Section: General Surgery

Original Research Article

EVALUATION OF TRISS SCORING SYSTEM FOR PREDICTING OUTCOMES OF MULTIPLE TRAUMA PATIENTS

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ABSTRACT

Background: Trauma scoring systems, such as the Trauma and Injury Severity Score (TRISS), integrate physiological, anatomical, and age-related factors to quantify the severity of injury and predict patient outcomes. TRISS provides a standardised framework for trauma care, facilitating accurate prognostication. This study aimed to evaluate the effectiveness of TRISS in predicting mortality and morbidity outcomes in multiple trauma patients and compare its predictive accuracy with that of ISS and RTS.

Materials and Methods: This longitudinal observational study included 100 patients with multiple traumas at Thiruvarur Medical College and Hospital over one year. The data collected included patient demographics, injury characteristics, RTS and ISS scores, initial and subsequent TRISS scores, and clinical outcomes (mortality, ICU admission, surgical intervention, and hospital stay duration).

Results: Males predominated (60%), and the most affected age group was 41–50 years (22%). Blunt injuries were the most common, primarily caused by road traffic accidents (64%), and affected the extremities (55%), abdomen (56%), and head (52%). The ICU admission rate was 30%, and mortality occurred in 13% of the patients. The mean ISS was significantly higher in fatalities (40.08) than in survivors (6.34, $P < 0.001$). ROC analysis demonstrated high predictive accuracy for all scoring systems, with AUC values of 1.00 for ISS and TRISS and 0.95 for RTS. An ISS cutoff of 27.5 and a TRISS cutoff of 82.5 demonstrated perfect discrimination for mortality prediction.

Conclusion: This study validated the high accuracy of the TRISS in predicting trauma outcomes, showing strong correlations with ISS and RTS scores. These findings reinforce the value of the TRISS in guiding trauma care decisions, although periodic recalibration is necessary to adapt to evolving trauma management practices.

Keywords: Trauma and Injury Severity Score (TRISS), Injury Severity Score (ISS), Revised Trauma Score (RTS), Trauma severity assessment, Mortality prediction, ROC curve analysis.

INTRODUCTION

Traumatic damage is defined as the physical harm caused by contact with external forces that surpass the body's ability to endure them.[1] Trauma is a major global health concern and a primary cause of morbidity and death. It mostly affects younger populations and is the leading cause of mortality in people aged < 40 years.[2,3] India ranks fourth in the world for road traffic accidents, with fatality rates among severely injured patients ranging from 7% to 45%.4 These differences in mortality may represent differences in treatment results or may be affected by variables such as injury severity and age. Given the heterogeneity of prognostic markers, a technique that accounts for these disparities when assessing trauma outcomes is required.[5]

Trauma evaluations are used to assess the severity of injuries and convert the complexity of trauma into numerical values. These scores allow doctors to uniformly describe injury severity.[6] Quantitative assessment of injury severity is critical for research, patient outcome evaluation, care quality improvement, and the implementation of effective preventative programs. Trauma research has primarily focused on establishing trauma severity indices. Approximately 50 grading systems are available for categorizing trauma patients, illustrating both the need for such tools and difficulties in designing a generally applicable system.[7]

The Trauma and Injury Severity Score (TRISS), first used in 1981, is a composite score that combines the Revised Trauma Score (RTS), Injury Severity Score (ISS), and patient age. A study showed that integrating physiological and anatomical parameters with age is a strong predictor of outcomes in patients with trauma. They created the TRISS by combining trauma and injury severity ratings with age to create a new index that improved the prediction accuracy of trauma prognosis.[7-10]

Trauma scoring systems may be anatomical (ISS), physiological (RTS), or combined. Physiological scores are frequently recorded at the initial clinical assessment, while anatomical values are calculated following stabilisation. The technique enables better classification of trauma casualties. Combined scores, both anatomical and physiological, can be used for predicting patient outcomes. The TRISS of the Major Trauma Outcome Study (MTOS) of the United States integrates the ISS and RTS to predict the prognosis of multiple injured patients.11 In India, there is not much evidence on the application of various trauma scoring systems, including TRISS, to predict outcomes of patients.[11-13]

Aim

This study aimed to evaluate the effectiveness of the TRISS in predicting mortality and morbidity outcomes, including the need for intensive care unit (ICU) admission and surgical intervention, among multiple trauma patients at a tertiary care centre.

MATERIALS AND METHODS

This longitudinal observational study included 100 patients admitted with multiple traumas at the TAEI ward of Thiruvarur Medical College and Hospital from December 2022 to December 2023. The study was approved by the Institutional Human Ethics Committee, and informed consent was obtained from all participants before enrolment.

Inclusion Criteria

Patients of any sex aged ≥ 12 years who were admitted with multiple traumas were included in the study.

Exclusion Criteria

Patients who left against medical advice, declined to participate or had isolated injuries were excluded from the study.

The patients were enrolled prospectively, and their information was obtained on a standardised case record form covering demographic information, trauma characteristics, severity scores, and clinical results of the patients. Demographic information consisted of age and gender. The trauma variables consisted of the nature, mechanism, and area of injury.

The physiological and clinical parameters at the time of admission were the Glasgow Coma Scale (GCS), ISS, RTS, and TRISS, which were revisited as and when required throughout hospitalization. Apart from that, vital parameters such as systolic and diastolic blood pressure, heart rate, respiratory rate, and oxygen saturation (SpO_2) were taken at admission.

Outcomes measured in the patients were mortality, admission to ICU, requirement of surgical intervention, and hospital stay.

Statistical Analysis

Information was entered into MS Excel and was analysed by SPSS version 16. Descriptive statistics were employed to present the information. Categorical data are represented as numbers and percentages, and continuous data are given as mean ± standard deviation (SD) or median (range), where appropriate.

To compare the predictive validity of the ISS, RTS, and TRISS with mortality, receiver operating characteristic (ROC) curve analysis and computation of the area under the curve (AUC) with 95% confidence intervals (CIs) was undertaken. Additionally, the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were estimated for each scoring system.

For statistical comparisons, intergroup analyses were conducted using the Student's t-test or Mann-Whitney U test for continuous variables and the chi-square test for categorical variables. Statistical significance was set at P-value < 0.05.

RESULTS

The majority of trauma patients were aged 41–50 years (22%). This was followed by 21% of patients aged 21–30 years and 20% aged 31–40 years. The gender distribution showed that 60% of the patients were male and 40% were female. Road traffic accidents (RTA) were the predominant cause, involving 64 patients, and falls were the second most common cause (22 patients). The majority of injuries were blunt, affecting 87 patients, and penetrating injuries were less common (13 patients).

Injuries to the extremities and abdomen were the most prevalent, affecting 55 and 56 patients, respectively. Head injuries were also common, involving 52 patients. Chest trauma was slightly less frequent, occurring in 37 patients. Thirty trauma patients required admission to the Intensive Care Unit (ICU), and most patients (70) did not require ICU admission. A total of 87 patients survived their traumatic events and 13 died (Table 1).

Table 1: Demographic and clinical characteristics of trauma patients: age, gender, injury profile, and outcomes

		No of patients	Percentage
AGE	<20	5	5%
	21-30	21	21%
	31-40	20	20%
	41-50	22	22%
	51-60	17	17%
	>61	15	15%
Gender	Female	40	40%
	Male	60	60%
Mode of injury	Assault	14	14%
	Fall	22	22%
	RTA	64	64%
Nature of Injury	Blunt	87	87%
	Penetrating	13	13%
Region of trauma	Abdomen	56	56%
	Chest	37	37%
	Extremity	55	55%
	Head	52	52%
ICU admission	No	70	70%
	Yes	30	30%
Mortality	No	87	87%
	Yes	13	13%

The mean GCS score was 9.83±2.72 and the mean ISS score was 10.73±12.50. The RTS averaged 8.15±1.07 and the TRISS probability of survival score averaged 84.73±12.65. Physical examination findings on vital signs included a mean systolic blood pressure (SBP) of 129.40±16.19 and diastolic blood pressure (DBP)of 89.30±13.05 within normal limits. The heart rate averaged 88.52±7.38 bpm and the respiratory rate (RR) was 16.73±5.54 bpm. Specific injury scores were also calculated, with a mean of 3.23±0.76 for head injury. Chest injuries averaged 2.32±0.63, while abdominal trauma had a mean of 1.52±1.16 (Table 2).

Table 2: Clinical and injury severity scores

	Mean	Standard Deviation
Head injury	3.23	0.76
Chest injury	2.32	0.63
Abdomen injury	1.52	1.16
SBP	129.40	16.19
DBP	89.30	13.05
HR	88.52	7.38
RR	16.73	5.54
GCS	9.83	2.72
ISS	10.73	12.50
RTS	8.15	1.07
TRISS	84.73	12.65

Patients who did not survive exhibited a significantly higher mean ISS of 40.08±8.25 compared to survivors with a mean ISS of 6.34±4.56. RTS recorded a lower average of 6.51±0.85 versus 8.39±0.86 for the survivors. In the TRISS, a combination of anatomical and physiological assessments, the mean score was 88.93±3.74 for survivors compared with a significantly lower score of 56.62±15.33 for non-survivors (Table 3).

Table 3: Comparative analysis of injury and physiological scores by mortality outcome

Mortality	Scores		
	ISS (Mean ± SD)	RTS (Mean ± SD)	TRISS (Mean ± SD)
Yes	40.08 ± 8.25	6.51 ± 0.85	56.62 ± 15.33
No	6.34 ± 4.56	8.39 ± 0.86	88.93 ± 3.74

All 13 patients with an ISS > 27.50 succumbed to their injuries, resulting in a 100% mortality rate among severely injured patients. None of the patients with ISS < 27.50 died, leading to a 0% mortality rate in this category. The area under the ROC curve (AUC) for ISS was 1.00, with a sensitivity, specificity, PPV, NPV, and overall accuracy of 100% ($P < 0.0001$) (Figure 1).

Regarding the RTS, a value > 7.35 was associated with a low mortality rate, as only one of 79 patients in this group died (1.26% mortality). In contrast, an RTS ≤ 7.35 was associated with a significantly higher mortality rate, with 12 of 21 patients (57.14%) succumbing to their injuries. The AUC for RTS was 0.95, with a sensitivity of 89.66%, specificity of 92.32%, PPV of 98.73%, NPV of 57.14%, and an overall accuracy of 90% (P < 0.0001) (Figure 2).

For the TRISS, no patients with a TRISS > 82.50 died, with all 87 patients surviving (100%). All 13 patients with a TRISS ≤ 82.50 died (100% mortality). The AUC for TRISS was 1.00, with a sensitivity, specificity, PPV, NPV, and accuracy all at 100.00% (P < 0.0001) (Figure 3 and Table 4).

Table 4: Diagnostic performance of ISS, RTS, and TRISS in predicting mortality

Scores		ISS	RTS	TRISS
Cut-off Value		>27.50	≤7.35	≤82.50
Mortality	Yes (n)	13	12	13
	No (n)	0	9	0
AUC		1	0.95	1
P-Value		<0.0001	<0.0001	<0.0001
Sensitivity (%)		100	89.66	100
Specificity (%)		100	92.32	100
PPV (%)		100	98.73	100
NPV (%)		100	57.14	100
Accuracy (%)		100	90	100

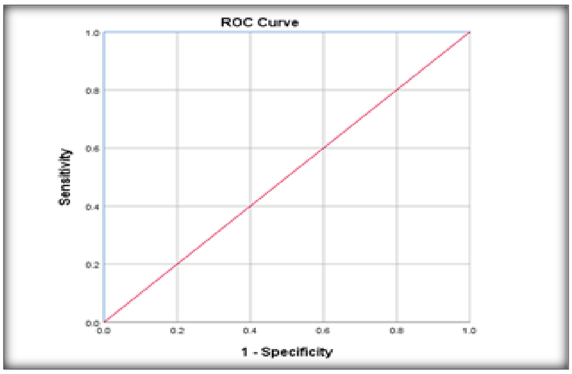

Figure 1: ROC Curve Analysis of ISS

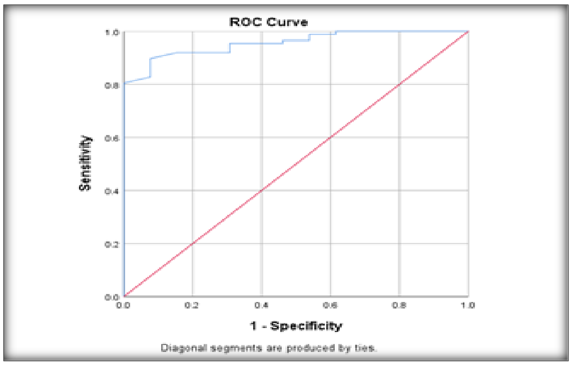

Figure 2: ROC Curve Analysis of RTS

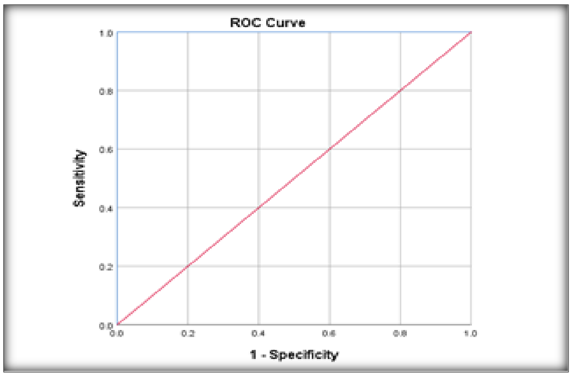

Figure 3: ROC Curve Analysis of TRISS

DISCUSSION

In this study, we evaluated the TRISS as a predictive tool for multiple trauma cases in terms of mortality, ICU admission, and surgical intervention. An AUC of 1.00 for the TRISS indicated excellent discrimination between survivors and non-survivors. This aligns with the findings of Höke et al. (2021), who identified TRISS as the best-performing score for predicting mortality in trauma patients, with an AUC of 0.93. Höke et al. reviewed several trauma scoring systems, concluding that while all offer predictive value, TRISS remained the most accurate for mortality outcomes. These findings support TRISS as a strong predictor in trauma care, particularly for estimating survival probability.[14]

Jeong et al. (2022) further indicated that TRISS scores of the favourable and unfavourable outcome groups differed significantly, as they were 71.02 and 48.05, respectively. It was also identified in our research that the TRISS score significantly differed between survivors and non-survivors. This concordance highlights TRISS's efficiency in forecasting results for polytrauma patients as well as in subcategories of traumatic brain injury.[15]

Indurkar et al. (2023) identified TRISS as being very sensitive (94.7%) and specific (76.6%) in predicting trauma mortality, in agreement with our result of 100% sensitivity and specificity. Their research indicated that TRISS is a suitable model for the prediction of patient outcomes and a valuable tool for trauma management in emergencies.[16]

Deshmukh et al. (2012) found a mortality rate of 33.3% in Pune, India, which was much higher than the TRISS prediction (15.7%). Our results indicate that TRISS works best in well-equipped settings but might require recalibration for other healthcare settings.[17]

The literature has identified that TRISS is effective in predicting ICU admission. Stewart et al. (2021)

found that TRISS was extremely predictive of ICU admission, with an AUC of 0.801, as opposed to ISS's AUC of 0.811. TRISS scores were significantly higher with longer ICU admission.18

Supporting these findings, Thanapaisal and Saksaen (2012) reported that TRISS achieved good sensitivity (25.9%) and specificity (98%) for identifying trauma patients requiring ICU care, suggesting it is valuable for triaging patients requiring intensive care after severe trauma.[19]

Alam et al. (2021) found that TRISS, along with other scoring systems, significantly predicted the need for operative management in blunt trauma cases. Their findings align with our study, where patients with higher TRISS scores were more likely to undergo surgery, reflecting TRISS's critical role in managing abdominal trauma.[20]

Rogers et al. (2012) discussed the limitations of the TRISS, reasoning that it has been outmoded given the improvements in trauma care since the original model's development. By analysing a large dataset in Pennsylvania, they found a steady improvement in outcomes, indicating that the TRISS model may drift out of calibration. Rogers et al. called for an update of the TRISS in contemporary practice. The excellent sensitivity and specificity in our study suggest that TRISS remains valid and powerful, with good basic predictiveness despite advances in trauma management.[21]

Schluter (2011) supported this by proposing a revised TRISS model, whose main effects and two-factor interaction terms increased the predictive power. Schluter's revised model had higher AUCs than the original TRISS model when applied to several trauma patient subsets. This emphasizes that continuous updating and recalibration will be necessary as predictive models are applied to diverse populations.[22]

Höke et al. (2021) revealed that TRISS was excellent in predicting mortality, whereas NISS outperformed it in predicting ICU admission, with an AUC of 0.81. This indicates that although TRISS provides a comprehensive survival probability analysis, it is less effective in predicting other crucial trauma outcomes, such as ICU needs. It suggests that combining TRISS with other scoring systems could enhance trauma patient management.[14]

Singh et al. (2011) evaluated TRISS performance on 1,000 trauma patients and demonstrated a linear increase in mortality rates with decreasing RTS. This aligns with our findings of significantly low RTS scores in the non-survivor group, supporting the concept of combining anatomical and physiological measures for an accurate prediction. The findings support Singh et al. (2011) that declining RTS and rising ISS indicate a poor prognosis, as confirmed by our results.[23]

Orhon et al. (2014) reported that TRISS was an excellent predictor of mortality but less effective in determining the ICU length of stay or mechanical ventilation needs. Our study found similar limitations, indicating that while effective for mortality prediction, TRISS might be complemented by other scores for predicting resource needs like ICU admission or hospital stay length.[24]

Our study found that the TRISS is a valuable and accurate tool for predicting mortality in patients with multiple traumas. However, its limitations are evident when used in different settings without proper adjustments. Many studies have noted the need to recalibrate the TRISS, especially in places with different healthcare resources. Newer models and updates to TRISS have shown better predictive performance, suggesting that adding variables, such as the GCS and including interactions between factors, could improve outcome prediction. TRISS remains essential in trauma care; however, it is important to keep updating and adapting it locally to ensure that it works well for diverse trauma patient groups.

CONCLUSION

Our study reinforces the utility of the TRISS in accurately predicting trauma patient outcomes, demonstrating strong correlations with the ISS, RTS, and patient mortality and morbidity. Demographic analysis revealed a predominance of trauma in males and specific age groups, with road traffic accidents and blunt trauma being the leading causes. Identifying these at-risk groups is essential for guiding prevention strategies and optimising resource allocation. TRISS, ISS, and RTS provided highly reliable predictions of patient outcomes, with ISS and TRISS achieving perfect predictive values for the AUC, sensitivity, specificity, and other statistical measures. The discrepancies between the predicted and actual outcomes in severe cases highlight the effectiveness of these scoring systems in identifying high-risk patients and guiding intensive interventions. Our findings support the continued use of TRISS but emphasise the need for periodic recalibration to reflect advancements in trauma care and evolving patient demographics, ensuring its continued relevance in trauma management.

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