



VALIDATION OF THE GAP SCORE (GLASGOW COMA SCALE, AGE, AND SYSTOLIC BLOOD PRESSURE) AS A PREDICTOR OF CLINICAL DETERIORATION IN HEAD INJURY PATIENTS IN THE EMERGENCY DEPARTMENT

Fatimah*, Iswenti Novera, Yenni Elfira, Irwadi, Aric Frendi Andriyan, Leo Agistigno, Defina Rianza

Department of Anesthesiologi Nursing, Faculty of Vocational, Universitas Baiturrahmah, Jl. By Pass No.Km.15, Aie Pacah, Koto Tangah, Padang, Sumatera Barat 25586, Indonesia

*fatimah@staff.unbrah.ac.id

ABSTRACT

Head injuries are a leading cause of death and disability globally and in Indonesia; therefore, early assessment of injury severity is crucial to prevent the deterioration of a patient's condition. One method that can be employed is the GAP Score a prognostic scoring system that integrates three simple parameters: the Glasgow Coma Scale (GCS), patient age, and systolic blood pressure designed to predict clinical outcomes quickly and accurately. This study aimed to determine the association between the GAP Score and the deterioration of the condition of patients with head injuries at Siti Rahmah Islamic Hospital, Padang. Method: This was an observational, analytical study with a retrospective cohort design. It utilized medical record data from all patients with head injuries treated throughout 2024, resulting in a sample size of 34 individuals selected via total sampling. Data were collected from medical records and analyzed using the Fisher's Exact Test. The findings indicate that the majority of patients presented with a mild GCS score (91.2%), were under 60 years of age (91.2%), and had a stable systolic blood pressure between 60–120 mmHg (52.9%). Based on the GAP Score, 91.2% of patients were classified as low-risk, while 8.8% were classified as moderate-risk; clinical deterioration was observed in only 8.8% of the respondents. Statistical analysis revealed a highly significant association between the GAP Score and clinical deterioration ($p = 0.000$), with patients in the moderate-risk category facing a substantially higher risk. The individual parameters age, GCS, and systolic blood pressure also showed significant associations ($p < 0.05$). The GAP Score is an effective instrument for predicting the deterioration of a patient's condition. The GAP Score is an effective instrument for predicting clinical deterioration in head injury patients.

Keywords: age; clinical deterioration; GAP score; glasgow coma scale; head injury; systolic blood pressure

How to cite (in APA style)

Fatimah, F., Novera, I., Elfira, Y., Irwadi, I., Andriyan, A. F., Agistigno, L., & Rianza, D. (2026). Validation of the Gap Score (Glasgow Coma Scale, Age, and Systolic Blood Pressure) as A Predictor of Clinical Deterioration in Head Injury Patients in the Emergency Departmen. Indonesian Journal of Global Health Research, 8(5), 1473–1480. <https://doi.org/10.37287/ijghr.v8i5.2820>.

INTRODUCTION

Head injuries are a leading cause of death and disability worldwide (Susanto et al., 2024; Andrade, 2021). According to the World Health Organization (2024) and the Centers for Disease Control and Prevention (2023), there are an estimated 69 million new cases of head injury annually, resulting in approximately 5 million deaths (Susanto et al., 2024; Andrade, 2021; Rickels et al., 2023). These injuries occur most frequently among individuals of productive age, primarily due to traffic accidents, falls, and physical violence (Rickels et al., 2023). Globally, head injuries impose a significant burden in terms of mortality and morbidity, with long-term consequences for patients' quality of life (Basak et al., 2023). The high mortality rate among head-injured patients is largely attributed to delays in treatment and inaccuracies in assessing the severity of the injury during the initial phase of care, particularly in the Emergency Department (ED) (Deswal et al., 2022). If not addressed early, mild head injuries can progress to moderate or severe cases manifesting as a decline in consciousness, neurological impairment, or secondary complications such as intracranial hemorrhage and cerebral edema (Dilawar et al., 2025). In Indonesia, a study by Maran et al. (2025) reports that head injury patients are predominantly within the productive age range (21–40 years), with a recovery rate of 76% and a mortality rate of 22.7% (Drajati, 2023). The GAP score (Glasgow

Coma Scale, Age, Systolic Blood Pressure) incorporates three fundamental physiological parameters and has been shown to be an effective predictor of mortality (Eghzawi et al., 2024; Farzan et al., 2022a; Farzan et al., 2022b). A preliminary study at Siti Rahmah Islamic Hospital, involving 34 patients with head injuries between January and December 2024, revealed that the hospital currently relies on the conventional GCS and has yet to implement the GAP score. Therefore, this study aims to determine whether the GAP score serves as a predictor for clinical deterioration in patients with head injuries at Siti Rahmah Islamic Hospital.

METHOD

This study employs an analytical observational quantitative approach with a retrospective cohort design (Fatimah et al., 2022; Fawzi & Franck, 2023). Data were collected from the medical records of patients with head injuries. The GAP score was calculated based on the Glasgow Coma Scale (GCS) score, age, and systolic blood pressure (Eghzawi et al., 2024; Farzan et al., 2022b). Clinical deterioration was defined as a decrease in GCS score by ≥ 2 points, the development of neurological deficits, hemodynamic instability, or the need for an ICU referral or the occurrence of mortality (Deswal et al., 2022; Dilawar et al., 2025; I Nyoman Surya et al., 2022). Bivariate analysis was performed using Fisher’s exact test ($\alpha=0.05$) (Iriani et al., 2022).

RESULT

Respondent Characteristics and Univariate Analysis

Table 1.

Frequency Distribution of Respondent Characteristics

Karakteristik Responden	f	%
<i>Glasgow Coma Scale</i>		
Mild (13-15)	31	91,2
Moderat (9-12)	3	8,8
<i>Age</i>		
<60 tahun	31	91,2
>60 tahun	3	8,8
<i>Systolic Blood Pressure</i>		
>120	15	44,1
60-120	18	52,9
<60	1	2,9

Table 1, among 34 patients with head injuries, the majority—31 patients (91.2%) fell into the mild category (13–15) on the Glasgow Coma Scale (GCS), while 3 patients (8.8%) fell into the moderate category (9–12). Regarding age, 31 patients (91.2%) were under 60 years old, and 3 patients (8.8%) were over 60 years old. In terms of systolic blood pressure (SBP), 18 patients (52.9%) had an SBP of 60–120 mmHg, 15 patients (44.1%) had an SBP >120 mmHg, and 1 patient (2.9%) had an SBP <60 mmHg.

Bivariate Analysis

Association Between GCS and Clinical Deterioration in Patients with Head Injury

Table 2.

Results of Fisher’s Exact Test for the Association Between GCS and Clinical Deterioration

Clinical Deterioration							
GCS	No		Clinical Deterioration		Total		P- Value
	f	%	f	%	f	%	
Mild	1	33.3	2	66.7	3	8.8	0.016
Moderat	30	96.8	1	3.2	31	91.2	

Table 2, it can be seen that out of 34 respondents, 31 (91.2%) fell into the "mild" GAP score category, and none of these individuals experienced a deterioration in their condition. Meanwhile, the remaining 3 respondents (8.8%) when considered alongside the others indicate a statistically significant relationship between Glasgow Coma Scale scores and the occurrence of clinical

deterioration in patients with head injuries at the Siti Rahmah Islamic Hospital in Padang.

Association Between Age and Clinical Deterioration in Patients with Head Injury

Tabel 1.

Results of Fisher's Exact Test for the Association Between Age and Clinical Deterioration

Clinical Deterioration							
Age	No		Clinical Deterioration		Total		P- Value
	f	%	f	%	f	%	
<60	30	96.8	1	3.2	31	91.2	0.016
>60	1	33.3	2	66.7	3	8.8	

Table 3 presents the results of the statistical analysis, which yielded a p-value of 0.016. Since this value is less than 0.05, it indicates a significant association between age and the occurrence of clinical deterioration in patients with head injuries; specifically, individuals over the age of 60 are at a higher risk of deterioration compared to those under 60. Consequently, there is a relationship between age and the worsening of the patient's condition among those with head injuries at the Siti Rahmah Islamic Hospital in Padang.

Relationship between Systolic Blood Pressure Score category and worsening of head injury

Tabel 2.

Fisher's Exact Test Results for the Variable "Systolic Blood Pressure" and the Variable "Occurrence of Deterioration"

SBP	No		Clinical Deterioration		Total		P- Value
	f	%	f	%	f	%	
<60	0	0.0	1	100.0	1	2.9	0.026
60-120	16	88.9	2	11.1	18	52.9	
>120	15	100.0	0	0.0	15	44.1	

Table 4 above shows that among 34 respondents, 1 fell into the systolic blood pressure category of < 60 mmHg, 18 into the 60–120 mmHg category, and 15 into the > 120 mmHg category. Of these, 3 respondents experienced a deterioration in their condition specifically, 1 respondent from the < 60 mmHg category and 2 from the 60–120 mmHg category while no respondents in the > 120 mmHg category experienced such deterioration. Statistical analysis yielded a p-value of 0.026, indicating a significant association between systolic blood pressure and the occurrence of clinical deterioration in patients with head injuries.

Relationship between GAP Score categories and the worsening of head injuries.

Tabel 5.

Results of the Fisher Exact Test for the GAP Score variable and the occurrence of worsening condition

Perburukan		Condition				P-Value	
GAP Score	No		Clinical Deterioration		Total		
	f	%	f	%	f		%
Mild 19-24	31	100.0	0	0.0	31	91.2	<0.001
Moderate 11-18	0	0.0	3	100.0	3	8.8	

Table 5, out of 34 respondents, 31 (91.2%) had a GAP score in the mild category (19–24), and none of them experienced deterioration. Meanwhile, 3 respondents (8.8%) had a GAP score in the moderate category (11–18), and all of them experienced deterioration. The Fisher's Exact Test yielded a p-value of <0.001 ($p < 0.05$), indicating a significant association between the GAP score category and the occurrence of deterioration in patients with head injuries at Siti Rahmah Islamic Hospital, Padang.

DISCUSSION

Respondent Characteristics

Glasgow Coma Scale

Based on the Glasgow Coma Scale (GCS) scores, the majority of the 34 respondents fell into the mild category (13–15)—comprising 31 individuals (91.2%)—while 3 individuals (8.8%) fell into the moderate category (9–12). This predominance of mild GCS scores indicates that most patients presented with a relatively good level of consciousness. These findings are consistent with those of Wijaya and Sari (2023), who reported that 84.7% of head injury patients fell into the mild GCS category, and Rahman and Pratama (2021), who found that 79.2% of patients were in the mild GCS category. A higher GCS score reflects relatively preserved neurological function, whereas a decline in the GCS score indicates more severe impairment of brain function, resulting from either tissue damage or increased intracranial pressure (Maas et al., 2022).

Age

Based on age, 31 respondents (91.2%) were under 60 years old, while 3 respondents (8.8%) were over 60. The predominance of the under-60 age group aligns with findings by Wulandari (2024) as well as Putra and Lestari (2022), who attribute the high incidence of head injuries among the productive age group to greater mobility, outdoor activities, employment, and a higher risk of accidents. Younger individuals generally possess better physiological compensatory capacity and cerebral autoregulation, whereas older individuals experience a decline in compensatory ability and structural brain changes associated with the aging process. Furthermore, the presence of comorbidities, blood clotting disorders, and the use of anticoagulants in older age can increase the risk of hemorrhage and secondary injury (Hidayat, 2024; Santoso, 2022).

Systolic Blood Pressure

Based on systolic blood pressure (SBP), 18 respondents (52.9%) had an SBP of 60–120 mmHg, 15 respondents (44.1%) had an SBP >120 mmHg, and 1 respondent (2.9%) had an SBP <60 mmHg. In general, most respondents maintained a relatively stable hemodynamic status. Blood pressure plays a role in sustaining cerebral perfusion, whereas severe hypotension can reduce cerebral blood flow and exacerbate secondary damage resulting from ischemia (Deswal et al., 2022). These findings align with those of Susanto and Wulandari (2024), who noted that patients with normal to high blood pressure present with a better initial status compared to those with hypotension. In this study, one patient with an SBP <60 mmHg experienced a deterioration in their condition, necessitating ICU care (Dilawar et al., 2025).

Relationship Between GAP Score and Occurrence of Deterioration

The Fisher Exact Test results indicate a significant association between GAP Score categories and the occurrence of clinical deterioration in patients with head injuries ($p < 0.001$). All 3 respondents (8.8%) with a moderate GAP Score (11–18) experienced deterioration, whereas all 31 respondents (91.2%) with a mild GAP Score (19–24) did not. These findings reveal a clear pattern between GAP Score categories and the occurrence of deterioration. The results of this study are consistent with the findings of Utomo (2024), Chen et al. (2022), and Wijaya and Sari (2023), which demonstrate a relationship between the GAP Score and the clinical status of patients with head injuries, as well as the score's advantage in integrating the Glasgow Coma Scale (GCS), age, and blood pressure offering a more comprehensive assessment than one based on a single parameter. The increased risk of deterioration in lower GAP score categories is linked to a combination of a lower GCS, advanced age, and blood pressure abnormalities, all of which can heighten the risk of secondary brain injury (Basak, 2023).

Limitations

This study has several limitations. First, it does not utilize head CT scan results as a basis for assessing injury severity; therefore, the classification of the patient's condition is based solely on clinical parameters specifically the Glasgow Coma Scale (GCS), age, and systolic blood pressure

(SBP) without considering the structural state of the brain. Second, because the study relies on secondary data from medical records, the quality of the analysis is contingent upon the completeness and accuracy of the documentation. Third, the study focuses exclusively on the components of the GAP score and does not account for other factors that could influence clinical deterioration, such as the mechanism of injury, the type of injury, comorbidities, or findings from other diagnostic tests.

CONCLUSION

There is a significant association between the Glasgow Coma Scale (GCS), age, and systolic blood pressure regarding the deterioration of patients with head injuries. Most patients with a GCS score in the mild category and an age under 60 do not experience deterioration, whereas those with lower GCS scores and an age of 60 or older face a higher risk of their condition worsening. There is a significant association between systolic blood pressure and the deterioration of patients with head injuries. Patients with systolic blood pressure within the normal range tend to remain stable, while those with a decrease in systolic blood pressure or hypotension are at a greater risk of deterioration. There is a highly significant association between the GAP score and the deterioration of patients with head injuries. A lower GAP score indicates a higher risk of clinical deterioration; therefore, the GAP score can serve as an effective initial assessment tool for predicting the worsening of a patient's condition following a head injury.

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