

REVISED TRAUMA SCORE (RTS) AS A PREDICTOR OF MORTALITY RISK IN PATIENTS WITH HEAD INJURY IN THE EMERGENCY DEPARTMENT

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ABSTRACT

Mortality risk in patients with head injury remains a major challenge in emergency care, requiring early assessment to support clinical decision-making. This study aimed to describe mortality risk based on the Revised Trauma Score (RTS) among head injury patients in the emergency department of RSI Sakinah Mojokerto. A quantitative descriptive study with a retrospective approach was conducted using medical records of 138 patients selected by purposive sampling from 193 eligible cases between December 2025 and February 2026. RTS was calculated using the Glasgow Coma Scale (GCS), Systolic Blood Pressure (SBP), and Respiratory Rate (RR). The mean values were 13.11 for GCS, 133.71 mmHg for SBP, and 22.13 breaths/min for RR. Most patients (75.4%) had a low mortality risk, while 24.6% had a moderate risk; no patients had a high mortality risk. These findings indicate that most patients present with relatively stable physiological conditions, resulting in high RTS scores.

Keywords: *Head Injury, Mortality Risk, Revised Trauma Score (RTS), Emergency Department*

INTRODUCTION

Mortality risk in patients with head injury remains a major clinical challenge in emergency care. Head injury is a condition resulting from external mechanical trauma that can impair the structure and function of the brain (Yuniarti & Astutik, 2016). It may involve damage to the scalp, skull, and brain tissue caused by physical impact or blunt force (Padaruntung et al., 2023). The resulting physiological disturbances may contribute to clinical deterioration, particularly during the early phase of management in the emergency department. Early identification of mortality risk is essential to support clinical decision-making and the selection of appropriate interventions. The Revised Trauma Score (RTS) is an objective physiological assessment tool that is widely used for the initial evaluation of trauma patients. It incorporates three key clinical parameters Glasgow Coma Scale (GCS), Systolic Blood Pressure (SBP), and Respiratory Rate (RR). By integrating these parameters, the RTS provides a comprehensive assessment of a patient's physiological stability upon arrival at the Emergency department (Widiyawati & Lestari, 2025).

According to the World Health Organization (WHO), road traffic accidents cause approximately 1.19 million deaths annually, with head injuries accounting for nearly 50% of trauma related deaths (World Health Organization, 2023). In Indonesia, the prevalence of head injury increased from 11.9% in 2018 to 13.2% in 2023 (Riskesdas, 2023, as cited in Pritayanti et al., 2025). At RSI Sakinah Mojokerto, a total of 681 head injury cases were recorded throughout 2025, indicating a substantial clinical burden and a potentially significant risk of mortality, particularly during the initial phase of emergency management.

Pathophysiological changes following head injury may be reflected by decreased GCS scores, hypotension, and respiratory abnormalities, which indicate deterioration in the patient's physiological condition. These changes are closely associated with an increased risk

of mortality, highlighting the importance of accurate early assessment to identify mortality risk at the initial stage of care. RTS is one of the physiological scoring systems that can be used to monitor patients' physiological status by incorporating physiological parameters to assess clinical condition and estimate mortality risk during the early phase of management (Sari Laksmi et al., 2024). The validity of this instrument is supported by the findings of Kumar et al. (2025) who reported that the RTS effectively predicts mortality risk based on patients' initial physiological parameters, thereby facilitating the early identification of high-risk patients. Other research conducted by Norhaliza et al. (2025) demonstrated that, compared with other trauma scoring systems, the RTS is more practical and can be applied more rapidly during the initial assessment in the emergency department.

Although numerous studies have identified head injury as one of the leading causes of trauma-related mortality, information regarding the distribution of mortality risk among patients with head injury during the initial phase of emergency department admission remains limited, particularly in the context of Indonesian hospitals. Early assessment of mortality risk is essential for appropriate triage prioritization and timely clinical decision-making in emergency care. Therefore, this study aimed to describe the distribution of mortality risk among patients with head injury during the initial phase of emergency department management. The novelty of this study lies in the use of the RTS to represent the distribution of mortality risk in patients with head injury upon ED admission, thereby providing a more specific representation of the physiological condition of trauma patients during the early stage of emergency care.

METHOD

This study employed a quantitative descriptive research design. Descriptive research focuses on a single variable independently without examining comparisons or relationships with other variables (Sembiring et al. 2024). The research data were obtained retrospectively from secondary data extracted from the medical records of patients with head injury who were admitted to the emergency department of RSI Sakinah Mojokerto between December 2025 and February 2026.

The study population consisted of all patients with head injury recorded in the medical records of the emergency department at RSI Sakinah Mojokerto from December 2025 to February 2026, totaling 193 patients. The sample was selected using a purposive sampling technique, resulting in 138 patients who met the study criteria. The inclusion criterion was patients aged ≥ 18 years with head injury. The exclusion criterion was medical records with incomplete data required for the calculation of the Revised Trauma Score (RTS), including the GCS, SBP, and RR at the time of admission to the emergency department.

Data were collected retrospectively through a review of the medical records of patients with head injury. Patients were identified based on the ICD-10 diagnosis code S06, followed by screening according to the study period and the inclusion criteria. The variables collected included age, sex, head injury classification, GCS, SBP, and RR. The research instrument consisted of an observation checklist developed based on the components of the RTS. The RTS was calculated using the weighted scoring formula proposed by Champion et al. (1989):

GCS	SBP	RR	Code Value
13-15	>89	10-29	4
9-12	76-89	>29	3
6-8	50-75	6-9	2
4-5	1-49	1-5	1
3	0	0	0

(Champion et al., 1989 ; Abouelfetouh, 2024)

After assigning a coded value to each physiological indicator, the RTS was calculated using the following formula: $RTS = (0.9368 \times GCS) + (0.7326 \times SBP) + (0.2908 \times RR)$. The RTS scores were then classified into three mortality risk categories: low risk (>7.2), moderate risk ($3.4-7.2$), and high risk (<3.4), based on the classification proposed by Kondo et al. (2011).

Data were analyzed using SPSS software with descriptive statistical analysis. The results were presented as frequency distributions, percentages, and cross-tabulations to describe the distribution of mortality risk according to head injury classification, without performing statistical tests of association.

FINDING AND DISCUSSION

RESEARCH RESULT

General Data

1. Respondent Characteristics

Table 1: Frequency Distribution of the Characteristics of Patients with Head Injury in the Emergency Department of RSI Sakinah Mojokerto (December 2025–February 2026)

Category	Frequency	Percentage (%)
Age		
1. $\geq 18-59$ Years	100	72,5
2. ≥ 60 Years	38	27,5
Total	138	100
Gender		
1. Male	89	64,5
2. Female	49	35,5
Total	138	100
Injury Classification		
1. Mild head injury	103	74,6
2. Moderate head injury	16	11,6
3. Severe head injury	19	13,8
Total	138	100

Source: Secondary medical record data, December 2025–February 2026

Table 1 shows that the majority of patients were aged 18–59 years 100 patients (72.5%), were male 89 patients (64.5%), and had mild head injury 103 patients (74.6%).

Specialized Data

1. RTS Components

Table 2: Descriptive Statistics of the Revised Trauma Score (RTS) Components among Patients with Head Injury in the Emergency Department of RSI Sakinah Mojokerto (December 2025–February 2026)

	<i>Minimum</i>	<i>Maximum</i>	<i>Mean</i>	<i>Std. Deviation</i>
Glasgow Coma Scale (GCS)	3	15	13,11	3,468
Systolic Blood Pressure (SBP)	57	223	133,71	24,139
Respiratory Rate (RR)	12	35	22,13	3,714

Source: Secondary medical record data, December 2025–February 2026

Table 2 shows that the mean GCS score among patients with head injury was 13.11 (SD = 3.468). The mean SBP was 133.71 mmHg (SD = 24.139), while the mean RR was 22.13 breaths/min (SD = 3.714).

2. Mortality Risk of Patients with Head Injury Based on the RTS

Table 3: Distribution of Mortality Risk among Patients with Head Injury Based on the RTS in the Emergency Department of RSI Sakinah Mojokerto (December 2025–February 2026)

Mortality Risk	Frequency	Percentage (%)
1. Low Risk	104	75,4
2. Moderate Risk	34	24,6
3. High Risk	0	0
Total	138	100

Source: Secondary Medical Record Data, December 2025–February 2026.

Table 3 shows that the majority of patients were classified as having a low mortality risk, accounting for 104 patients (75.4%). Meanwhile, 34 patients (24.6%) were categorized as having a moderate mortality risk, and no patients were classified as having a high mortality risk.

Table 4: Cross-tabulation of Head Injury Classification and Mortality Risk Based on the RTS in the Emergency Department of RSI Sakinah Mojokerto (December 2025–February 2026)

Head Injury Classification	Mortality Risk						Total
	Low		Moderate		High		
	n	%	n	%	n	%	
Mild Head Injury	102	99	1	1	0	0	103
Moderate Head Injury	2	12,5	14	87,5	0	0	16
Severe Head Injury	0	0	19	100	0	0	19
Total	104	75,4	34	24,6	0	0	138

Source: Processed Research Data, 2026

Table 4 demonstrates that almost all patients with mild head injury 102 patients (99.0%) were classified as having a low mortality risk. In contrast, most patients with moderate head injury 14 patients (87.5%) and all patients with severe head injury (19 patients; 100.0%) were classified as having a moderate mortality risk according to the RTS. No patients in any head injury classification were categorized as having a high mortality risk.

DISCUSSION

The findings showed that the majority of patients with head injury were classified as having a low mortality risk based on the Revised Trauma Score (RTS), comprising 104 patients (75.4%). Meanwhile, 34 patients (24.6%) were categorized as having a moderate mortality risk, and no patients were classified as having a high mortality risk. These findings indicate that most patients presented with relatively stable physiological conditions during the initial assessment in the emergency department. In this study, mortality risk was determined using the RTS. The RTS is a physiological trauma scoring system used to predict mortality risk in trauma patients, including those with head injuries, by assessing three key physiological parameters the Glasgow Coma Scale (GCS), systolic blood pressure (SBP), and respiratory rate (RR) (Elfa et al., 2025). A higher RTS reflects better physiological status and is associated with a lower risk of mortality, whereas a lower RTS indicates more severe physiological impairment and is associated with an increased risk of mortality (Jeong et al., 2022).

The predominance of the low mortality risk category in this study was supported by the relatively stable physiological condition of most patients during the initial assessment in the emergency department. This was reflected in the mean GCS score of 13.11, mean SBP of 133.71 mmHg, and mean RR of 22.13 breaths/min. These findings indicate that most patients maintained adequate neurological, hemodynamic, and respiratory function. Such relatively stable physiological conditions contributed to higher RTS values, resulting in a low mortality risk classification. These findings are consistent with those reported by Agnes et al. (2020) and Kurniawan (2018) who stated that decreased GCS, hypotension, and respiratory impairment are associated with an increased risk of mortality in patients with head injury.

The findings of this study are consistent with those of Maulida & Khotimah (2020) who reported that the majority of patients with head trauma (85.4%) were classified into the mild RTS category and did not experience mortality. Similarly, Elfa et al. (2025) found that most patients were categorized as having a low mortality risk and demonstrated better survival outcomes than those in the high-risk group. Furthermore, Padaruntung et al. (2023) reported that all patients classified in the mild RTS category survived, whereas most deaths occurred among patients in the severe RTS category. These consistent findings suggest that patients with higher RTS scores generally have more stable physiological conditions, resulting in a greater likelihood of survival.

An interesting finding of this study was the absence of patients classified as having a high mortality risk, despite the presence of patients with a minimum GCS score of 3, a minimum SBP of 57 mmHg, and a respiratory rate of up to 35 breaths per minute. This finding indicates that the RTS is not determined by a single physiological parameter but rather represents a composite score derived from the combination of its three components.

Consequently, although one parameter may indicate severe physiological impairment, patients may still obtain an RTS corresponding to a low or moderate mortality risk category if the remaining physiological parameters remain relatively stable. This finding suggests that the RTS better reflects the patient's overall physiological status during the initial assessment rather than relying on a single clinical parameter (Abouelfetouh, 2024).

These findings differed from those reported by Norhaliza et al. (2025) who found that the majority of patients were classified into the severe and very severe mortality risk categories based on the RTS. This discrepancy may be attributed to differences in the characteristics of the study populations. In the present study, most respondents had mild head injuries (74.6%), whereas the study by Norhaliza et al. (2025) included a higher proportion of patients with more severe conditions, resulting in a different distribution of RTS categories. Differences in sample characteristics and injury severity may influence the distribution of RTS scores, thereby leading to variations in the proportion of mortality risk categories.

The findings also demonstrated that the predominance of low mortality risk was consistent with the high proportion of patients with mild head injury. Almost all patients with mild head injury were classified as having a low mortality risk, whereas all patients with severe head injury were categorized as having a moderate mortality risk. Nevertheless, one patient with mild head injury was classified as having a moderate mortality risk due to a systolic blood pressure of 80 mmHg. In addition, two patients with moderate head injury remained in the low mortality risk category because their other physiological parameters were within normal ranges. The first patient had a GCS score of 13, SBP of 95 mmHg, and respiratory rate of 20 breaths/min, while the second had a GCS score of 13, SBP of 110 mmHg, and respiratory rate of 18 breaths/min. These findings indicate that the severity of head injury does not always correspond to the mortality risk category based on the RTS. This finding supports the theory that increasing head injury severity is generally associated with a higher risk of mortality due to physiological disturbances such as decreased level of consciousness, hypotension, and respiratory impairment (Elfa et al., 2025). However, this relationship is not absolute. Mortality risk in patients with head injury is also influenced by several other factors, including systolic blood pressure, respiratory rate, age, and gender (Agnes et al., 2020). Furthermore, Singh et al. (2025) reported that patients with mild head injury generally have a better prognosis than those with moderate or severe head injury. However, prognosis and mortality risk are not determined solely by injury severity, as physiological status and patient characteristics also play important roles in influencing clinical outcomes (Agnes et al., 2020).

The findings of this study were consistent with those of Wikantama & Widyastuti. (2020) who reported that the Revised Trauma Score (RTS) has high predictive accuracy in estimating mortality risk among patients with traumatic brain injury, with lower RTS values indicating a higher risk of death. Similarly, Padaruntung et al. (2023) demonstrated a significant association between RTS and mortality in patients with head injury. Furthermore, Elfa et al. (2025) found that RTS was effective in predicting clinical outcomes among patients with head injury in the emergency department. The consistency of these findings further supports the use of RTS as an initial assessment tool for identifying mortality risk in patients with head injury.

Nevertheless, after reviewing the patients' final outcomes, several deaths were identified despite the patients being classified as having low or moderate mortality risk according to the RTS. All patients with severe head injury who died were classified as having moderate mortality risk, whereas three patients with mild head injury who died were classified as having low mortality risk. All three of these patients were older than 60 years, suggesting that advanced age and the possible presence of comorbidities may have contributed to their outcomes. These findings indicate that the RTS does not always correspond with the patients' final outcomes because it reflects only the physiological condition at the time of the initial assessment in the emergency department. Patient outcomes are also influenced by the progression of clinical conditions during hospitalization, including intracranial hemorrhage, increased intracranial pressure, cerebral edema, systemic complications, response to treatment, and medical interventions, none of which are incorporated into the RTS. Therefore, RTS should be interpreted in conjunction with a more comprehensive clinical assessment to improve the accuracy of mortality risk prediction.

This study had several limitations. First, it employed a retrospective design using medical records as the data source, making the findings dependent on the completeness and accuracy of the available documentation. Second, the study used the Revised Trauma Score (RTS) solely as a representation of mortality risk without considering other factors that may influence patient outcomes, such as comorbidities, injury mechanism, medical interventions, and changes in clinical condition during hospitalization. These limitations suggest that additional factors influencing patient outcomes may not have been fully captured or explained in the present study.

CONCLUSION

This study showed that the majority of patients with head injury in the emergency department of RSI Sakinah Mojokerto were classified as having a low mortality risk based on the RTS, accounting for 104 patients (75.4%). Meanwhile, 34 patients (24.6%) were classified as having a moderate mortality risk, and no patients were classified as having a high mortality risk. These findings indicate that the RTS is capable of representing patients' initial physiological status through the assessment of the GCS, SBP, and RR, making it a useful tool for the early identification of mortality risk in patients with head injury in the emergency department. However, the findings also suggest that RTS based mortality risk categories do not always correspond to patients' final clinical outcomes, as mortality is influenced by various other clinical factors that are not included in the RTS assessment.

Future studies are recommended to employ a prospective design by directly monitoring patients' clinical progression from admission to the emergency department until clinical outcomes are determined. In addition, future research should consider combining the RTS with other trauma scoring systems or incorporating additional variables, such as comorbidities, mechanism of injury, time to hospital arrival, medical interventions, and changes in clinical condition during hospitalization, to provide a more comprehensive assessment of mortality risk. Given that some patients with severe head injury were classified as having a moderate mortality risk based on the RTS despite presenting with severe clinical conditions, further studies should also re-evaluate the appropriateness of the RTS mortality risk classification, particularly for patients with severe head injury, to optimize its application in clinical practice.

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