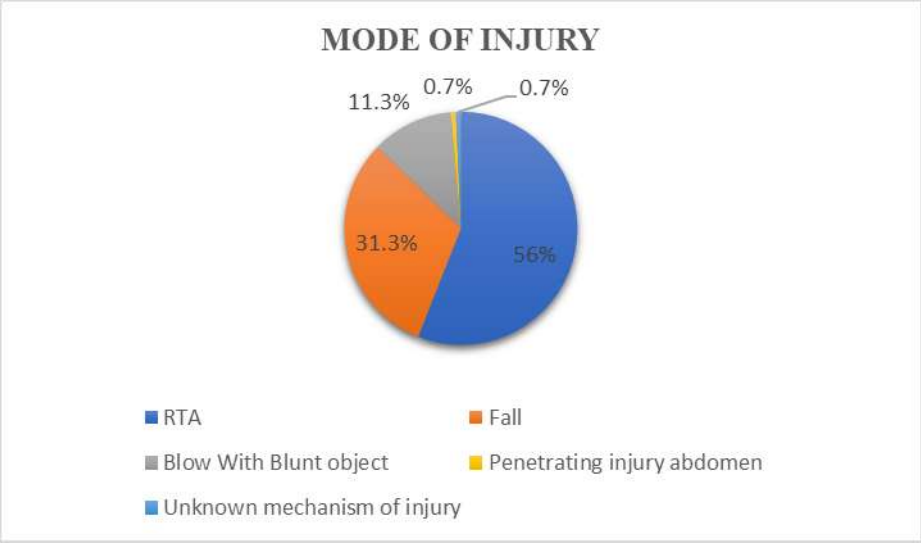
Statistical analysis:

Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 27. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Comparisons between survivors and non-survivors were performed using appropriate statistical tests. The predictive accuracy of RTS, ISS, and TRISS was assessed using receiver operating characteristic (ROC) curve analysis. A p-value < 0.05 was considered statistically significant.

Observations And Results

Figure 1. Mode Of Injury



The most common mode of injury among the participants was road traffic accidents (RTA), accounting for 84 cases (56.0%). Falls were the second most common, with 47 cases (31.3%), followed by injuries caused by a blow with a blunt object, which accounted for 17 cases (11.3%). Penetrating abdominal injuries and injuries from unknown mechanisms each accounted for 1 case (0.7%).

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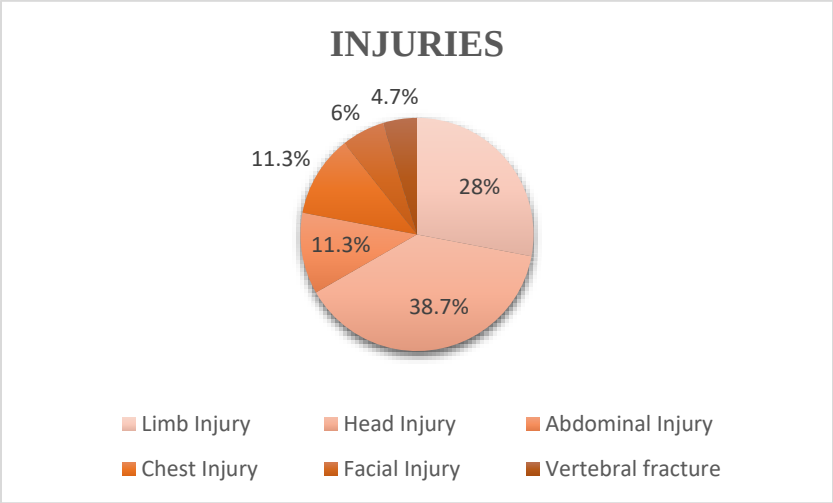
Figure 2. Injuries



Head injuries were the most predominant, occurring in 58 participants (38.7%), followed by limb injuries in 42 participants (28.0%). Abdominal and chest injuries each accounted for 17 cases (11.3%), facial injuries were seen in 9 participants (6.0%), and vertebral fractures occurred in 7 participants (4.7%).

TABLE 1. VITAL PARAMETERS

Vital parameters	Mean	Std. Deviation
SBP	111.67	25.363
RR	17.86	5.175

The mean systolic blood pressure (SBP) of the participants was 111.67 ± 25.363 mmHg, and the mean respiratory rate (RR) was 17.86 ± 5.175 breaths per minute.

TABLE 2. GLASGOW COMA SCALE (GCS)

	Mean	Std. Deviation
GCS	12.52	3.696

The mean Glasgow Coma Scale (GCS) score among the participants was 12.52 ± 3.696.

TABLE 3. ABBREVIATED INJURY SCALE (AIS) POINTS

	Mean	Std. Deviation
AIS	3.57	1.648

The mean Abbreviated Injury Scale (AIS) points among the participants was 3.57 ± 1.648.

TABLE 4. SCORING SYSTEMS

SCORING SYSTEMS	Mean	Std. Deviation
RTS	7.040279	1.2477199

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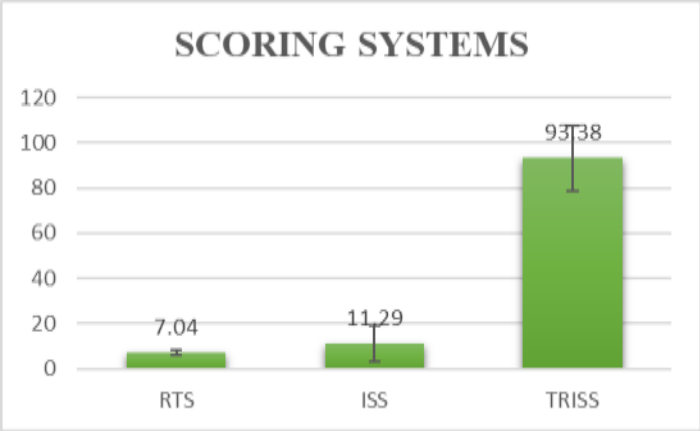
ISS	11.29	7.895
TRISS	93.3813	14.49029

FIGURE 3. SCORING SYSTEMS



The mean RTS was 7.040 ± 1.248, the mean ISS was 11.29 ± 7.895, and the mean TRISS was 93.38 ± 14.49.

TABLE 5. Association of TRISS scoring with ISS and RTS.

		TRISS
RTS	Pearson Correlation	-0.583
	P value	**0.000**
ISS	Pearson Correlation	0.760
	P value	**0.000**

The correlation between TRISS and RTS showed a Pearson correlation coefficient of -0.583, which was statistically significant (p = 0.000). The correlation between TRISS and ISS had a Pearson correlation coefficient of 0.760, also statistically significant (p = 0.000).

TABLE 6. MORTALITY

MORTALITY	**FREQUENCY**	**PERCENT**
Yes	69	46.0
No	81	54.0

Among the participants, 69 (46.0%) died, and 81 (54.0%) survived. Additionally, 46% of the study participants experienced shock.

TABLE 7. ASSOCIATION OF SCORING SYSTEMS WITH THE OUTCOME OF THE STUDY.

Scoring systems	**Alive**		**Dead**		**P value**
	Mean	**S. D**	**Mean**	**S. D**	

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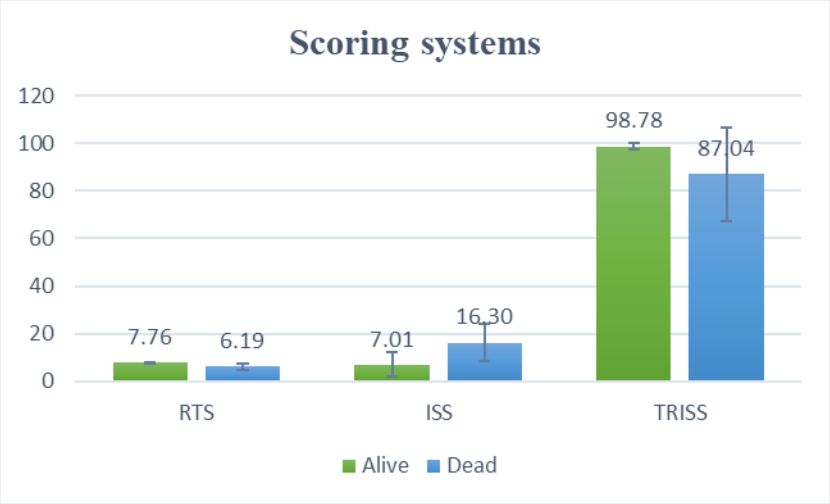
RTS	7.760881	.3533793	6.194354	1.3855206	**<0.001**
ISS	7.01	5.051	16.30	7.697	**<0.001**
TRISS	98.7835	1.21197	87.0396	19.56473	**<0.001**

FIGURE 4. ASSOCIATION OF SCORING SYSTEMS WITH THE OUTCOME OF THE STUDY



The mean RTS for survivors was 7.76 ± 0.353, whereas for those who died, it was 6.19 ± 1.386, with a statistically significant p-value of <0.001. The mean ISS for survivors was 7.01 ± 5.051, and for those who died, it was 16.30 ± 7.697, also statistically significant with a p-value of <0.001. The mean TRISS for survivors was 98.78 ± 1.212, and for those who died, it was 87.04 ± 19.565, with a p-value of <0.001.

TABLE 8. Predictive Accuracy of Scoring Systems

SCORING SYSTEMS	Area	P value	Asymptotic 95% CI	
			Lower Bound	Upper Bound
RTS	0.892	**<0.001**	0.833	0.950
ISS	0.854	**<0.001**	0.796	0.913
TRISS	0.919	**<0.001**	0.878	0.960

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ISS

Area Under the Curve

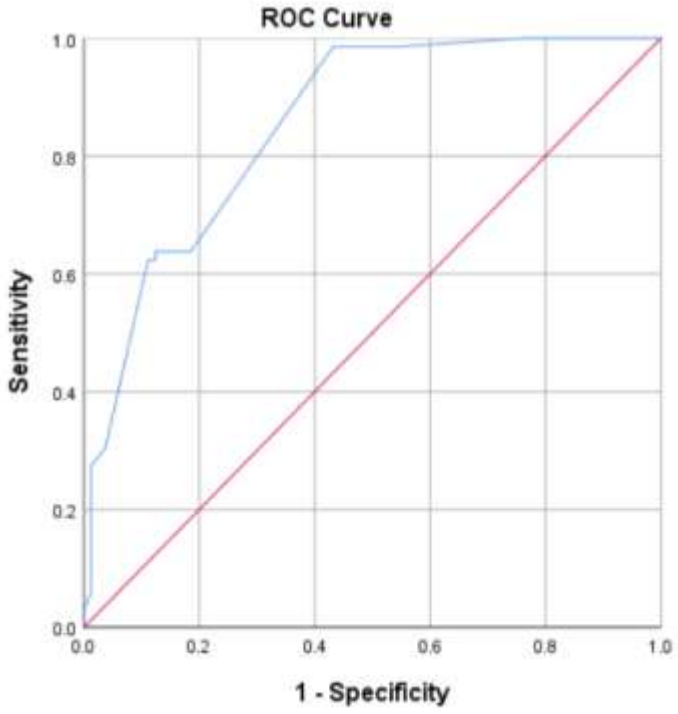
Test Result Variable(s): iss

Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.854	.030	.000	.796	.913

The test result variable(s): iss has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

a. Under the nonparametric assumption

b. Null hypothesis: true area = 0.5



Interpretation:

ROC analysis showed that the Injury Severity Score (ISS) had good discriminatory ability for predicting in-hospital mortality in this cohort. The area under the ROC curve (AUC) was 0.854 (SE 0.030), which was significantly greater than chance ($p<0.001$), with a 95% confidence interval of 0.796–0.913, indicating robust performance. Clinically, this AUC implies that in a randomly selected pair of patients—one who died and one who survived—there is an ~85% probability that the non-survivor would have a higher ISS than the survivor, supporting ISS as a reliable marker of mortality risk stratification.

RTS

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Area Under the Curve

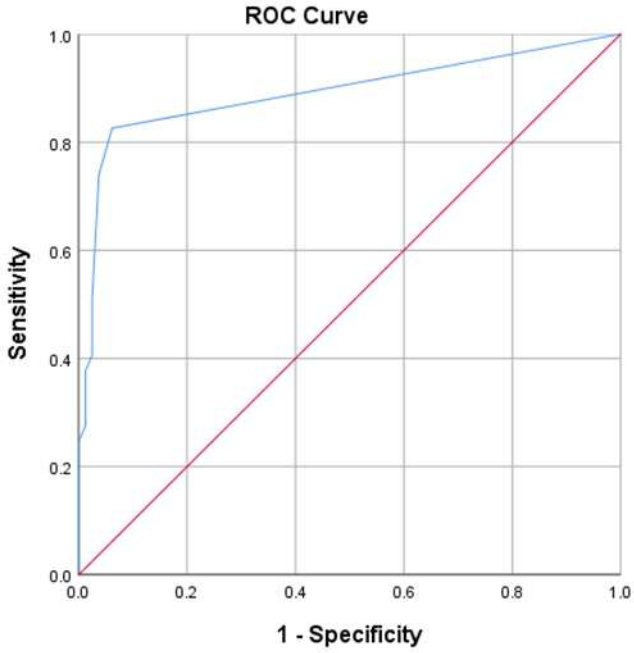
Test Result Variable(s): RTS_death

Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.892	.030	.000	.833	.950

The test result variable(s): RTS_death has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

a. Under the nonparametric assumption

b. Null hypothesis: true area = 0.5



Interpretation:

Receiver operating characteristic (ROC) analysis demonstrated that RTS exhibited excellent discriminatory ability for predicting in-hospital mortality. The area under the curve (AUC) was 0.892 (SE 0.030), which was highly statistically significant ($p<0.001$), with a 95% confidence interval of 0.833–0.950, indicating strong precision and robustness of the estimate. This AUC signifies that there is an approximately 89% probability that a randomly selected patient who died would have a worse RTS value compared with a survivor, confirming the strong prognostic value of physiological derangement at presentation.

TRISS

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Area Under the Curve

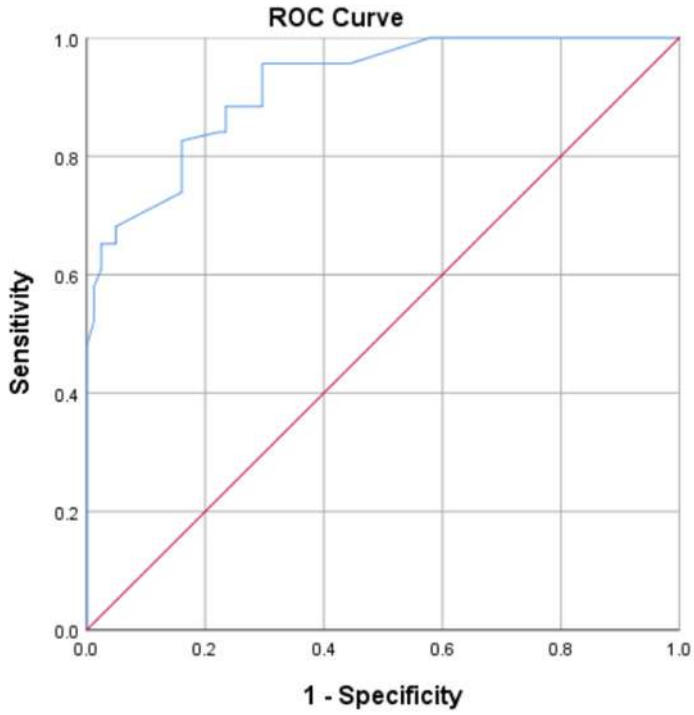
Test Result Variable(s): TRISS_death

Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.919	.021	.000	.878	.960

The test result variable(s): TRISS_death has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

a. Under the nonparametric assumption

b. Null hypothesis: true area = 0.5



Interpretation:

Receiver operating characteristic (ROC) analysis showed that TRISS had excellent discriminatory performance for predicting in-hospital mortality. The area under the curve (AUC) was 0.919 with a standard error of 0.021, which was highly statistically significant ($p<0.001$), and the 95% confidence interval ranged from 0.878 to 0.960, indicating a precise and robust estimate. This AUC indicates that there is an approximately 92% probability that a randomly selected non-survivor would have a worse TRISS value than a survivor, underscoring the strong prognostic value of this composite score integrating physiological, anatomical, age, and mechanism-related variables.

Discussion

This study evaluated the predictive performance of the Revised Trauma Score (RTS), Injury Severity Score (ISS), and Trauma and Injury Severity Score (TRISS) in trauma patients. Our results demonstrated significant associations between these scoring systems and in-hospital survival, with all three scores showing good discriminatory ability, consistent with findings from previous studies.

Revised Trauma Score (RTS)

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The mean RTS was 7.76 ± 0.35 among survivors and 6.19 ± 1.39 among non-survivors ($p < 0.001$). This aligns with the study by Champion et al. [12], which demonstrated that higher RTS scores are associated with better survival outcomes, confirming its utility in early trauma assessment.

Injury Severity Score (ISS)

Survivors had a mean ISS of 7.01 ± 5.05, whereas non-survivors had a mean ISS of 16.30 ± 7.70 ($p < 0.001$). Baker et al. [13] established ISS as a key indicator of trauma severity and mortality risk. Higher ISS scores reflect more extensive anatomical injury, which in our study corresponded with increased mortality.

Trauma and Injury Severity Score (TRISS)

The mean TRISS was 98.78 ± 1.21 in survivors and 87.04 ± 19.57 in non-survivors ($p < 0.001$). Boyd et al. [14] developed TRISS to estimate survival by combining physiological and anatomical injury severity with age. In our study, TRISS demonstrated excellent discriminatory ability on ROC analysis, reflecting its advantage in integrating physiological, anatomical, age, and mechanism-related variables into a single predictive model.

TRISS as the superior predictor

In our study, TRISS demonstrated the highest predictive accuracy for mortality, as evidenced by the largest area under the ROC curve among the three scoring systems. This finding highlights the benefit of combining physiological and anatomical parameters with patient age and mechanism of injury when estimating survival in trauma patients.

Clinical implication

These findings suggest that while RTS, ISS, and TRISS are all valuable for trauma assessment, TRISS may provide the most reliable prediction of in-hospital mortality in tertiary care settings where physiological parameters on admission may not fully capture evolving injury severity.

Limitations

Our study has several limitations. The sample size, although adequate for statistical analysis, may limit the generalizability of our findings to broader populations. The study was conducted in a single tertiary care centre, which may introduce selection bias. Additionally, variations in trauma care practices and protocols across different institutions could affect the applicability of our results to other settings.

Recommendations

Based on our findings, the following recommendations are suggested:

1. Standardized training for healthcare professionals in the use of trauma scoring systems should be implemented to ensure consistent and accurate assessments.
2. Multicentre prospective studies are warranted to validate these findings across diverse populations and healthcare settings.
3. Integration of trauma scoring systems into national trauma registries should be considered to improve data collection, quality of care, and patient outcomes.

Conclusion

This study demonstrates that RTS, ISS, and TRISS are all effective predictors of in-hospital mortality in trauma patients. Among the three scoring systems, the Trauma and Injury Severity Score showed the highest predictive accuracy, suggesting it may be the most reliable tool for mortality prediction in this cohort. These findings support the continued use of standardized trauma scoring systems to facilitate early risk stratification, inform clinical decision-making, and aid trauma care audit in tertiary care centres.

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Ethical Approval:

Approved by the **Institutional Ethics Committee of MGM Medical College, Navi Mumbai.**

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