The EuroBiotech Journal
RESEARCH ARTICLE
Medical Biotechnology

# Pediatric Trauma Severity Assessment and Prognosis Using Automated Scoring Systems

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## Abstract

**Background**: Trauma remains one of the leading causes of morbidity and mortality in the pediatric population. Early assessment of injury severity is essential for timely triage, risk stratification, and clinical decision-making. The Revised Trauma Score (RTS), Pediatric Trauma Score (PTS), and Shock Index (SI) are widely used tools for evaluating physiological status and trauma severity in injured children.

**Materials and Methods**: A prospective observational study was conducted between December 2025 and March 2026 and included 100 pediatric trauma patients registered in the Pediatric Trauma Support System (PTSS). Patients were stratified into four age groups: ≤2 years (n=15), 2-6 years (n=39), 6-12 years (n=34), and 12-18 years (n=12). RTS, PTS, and SI were calculated automatically within the PTSS platform. Severe trauma was defined as hemodynamic instability and/or a Pediatric Trauma Score below 8. Six patients met the criteria for severe trauma. Descriptive statistical analysis was performed.

**Results**: Patients with severe trauma demonstrated lower PTS values (5-6/12), RTS values ranging from 6.00 to 7.11, and a mean SI of 1.38. In children aged ≤2 years, PTS values decreased to 9/12 even in cases of minor head injury, while RTS remained 7.84 and mean SI was 1.27, reflecting age-related physiological differences. In the 2-6 and 6-12 year groups, PTS values ranged from 10-11/12, RTS remained stable at 7.84, and SI ranged from 0.80 to 1.11. Similar patterns were observed among adolescents aged 12-18 years. The combined assessment of RTS, PTS, and SI provided complementary information regarding injury severity across age groups.

**Conclusions**: RTS, PTS, and SI remain useful tools for the early assessment of pediatric trauma patients. Their integration within the PTSS clinical decision-support platform enables standardized calculation and facilitates rapid evaluation in emergency settings. Age-related physiological variations should be considered when interpreting trauma scores in children.

**Keywords:** pediatric trauma, trauma scores, RTS, PTS, Shock Index, PTSS, prognosis, triage

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**DOI:** 10.2478/ebtj-2026-0013

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## Introduction

Pediatric trauma remains one of the leading causes of morbidity and mortality worldwide and continues to represent a major public health challenge and a critical component of emergency healthcare systems. Despite substantial advances in trauma management and critical care, the early recognition and accurate assessment of injury severity in children remain challenging due to age-dependent physiological variability, diverse injury mechanisms, and often subtle clinical presentations. Timely and reliable evaluation is essential for effective triage, risk stratification, appropriate allocation of healthcare resources, and early therapeutic intervention. To improve the objectivity and consistency of trauma assessment, several physiological scoring systems have been developed and implemented in both prehospital and hospital settings [14].

Among the most widely utilized pediatric trauma assessment tools, the Pediatric Trauma Score (PTS) has demonstrated considerable value in estimating injury severity and predicting outcomes in injured children. By incorporating both physiological and anatomical parameters specifically adapted to the pediatric population, PTS provides a structured approach to early risk assessment and clinical decision-making [2,3]. Similarly, the Revised Trauma Score (RTS), which integrates the Glasgow Coma Scale, systolic blood pressure, and respiratory rate, offers a quantitative measure of physiological impairment and has been extensively validated in a variety of trauma populations [4]. In addition, the Shock Index (SI), defined as the ratio of heart rate to systolic blood pressure, has emerged as a practical and sensitive indicator of hemodynamic instability. Increasing evidence suggests that SI may provide valuable prognostic information in pediatric trauma, particularly when interpreted according to age-specific physiological reference ranges [6,7].

Despite their widespread use and established clinical utility, each trauma scoring system possesses inherent limitations when applied independently. The predictive accuracy of physiological scores may be influenced by patient age, mechanism of injury, compensatory physiological responses, and the overall clinical context. Previous studies have demonstrated variability in the performance of individual trauma scores, and no single scoring system has consistently shown superiority across all pediatric trauma scenarios [8,9]. Consequently, a multidimensional assessment strategy incorporating complementary physiological indicators may provide a more comprehensive evaluation of injury severity. This consideration is particularly important in children, where substantial age-related differences in heart rate, respiratory rate, and blood pressure can complicate score interpretation and potentially influence clinical decision-making if not appropriately considered [10,11].

The ongoing digital transformation of healthcare has created new opportunities for integrating automated clinical decision-support technologies into emergency medicine. Modern digital platforms facilitate standardized data acquisition, automated score calculation, and rapid presentation of clinically relevant information, thereby reducing calculation errors and improving workflow efficiency. Digital and AI-supported clinical decision-support approaches have demonstrated growing potential in assisting clinicians during complex diagnostic and therapeutic processes, particularly in time-critical environments such as emergency departments and trauma centers [12,13]. Within pediatric trauma care, these technologies may support the rapid interpretation of multiple physiological parameters while promoting consistency in assessment across different age groups.

The Pediatric Trauma Support System (PTSS) was developed as a digital clinical decision-support platform designed to support the initial evaluation of injured children through the automated integration of established trauma assessment tools. The system combines the Pediatric Trauma Score (PTS), Revised Trauma Score (RTS), and Shock Index (SI) within a unified framework and provides automated calculations based on routinely collected clinical parameters. PTSS was developed according to evidence-based pediatric trauma management principles and incorporates decision-support logic derived from internationally recognized pediatric trauma care protocols and best-practice recommendations. These principles were informed by pediatric trauma management pathways and clinical recommendations implemented in leading international pediatric centers, including Oxford Children's Hospital, Bambino Gesù Children's Hospital, and Johns Hopkins Children's Center. In addition to automated score generation, the platform supports age-adapted interpretation of physiological variables, addressing one of the major challenges in pediatric trauma assessment. To date, limited data are available regarding the integration of multiple pediatric trauma scoring systems within a unified digital assessment platform, highlighting the need for further evaluation of such approaches in clinical practice.

The present study evaluates the implementation of RTS, PTS, and SI within the PTSS environment in a cohort of pediatric trauma patients managed between December 2025 and March 2026. Particular attention is given to the distribution of trauma scores across different pediatric age groups and to the characteristics of patients presenting with severe trauma. Furthermore, the study examines the clinical applicability of combined score assessment within an automated decision-support framework and explores the influence of age-related physiological differences on trauma score interpretation. Through this analysis, the study aims to evaluate the practical applicability of integrated trauma scoring systems within a digital pediatric trauma assessment framework and to provide additional insight into their potential role in supporting pediatric trauma evaluation and triage.

## Materials and Methods

### Study Design and Setting

A prospective observational study was conducted between December 2025 and March 2026 using data collected through the Pediatric Trauma Support System (PTSS), a structured digital clinical decision-support platform designed for real-time registration and assessment of pediatric trauma patients. The study reflects the initial clinical implementation of PTSS in Bulgaria and enabled standardized and simultaneous calculation of the Pediatric Trauma Score (PTS), Revised Trauma Score (RTS), and Shock Index (SI) during routine emergency care.

PTSS was developed according to evidence-based pediatric trauma management principles and incorporates automated calculation of established trauma scoring systems within a unified digital environment. The platform integrates routinely collected clinical and physiological parameters and provides age-adapted interpretation of trauma-related indicators to support the initial assessment of injured children.

### Study Population

The study included 100 consecutive pediatric trauma patients who were prospectively registered in the PTSS database. Patients were stratified into four age groups according to physiological characteristics and established pediatric reference ranges: ≤2 years (n=15), 2-6 years (n=39), 6-12 years (n=34), and 12-18 years (n=12) [10,11].

Inclusion criteria comprised all pediatric trauma patients presenting during the study period with complete clinical and physiological data available at initial assessment. Patients with incomplete datasets or missing variables required for trauma score calculation were excluded from the analysis.

**Data Collection**

Clinical and physiological data were collected prospectively at the time of patient presentation and entered into the PTSS platform in real time. Standardized data collection included demographic information, injury characteristics, and physiological parameters relevant to trauma score calculation, including heart rate, systolic blood pressure, respiratory rate, Glasgow Coma Scale (GCS), mechanism of injury, and clinical management approach.

Following data entry, PTSS automatically calculated PTS, RTS, and SI using predefined algorithms based on established scoring methodologies. Automated calculation was implemented to ensure standardized score derivation and reduce variability associated with manual computation.

Trauma Severity Assessment

PTS and RTS were calculated according to their original validated methodologies [2-4]. Shock Index was calculated as the ratio of heart rate to systolic blood pressure and interpreted according to age-adjusted pediatric reference values [6,7].

Patients were classified as having severe trauma when presenting with hemodynamic instability and/or a Pediatric Trauma Score below 8. Within the study cohort, six patients fulfilled these criteria. All severe trauma cases involved significant abdominal injuries requiring either operative or conservative management.

**Statistical Analysis**

Statistical analysis was limited to descriptive methods, reflecting the exploratory nature of the study and the relatively small number of patients with severe trauma. Continuous variables were summarized using means and observed ranges, while categorical variables were presented as frequencies and percentages.

Descriptive comparisons of PTS, RTS, and SI values were performed across predefined age groups. Particular attention was given to children aged ≤2 years because age-related physiological variability may influence trauma score interpretation [10,11].

No inferential statistical analyses were performed. The primary objective was to describe the distribution of trauma scores within a prospectively collected pediatric trauma cohort and to explore their application within an automated clinical decision-support platform.

## Results

A total of 100 pediatric trauma patients were prospectively enrolled and analyzed. The study population included 15 patients (15%) aged ≤2 years, 39 patients (39%) aged 2-6 years, 34 patients (34%) aged 6-12 years, and 12 patients (12%) aged 12-18 years. Complete clinical and physiological datasets were available for all included patients, allowing automated calculation of PTS, RTS, and SI.

Six patients (6%) met the predefined criteria for severe trauma. All severe trauma cases involved significant abdominal injuries managed either surgically or conservatively. Within this subgroup, PTS values ranged from 5 to 6, RTS values ranged from 6.00 to 7.11, and the mean SI was 1.38.

Across the remaining patients, PTS values were predominantly between 10 and 12, RTS values were generally 7.84, and SI values ranged from 0.80 to 1.11. Lower PTS values, lower RTS values, and higher SI values were observed primarily among patients classified as having severe trauma.

Age-stratified analysis demonstrated differences in score distribution across pediatric age groups. In children aged ≤2 years, PTS values reached 9 even in cases of relatively minor injuries, including mild head trauma. In this age group, RTS remained 7.84 and the mean SI was 1.27. Children aged 2-6 years and 6-12 years generally demonstrated PTS values between 10 and 11, RTS values of 7.84, and SI values ranging from 0.80 to 1.11. Similar distributions were observed among adolescents aged 12-18 years.

Evaluation of the three trauma scores within the PTSS platform demonstrated that severe trauma cases were generally associated with concurrent abnormalities in PTS, RTS, and SI. In contrast, isolated score deviations were occasionally observed in younger children without evidence of severe injury. These observations suggest that combined assessment of multiple trauma scores may provide complementary information during the evaluation of pediatric trauma patients.

The PTSS platform enabled real-time automated calculation of PTS, RTS, and SI for all enrolled patients and provided immediate availability of scoring results during clinical assessment.

## Discussion

The present study evaluated the application of the Pediatric Trauma Score (PTS), Revised Trauma Score (RTS), and Shock Index (SI) within the Pediatric Trauma Support System (PTSS), a digital clinical decision-support platform designed for pediatric trauma assessment. The findings demonstrate distinct patterns of score distribution across pediatric age groups and show that patients classified as having severe trauma generally exhibited concurrent abnormalities in all three scoring systems. In contrast, isolated score deviations were observed in some younger children with less severe injuries, emphasizing the importance of interpreting trauma scores within an age-specific clinical context.

One of the principal observations of the present study was the influence of age-related physiological variability on trauma score interpretation. Children aged ≤2 years demonstrated lower PTS values and higher SI values even in the presence of relatively minor injuries. These findings are consistent with previous reports indicating that physiological parameters in infants and young children may differ substantially from those observed in older pediatric patients, potentially influencing the interpretation of trauma severity scores [10,11]. Consequently, age-adjusted assessment remains an important consideration when applying trauma scoring systems in pediatric emergency care.

The findings also support previous evidence regarding the clinical usefulness of established pediatric trauma scoring systems. The Pediatric Trauma Score has been widely used as an indicator of injury severity and outcome risk in children, and earlier studies have demonstrated its value in pediatric trauma assessment [2,3]. Similarly, the Revised Trauma Score remains one of the most frequently utilized physiological scoring systems in trauma care and provides a standardized method for evaluating physiological compromise [4]. The Shock Index has gained increasing recognition as a marker of hemodynamic instability, and recent studies have highlighted its potential relevance in pediatric trauma populations, particularly when interpreted according to age-adjusted reference values [6,7].

In the present cohort, severe trauma cases were generally associated with lower PTS values, lower RTS values, and higher SI values compared with the remainder of the study population. Although the limited number of severe trauma cases precludes definitive conclusions regarding predictive performance, these observations suggest that simultaneous assessment of multiple trauma scores may provide complementary clinical information during the initial evaluation of injured children.

An additional aspect of this study was the implementation of trauma score assessment within the PTSS platform. Automated calculation of PTS, RTS, and SI enabled standardized score generation using routinely collected clinical data. Digital clinical decision-support systems have been increasingly incorporated into emergency medicine workflows because they may facilitate standardized assessment processes and improve accessibility of clinically relevant information [12,13]. Within pediatric trauma care, such platforms may support consistent score calculation while reducing the need for manual computation.

The prospective design of the study represents a methodological strength because data were collected in real time during routine clinical practice. Furthermore, the use of a structured digital platform ensured standardized acquisition of physiological and clinical variables across all enrolled patients. These features enhance the consistency of data collection and provide insight into the practical implementation of trauma scoring systems within a real-world pediatric emergency setting.

Several limitations should be acknowledged. First, the study was conducted at a single center and included a relatively limited sample size. Second, only six patients fulfilled the criteria for severe trauma, restricting the ability to perform meaningful subgroup analyses. Third, statistical evaluation was limited to descriptive methods, and no inferential analyses were performed. Consequently, the findings should be interpreted as exploratory observations rather than evidence of causal relationships or predictive superiority of any individual trauma scoring system. Finally, the study evaluated the implementation of trauma scores within a digital clinical decision-support platform and did not directly assess patient outcomes, diagnostic accuracy, or comparative effectiveness against alternative assessment strategies.

Future multicenter investigations involving larger patient populations and a greater number of severe trauma cases are warranted to further evaluate the clinical utility of integrated trauma score assessment. Additional studies may also explore the incorporation of advanced analytical approaches and expanded clinical datasets to further support pediatric trauma evaluation within digital decision-support environments.

## Conclusion

This prospective observational study evaluated the application of the Pediatric Trauma Score (PTS), Revised Trauma Score (RTS), and Shock Index (SI) within the Pediatric Trauma Support System (PTSS) in a cohort of 100 pediatric trauma patients. The findings demonstrated differences in trauma score distribution across pediatric age groups and showed that patients classified as having severe trauma generally exhibited concurrent abnormalities in all three scoring systems.

The study highlights the importance of age-related physiological variability when interpreting trauma scores, particularly in children aged ≤2 years, where score deviations were observed even in the presence of relatively minor injuries [10,11]. These observations suggest that combined assessment of PTS, RTS, and SI may provide complementary information during the initial evaluation of pediatric trauma patients.

The implementation of PTSS enabled standardized, real-time calculation of trauma scores within a digital clinical decision-support environment. While the present findings support the practical applicability of integrated trauma score assessment in routine pediatric trauma care, the study should be considered exploratory because of its single-center design, limited sample size, and descriptive statistical methodology.

Further multicenter studies involving larger patient populations and a greater number of severe trauma cases are needed to better define the clinical utility of integrated trauma scoring systems and to evaluate their role within digital pediatric trauma assessment platforms.

**List of Abbreviations**

- PTS - Pediatric Trauma Score
- RTS - Revised Trauma Score
- SI - Shock Index
- PTSS - Pediatric Trauma Support System
- ED - Emergency Department
- AI - Artificial Intelligence
- mmHg - Millimeters of Mercury (used in blood pressure measurement)
- HR - Heart Rate
- RR - Respiratory Rate

## Acknowledgements

None

## Ethics Approval and Consent to Participate

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and applicable national regulatory requirements. All clinical data were collected prospectively through the Pediatric Trauma Support System (PTSS) and anonymized prior to analysis.

The study protocol was reviewed and approved by the Ethics Committee of the Medical University - Plovdiv.

- Ethics Committee: Ethics Committee, Medical University - Plovdiv
- Approval Code: R-KNE-65/12.12.2025
- Approval Date: 12 December 2025

The Ethics Committee reviewed the research proposal (Reference No. 2025_RKNE_2E2113204D_request) and confirmed that the study met the required standards for scientific validity, ethical conduct, and protection of participant confidentiality.

## Funding

This study received no external funding.

## Conflict of Interest

The authors declare no conflicts of interest related to this work.

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