Acute and Critical Care

Acute and Critical Care 2024 August 39(3):408-419
https://doi.org/10.4266/acc.2024.00570

| pISSN 2586-6052 | eISSN 2586-6060

The Glasgow Coma Scale and Full Outline of Unresponsiveness score evaluation to predict patient outcomes with neurological illnesses in intensive care units in the West Bank: a prospective cross-sectional study

Wourod Mahmoud Omar[1], Imad Rasheed Abu Khader[2], Salam Bani Hani[3], Mohammed ALBashtawy[4]

1An-Najah National University Hospital, Nablus, Palestine
2Faculty of Graduate Studies, Arab American University, Ramallah, Palestine
3Department of Nursing, Irbid National University, Irbid, Jordan
4Department of Community and Mental Health, Princess Salma Faculty of Nursing, Al al-Bayt University, Mafraq, Jordan

Background: Determining the clinical neurological state of the patient is essential for making decisions and forecasting results. The Glasgow Coma Scale and the Full Outline of Unresponsiveness (FOUR) Scale are commonly used tools for measuring behavioral consciousness. This study aims to compare scales among patients with neurological disorders in intensive care units (ICUs) in the West Bank.

Methods: A prospective cross-sectional design was employed. All patients admitted to ICUs who met inclusion criteria were involved in this study. Data were collected from from An-Najah National University, Al-Watani, and Rafedia Hospital. Both tools were used to collect data.

Results: A total of 84 patients were assessed, 69.0% of the patients were male, and the average length of stay was 6.4 days. The mean score on the Glasgow Coma scale was 11.2 on admission 11.6 after 48 hours, and 12.2 on discharge. The mean FOUR Scale score was 12.2 on admission, 12.4 after 48 hours, and 12.5 at discharge.

Conclusions: This study indicates that both the Glasgow Coma Scale and the FOUR scale are effective in predicting outcomes for neurologically deteriorated critically ill patients. However, the FOUR scale proved to be more reliable when assessing outcomes in ICU patients.

Key Words: intensive clinical units; Full Outline of Unresponsiveness scale; Glasgow Coma Scale; neurological assessment; unresponsiveness patients

Original Article

Received: February 1, 2024
Revised: July 19, 2024
Accepted: July 21, 2024

Corresponding author
Salam Bani Hani
Department of Nursing, Irbid National University, P.O. Box 2600, Irbid 21110, Jordan
Tel: +962-78-557-7701
Email: s.banihani@inu.edu.jo

INTRODUCTION

The unconscious state is known as the inability to respond to stimuli and is commonly observed among critically ill patients due to acute primary brain injury or secondary brain injuries such as cardiopulmonary disease, shock, and multi-organ failure [1]. To maximize patient outcomes in cases of unconsciousness, early physiological stabilization and accurate diagnosis are essential in this time-sensitive medical emergency [2]. Critically ill patients

require neurological evaluation to determine their status, prognosis, and therapy. For accurate decision-making and outcome prediction in the early stages of patient assessment, utilizing a suitable scale is crucial. Two commonly used scales are the Glasgow Coma Scale (GCS) and the Full Outline of Unresponsiveness (FOUR) Scale, which assess the consciousness status of critically ill patients [3]. Due to a lack of training, medical staff often face several ethical, social, and financial challenges when managing patients with severe brain injuries [4]. To provide optimal care for patients with consciousness issues, nurses must acquire specialized knowledge, competencies, and skills to implement conventional plans and activities tailored to the unique needs of these non-communicative patients [5].

An excessive number of prognostic models have been created to forecast patient outcomes since the 1970s [6]. Determining the initial diagnosis, the course of treatment, and the prognosis for the patient all depend on choosing and utilizing an effective diagnostic tool from the start [7]. The Edinburgh-2 coma scale, Glasgow-Liege scale, Pittsburgh brain stem score, Comprehensive state of awareness scale, Reaction Level Scale, Innsbruck Coma Scale, GCS, and FOUR scale are mainly used in assessment of neurological status [8,9]. However, healthcare professionals prefer using the GCS. On the other hand, the Glasgow-Liege Scale, the Pittsburgh Brainstem Score, and the FOUR Scale, which examine brainstem functions and are more sensitive than the GCS, are not used as frequently [10,11]. While these scoring systems are significant for making therapeutic judgments and identifying patients with uncertain outcomes, they are also useful for detecting unclear outcomes [10].

The GCS was first created in 1974 to provide a more objective assessment of a person's neurological status [12]. It is commonly used to predict an individual's outcome in the intensive care units (ICUs) [7]. The GCS has a high level of reliability which comprises three main components, namely, eye, verbal, and motor responses [13]; however, many studies from the 1990s have shown that experience with this scale is crucial, since novice observers can make significant errors in evaluation and revealed a gap between clinical practice and knowledge which suggested additional training for nurses [14]. Despite its extensive use, the GCS has limitations including its reliability and predictive validity [7]. Moreover, using the GCS did not assist in evaluating the ventilated or aphasic patients and cannot detect differences in breathing patterns and brainstem reflexes [15].

KEY MESSAGES

- Healthcare-associated infections are still a worldwide problem.
- In intensive care units, the most prevalent is intubation-associated pneumonia.
- Nurses' intervention is crucial to prevent and reduce the incidence and prevalence of intubation-associated pneumonia.

The FOUR scale was developed by Wijdicks et al. [16] to address the limitations of the GCS, especially for intubated patients and those with specific neurological impairments [10]. On the other hand, The FOUR Scale was designed to overcome these limitations. It consists of four components that assess eye responses, motor responses, brain stem reflexes, and breathing patterns. Because of the detailed neural information it provides, the FOUR scale is expected to be more effective than the GCS in predicting mortality in critical care units [16]. The FOUR Score features a standardized scoring system that can be used to measure brainstem function in all patients, including those who are unable to speak [17].

The FOUR scale has been shown to be a reliable tool in predicting outcomes among patients with depressed levels of consciousness [18]. It has been used to predict mortality and functional outcomes in a wide range of critically ill patients. For instance, a study was conducted by Abdallah, Demaerschalk [19] who revealed that the FOUR and GCS scale are simple to use, as evidenced by the consistency of scores given by two different practitioners to the same patient. Additionally, the FOUR Score is particularly useful for evaluating unconscious patients who rely on mechanical ventilation due to its distinct scoring categories. Hence, there has been a worldwide demand to assess the trustworthy instrument for patients with neurological conditions. In the past, most healthcare providers utilized either the FOUR or the GCS scales. The use of these two scales provides a basis for comparing their performance in prognosis and predicting outcomes for critically ill patients. Most researchers have concluded that the FOUR Scale is more reliable for predicting patient outcomes in the ICU [19,20]. However, more than eighty countries continue to use the GCS, which remains the gold standard in evaluating the neurological condition of patients for continuing monitoring, prognosis, and clinical judgment [21,22].

Additionally, access to trustworthy assessment scales is critical in current evidence-based medicine for predicting mortality risk and eventual outcomes in critical care, allowing healthcare providers to assess the severity and prognosis of a patient's illness and make vital healthcare decisions appropriately [23].

Selecting the right scale at the beginning of patient assessment can facilitate management and decision-making of the initial diagnosis, which helps in treating patients effectively. To our knowledge, there have been no previous studies conducted in Palestine comparing the FOUR and GCS scales in predicting mortality among patients with neurological disorders. Hence, the purpose of this study is to compare the FOUR and GCS scales among patients with neurological disorders in ICUs in the West Bank.

MATERIALS AND METHODS

Ethical Considerations

The Research Ethics Committee of the Arab American University in the Palestinian Ministry of Health approved the study (No. 2022/015). Additionally, the research study was conducted in accordance with the Declaration of Helsinki. If a participant was asleep, a permission form was collected from them since informed consent was waived, and they had the option to withdraw from the study or refuse participation. Each patient signed an informed consent form; if the patient was unconscious, his/her family provided consent. Additionally, all study participants were given code names to maintain their anonymity and confidentiality.

Study Design and Setting

A comparative, prospective, observational, cross-sectional design was used.

Settings and Population

Patients with neurological disorders admitted to ICUs at three hospitals in the West Bank between March and May 2022 were recruited for this study. To calculate the prediction of mortality and actual results on both scales, all information was acquired by evaluating patients using data sheets. An-Najah National University Hospital (NNUH), Rafedia Surgical Hospital, and Al-Watani Hospital in Nablus were the major referral hospitals in the West Bank. The first hospital is an academic-teaching affiliated, non-profit medical institution that was established in 2013 in cooperation with the Faculty of Medicine and Health Sciences of NNUH in Nablus. The hospital comprises 120 general admission beds and 18 adult ICU beds. It provides clinical education and training to current and future health professionals.

In addition, Rafedia Surgical Hospital is located in Nablus and is related to the Ministry of Health. This center receives patients from the West Bank and provides education and training opportunities for students. Al-Watani Governmental Hospital was established in 1,888 and specializes in internal medicine. It consists of 74 beds including 11 ICU and critical care unit beds. Rafedia Surgical Hospital was founded in 1976 and receives surgical cases. It has 200 beds, including 13 ICU beds. The target population comprises adult patients (1) over 18 years old and (2) who have been admitted to ICUs for at least 48 hours to treat neurological disorders. Based on hospital records, each institution treats 10–15 patients with neurological disorders each month (Figure 1).

Sampling Calculation

The sample size was calculated using Open EPI and guided by formulas reported by Bailey et al. [24] and Israel [25]. Based on the calculation, 80 patients would be required. However, we aimed to enroll 84 participants to account for potential dropouts. The sample was taken as follows: 27 patients (32.1%) from NNUH, 29 patients (34.5%) from Rafedia Surgical Hospital, and 28 patients (33.3%) from Al-Watani Governmental Hospital.

Data Collection Tools

A structured observational checklist with four components was created to collect data from each patient. (1) Demographics including age, sex, consciousness status, medical diagnosis, length of ICU stay, educational attainment, occupation, diagnosis, prior surgical and medical history, and whether or not the patient was sedated or intubated were all the variables that taken into account. (2) The GCS score evaluates the level of consciousness of the patient upon admission, after 48 hours, and upon discharge from the ICU. A GCS score of 13–15 indicates mild injury; a score of 9–12, moderate injury; and a score of 3–8, severe injury [26]. Each patient was followed up after 1 month to determine whether patient had died. (3) The FOUR scale was used to assess patients on admission, after 48 hours, and upon discharge. Additionally, each patient was evaluated after 1 month to determine if they had died. (4) Patient outcome after 1 month (dead or alive) and the predicted outcome based on calculated cut-off scores of 6 for the GCS

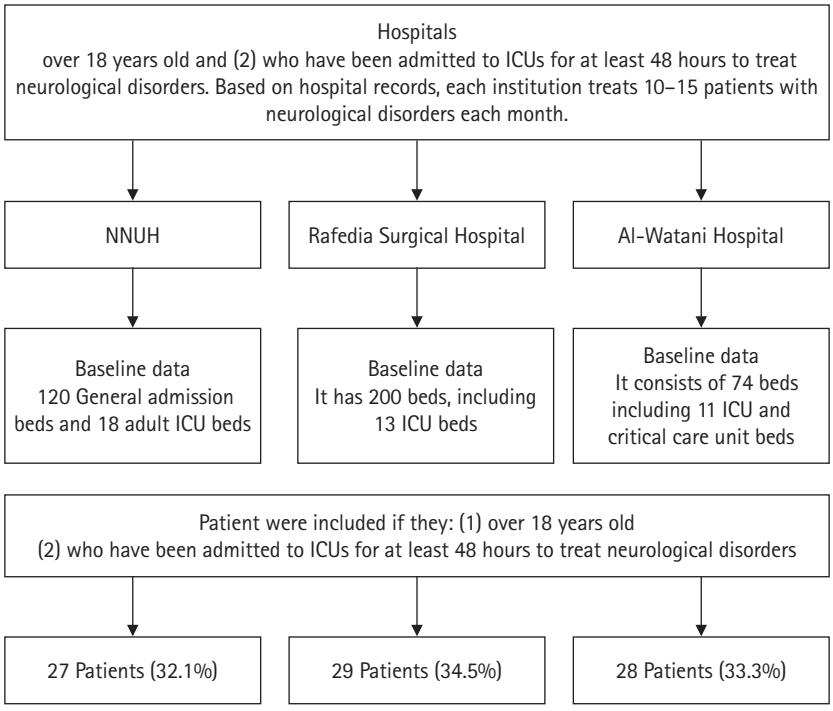

Figure 1. Flowchart of the Patient Selection Process for the Study on Neurological Disorders in intensive care units (ICUs) in the West Bank. NNUH: An-Najah National University Hospital.

and 9 for the FOUR score [3]. The calculated cut-off score of the FOUR scale among ICU neurological patients was 8, with a sensitivity of 0.94 and a specificity of 0.71. The calculated cut-off GCS score was 8.5, with a sensitivity of 0.94 and a specificity of 0.76.

Face validity was assured; after constructing the data collection sheet, it was reviewed by a panel of experts: an anesthesiologist in the ICU, a neurosurgeon, two ICU nurses who were experts in dealing with patients with neurological disorders, and academic doctors. The reliability of the GCS and the FOUR scales has been checked in previous studies [27,28]. In the current study, piloting was done, and Cronbach's alpha was found to be 0.920, revealing a satisfactory result.

Data Collection Procedures

The study's purpose and significance were explained to patients admitted to the ICUs with neurological injuries and/or their families. Each patient was assessed using the GCS and FOUR scales by the researcher. Assessments were conducted upon admission, after 48 hours, and upon discharge from the ICU. Each evaluation took 15–20 minutes. After 1 month, each participant was contacted by either phone call or interview to determine the patient's outcome.

Risk of Bias Management

To ensure the validity and reliability of the collected data in the ICU among recruited patients, a standardized protocol and training were provided to the assessors on the effective usage of GCS and FOUR scales to ensure consistency and reliability in both measurements. Additionally, this study used a prospective design to ensure that all relevant variables were recorded accurately and contemporaneously. Sensitivity analyses were also conducted to test the robustness of findings against different assumptions and potential biases.

RESULTS

Demographic Characteristics of Participants

A total of 84 patients were recruited in the current study. An almost equal number of patients was recruited from each hospital as follows: 27 patients from NNUH, 29 from Rafidia Hospital, and 28 from Al-Watani Hospital. According to the characteristics of the patients participating in the study, the results showed that the percentage of patients was similar across hospitals. The majority were unemployed (n=34, 40.5%), male (n=58, 69.0%), had only a school education (n=36, 42.9%), and had a mean age of 48 years (standard deviation [SD], 21 years)

(Table 1).

Hemorrhagic stroke was the most common neurological disorder among the participating patients (46.4%), followed by ischemic stroke (19%). Medical history (60.7%) was more common than surgical history (33.3%). Approximately 8.3% of patients were sedated, while 25% were intubated. Following up on the level of consciousness among patients using the GCS, the results showed that the average level of consciousness among the patients participating in the study was 11.2 out of 15 upon admission, and it increased to 12.2 out of 15 at the end of their follow-up (Table 2). On the other hand, when following up on the level of consciousness for patients using the FOUR scale, the results showed that the average level of consciousness among the patients participating in the study was 12.2 out of 16 upon admission, and it increased to 12.5 out of 16 at the end of the follow-up (Table 3).

Table 1. Demographic characteristics of the ICU neurological patients

Variable	Number (%)
Hospital	
NNUH	27 (32.1)
Rafedia	29 (34.5)
Alwatani	28 (33.3)
Department	
SICU	26 (31.0)
ICU	58 (69.0)
Sex	
Female	26 (31.0)
Male	58 (69.0)
Area	
Gaza	6 (7.1)
Salfeet	3 (3.6)
Ramallah	8 (9.5)
Qalqelia	5 (6.0)
Nablus	41 (48.8)
Jenin	12 (14.3)
Hebron	2 (2.4)
Bethlehem	1 (1.2)
Tulkarm	4 (4.8)
Tubas	2 (2.4)
Occupation	
Formal employment	6 (7.1)
Self-employed	20 (23.8)
Unemployed	34 (40.5)
Student	9 (10.7)
Other	15 (17.9)
Educational level	
Illiterate	24 (28.6)
Primary	36 (42.9)
University	24 (28.6)
Age (yr)	
Mean±SD	48±21
19–30	25 (29.8)
31–50	16 (19.0)
>50	43 (51.2)

ICU: intensive care unit; NNUH: An-Najah National University Hospital; SICU: surgical intensive care unit; SD: standard deviation.

Comparing the level of consciousness using both the GCS and FOUR scales among ICU neurological patients shows that a score above 12 out of 15 on the GCS indicates a good outcome. Similarly, a score above 12 out of 16 on the FOUR scale also indicates a good outcome. Additionally, actual outcomes at the end of the evaluation of ICU neurological patients show that 20.2% of the patients participating in the study died during their follow-up, while the average hospital stay was 6.42 days.

The chi-square test was used to assess the relationship between the demographic characteristics of the patients participating in the study and mortality at the endpoint. The results showed that the educational level of the patients had a statistically significant relationship with death (χ^2=6.478, P=0.039) (Table 4).

Area under the Curve of FOUR and GCS Scales in Predicting ICU Neurological Patients' Mortality

The receiver operating characteristic (ROC) curve analysis showed that the GCS had an ROC value of 0.926 with a 95% CI of 0.871–0.982, while the FOUR score had an ROC value of 0.941 with a 95% CI of 0.892–0.991 in predicting mortality. This indicates that the FOUR scale had higher discriminatory power than the GCS in predicting hospital mortality outcomes, as shown in Figure 2.

GCS and FOUR Scales' Sensitivity Analysis among ICU Neurological Patients

Sensitivity analysis was used to assess the ability of both scales to predict mortality among ICU patients. The results show that both scales had a high sensitivity upon admission and equal upon discharge to predict mortality. The FOUR scale demonstrated higher specificity in all three phases, and this means that the FOUR scale is more accurate than GCS in predicting outcomes (Table 5).

ICU Neurological Patients Survival Analysis Curve

Figure 3 shows that at admission (0 days) all patients were

Table 2. Level of consciousness among ICU neurological patients' using GCS scales

GCS item		On admission	After 48 hours	On discharge
Eye-opening	No response	4 (4.8)	8 (9.5)	16 (19.0)
	To pain	17 (20.2)	14 (16.7)	1 (1.2)
	To speech	21 (25.0)	6 (7.1)	1 (1.2)
	Spontaneous	42 (50.0)	56 (66.7)	66 (78.7)
Motor response	No response	3 (3.6)	7 (8.3)	15 (17.9)
	Extension to pain	8 (9.5)	6 (7.1)	2 (2.4)
	Flexion with pain	6 (7.1)	7 (8.3)	0
	Withdrawal with pain	7 (8.3)	4 (4.8)	2 (2.4)
	Localizing to pain	27 (32.1)	14 (16.7)	7 (8.3)
	Obeying command	33 (39.3)	46 (54.8)	58 (69.0)
Verbal response	No response	15 (17.9)	24 (28.6)	19 (22.6)
	Inappropriate sound	11 (13.1)	4 (4.8)	0
	Inappropriate words	13 (15.5)	2 (2.4)	1 (1.2)
	Confused	25 (29.8)	16 (19.0)	12 (14.3)
	Oriented	20 (23.8)	38 (45.2)	52 (61.9)
GCS		11.2±3.5	11.6±4.3	12.2±4.7

Values are presented as number (%) or mean±standard deviation.
ICU: intensive care unit; GCS: Glasgow Coma Scale.

Table 3. Level of consciousness using FOUR scales among ICU neurological patients

FOUR scale item		Admission	On 48 hours	Discharge
Eye response	Eyelids remain closed with pain	4 (4.8)	8 (9.5)	16 (19.0)
	Eyelids closed-but open to pain	15 (17.9)	14 (16.7)	1 (1.2)
	Eyelids closed but open to loud voice	13 (15.5)	5 (6.0)	1 (1.2)
	Eyelids opening but not tracking	9 (10.7)	3 (3.6)	1 (1.2)
	Eyelids open or opened, tracking or blinking to command	43 (51.2)	54 (64.3)	65 (77.4)
Motor response	No response to pain or generalized myoclonus status	3 (3.6)	7 (8.3)	15 (17.9)
	Extension response to pain	8 (9.5)	6 (7.1)	2 (2.4)
	Flexion response to pain	12 (14.3)	11 (13.1)	1 (1.2)
	Localizing to pain	25 (29.8)	14 (16.7)	9 (10.7)
	Thumbs up, fist, or peace sign	36 (42.9)	46 (54.8)	57 (67.9)
Brainstem reflexes	Absent pupil, corneal, and cough reflex	1 (1.2)	2 (2.4)	15 (17.9)
	Pupil and corneal reflexes absent	2 (2.4)	5 (6.0)	0
	Pupil or corneal reflexes absent	8 (9.5)	4 (4.8)	0
	One pupil wide and fixed	9 (10.7)	9 (10.7)	2 (2.4)
	Pupil and corneal reflexes present	64 (76.2)	64 (76.2)	67 (79.8)
Respiration	Breath at ventilator rate or apnea	0	4 (4.8)	15 (17.9)
	Breathe above the ventilator rate	17 (20.2)	20 (23.8)	3 (3.6)
	Not intubated irregular breathing	13 (15.5)	7 (8.3)	4 (4.8)
	Not intubated, Cheyne-stocks breathing	15 (17.9)	7 (8.3)	11 (13.1)
	Not intubated, regular breathing	39 (46.4)	46 (54.8)	51 (60.7)
FOUR scale		12.2±4.1	12.4±4.8	12.5±6.1

Values are presented as number (%) or mean±standard deviation.
FOUR: Full Outline of Unresponsiveness; ICU: intensive care unit.

Table 4. Associations between intensive care unit neurological patient's demographic characteristics and outcome at the end of evaluation

Item		Patient outcome		Total	χ^2	df	P-value
		Alive	Death				
Age (yr)	≤18	3 (75.0)	1 (25.0)	4	0.911	3	0.823
	19–30	17 (81.0)	4 (19.0)	21			
	31–50	14 (87.5)	2 (12.5)	16			
	>50	33 (76.7)	10 (23.3)	43			
Sex	Female	20 (76.9)	6 (23.1)	26	0.188	1	0.665
	Male	47 (81.0)	11 (19.0)	58			
Area	Gaza	5 (83.3)	1 (16.7)	6	10.316	9	0.326
	Salfeet	3 (100.0)	0	3			
	Ramallah	8 (100.0)	0	8			
	Qalqelia	5 (100.0)	0	5			
	Nablus	31 (75.6)	10 (24.4)	41			
	Jenin	9 (75.0)	3 (25.0)	12			
	Hebron	2 (100.0)	0	2			
	Bethlehem	0	1 (100.0)	1			
	Tulkarm	3 (75.0)	1 (25.0)	4			
	Tubas	1 (50.0)	1 (50.0)	2			
Occupation	Format employment	6 (100.0)	0	6	7.238	4	0.124
	Self-employment	17 (85.0)	3 (15.0)	20			
	Unemployed	23 (67.6)	11 (32.4)	34			
	Student	9 (100.0)	0	9			
	Other	12 (80.0)	3 (20.0)	15			
Educational level	Illiterate	16 (66.7)	8 (33.3)	24	6.478	2	0.039
	School	28 (77.8)	8 (22.2)	36			
	University	23 (95.8)	1 (4.20)	24			

Values are presented as number (%).

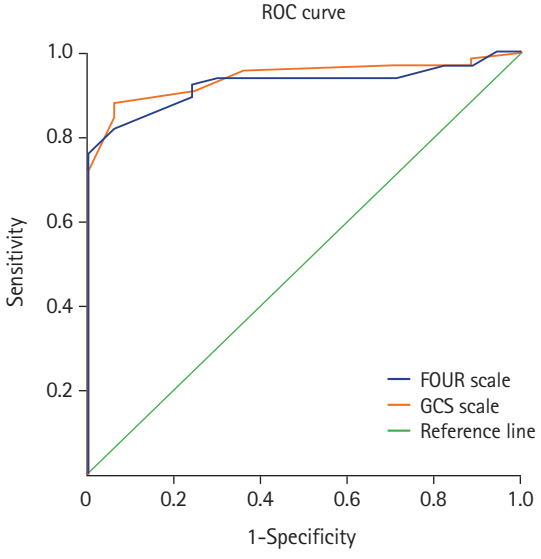

Figure 2. Area under the curve of Full Outline of Unresponsiveness (FOUR) and Glasgow Coma Scale (GCS) scales in predicting intensive care unit neurological patient's mortality. ROC: receiver operating characteristic.

alive, after 48 hours the results showed that 100% of the patients were alive. At 10 days, the probability of survival was 60%. The analysis also shows that by day 13, approximately 42% of the patients were still alive.

Relationship between Predicted GCS at Admission and Actual ICU Neurological Patients' Mortality

Binary logistic regression was performed to establish the relationship between the predicted GCS and actual patient mortality . The logistic regression model was statistically significant, ($\chi^2(1)=8.501$, P=0.004). The model explained 17.0% of the variance in mortality and correctly classified 29.0% of cases. The GCS score at admission was found to be a significant predictor of actual patient mortality (P=0.004; odds ratio [OR], 13.54; 95% CI, 2.349–78.055). The findings show that the GCS score at admission was 13.8 times more likely to predict accurate actual mortality at the end of an evaluation.

A binary logistic regression was also performed to establish the relationship between the predicted FOUR scale and

Table 5. GCS and FOUR scales for predicting ICU neurological patients' mortality

Scale	Cut-off	Period	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
GCS	6.0	At admission	97.4	29.4	84.4	71.4
		After 48 hours	97.0	58.8	90.3	83.3
		Discharge	100.0	94.1	98.5	100.0
FOUR	9.0	At admission	94.0	70.6	92.6	75.0
		After 48 hours	89.6	82.4	95.2	66.7
		Discharge	100.0	100.0	100.0	100.0

GCS: Glasgow Coma Scale; FOUR: Full Outline of Unresponsiveness; ICU: intensive care unit; PPV: positive predictive value; NPV: negative predictive value.

Table 6. Binary logistic regression to assess the relationship between predicted GCS and FOUR scores at admission and actual ICU neurological patients' mortality

	B	SE	Wald	df	P-value	OR	95% CI
GCS prediction at admission	2.606	0.894	8.501	1	0.004	13.542	2.349–78.055
Constant	−4.295	1.046	16.851	1	0.000	0.014	
FOUR predictions at admission	3.632	0.741	24.023	1	0.000	37.800	8.845–161.549
Constant	−6.166	1.094	31.767	1	0.000	0.002	

Variables entered on step 1: predict outcome by GCS admission.
GCS: Glasgow Coma Scale; FOUR: Full Outline of Unresponsiveness; ICU: intensive care unit; SE: standard error; OR: odds ratio.

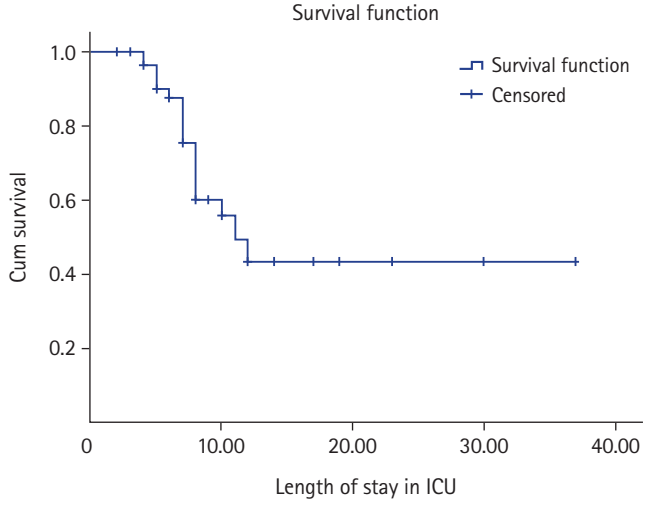

Figure 3. Survival analysis curve of neurological intensive care unit (ICU) study participants.

actual patient mortality. The logistic regression model was statistically significant, (χ^2 (1)=24.023, P<0.001). The model explained 48.5% of the variance in mortality and correctly classified 70.6 % of cases. FOUR scores at admission were found to be a significant predictor of actual patient mortality (P<0.001; OR, 37.80; 95% CI, 8.845–161.549]. The findings show that the FOUR score at admission was 37.8 times more likely to predict accurate mortality at the end of evaluation (Table 6).

DISCUSSION

The study presents its findings to investigate the predictive power of the GCS and the FOUR score in ICUs in the West Bank concerning patient outcomes and death. This study shows that most critically ill patients were male and had stroke-related medical illnesses. These findings align with earlier studies conducted by Qasem Surrati et al. [29] and Özçelik and Celik [30], which reported that more than half of the participants were men. The higher incidence of stroke among men may be attributed to the high rate of smoking and higher intake of fatty foods among Palestinian men leading to a high prevalence of atherosclerosis. Additionally, it has been demonstrated that estrogen's benefits shield women from stroke, while men are more genetically susceptible to having a stroke. At the same time, men were more genetically susceptible than women to having a stroke [31]. Men are also more likely to be exposed to car accidents than women, which is consistent with a study by Wilberforce et al. [32] that showed an increase in the number of men involved in traffic accidents in Kenya.

The level of education is found to be significantly correlated with the mortality rate. Most of the critically ill patients in the

current study had a secondary level of education. This finding was consistent with a study by Abira [3], which found that people with higher levels of education used their knowledge to stay healthy, and there is a correlation between education level and mortality and health conditions. Additionally, long-term wellness can be promoted by receiving psychological, social, and emotional support. The most prevalent neurological condition among the individuals was hemorrhagic stroke followed by ischemic stroke. These figures differ from those reported by Erkabu et al. [33], who found percentages of 59.4% for ischemic stroke and 40.6% for hemorrhagic stroke. Around 8.3% of the patients in this study had received only light sedation, while 29% had undergone intubation. Sedation lowers both the GCS and the FOUR score in trauma patients, with the mean GCS score being higher than the mean FOUR score, according to the study performed by Vaisi Raygani et al. [34]. Additionally, the FOUR score outperforms the GCS in determining the level of consciousness among sedated patients.

The results in the ICU can vary significantly for patients who are sedated and intubated, depending on several factors, such as the reasons for the ICU admission, the patient's general condition, the duration of sedation and intubation, and the standard of ICU treatment [35]. For example, due to the severity of their conditions, patients who are sedated and intubated often have higher ICU mortality rates compared to non-intubated patients [36]. This finding is consistent with a study by Mortensen et al. [36], which reported that mortality rates remain high after ICU discharge, with some patients dying from complications arising from their original illness or their stay in the ICU due to prolonged ventilation, complications of ventilation, and failure rates of the weaning process.

At admission, the mean GCS was 11.2 (SD, 3.5); at 48 hours, it was 11.6 (SD, 4.3); and at discharge, it was 12.2 (SD, 4.7). These figures show a better condition than that stated by Abira [3], who stated that the patient's GCS scores were 9/4 upon admission, 9/4 after 48 hours, and 10/5 upon discharge. Using the FOUR scale, the findings showed that the average score was 12.2 (SD, 4.10) at admission, 12.4 (SD, 4.77) after 48 hours, and it was 12.47 (SD, 6.07) upon discharge. The results of this study show higher levels of consciousness than those stated by Abira [3], who reported values of 104 at admission, 74.5 at 48 hours, and 11.35 at discharge.

In a study conducted in Kenya, the researchers used a cut-off score of 8 for the GCS and 9 for the FOUR score to determine the death rate. A GCS score of fewer than 8 was associated with a 2.7-fold higher risk of mortality, while a FOUR score of less than 11 was associated with a 2-fold higher risk of death [19]. At the end of the evaluation, the GCS score at admission was 13.8 times more likely to accurately predict actual mortality. Additionally, the likelihood that the FOUR score at admission would accurately predict actual mortality at the end of the evaluation was increased by 37.8 times. According to a study conducted in Egypt by Abd Elrazek Baraka and Shalaby [37], the FOUR score at admission was more accurate at predicting death than the GCS at admission (92.3% vs. 46.5%). At admission, both the GCS and the FOUR scores were highly sensitive in predicting death (97.4% and 94%, respectively). After 48 hours, the GCS continued to be more sensitive than the FOUR score to predict patient mortality (97.0% and 89.6%, respectively). The sensitivity of both scales in predicting mortality at the 1-month follow-up was 100%. This indicates that the GCS predicted death more accurately than the FOUR score both at admission and 48 hours following admission to the ICU.

Both the GCS and the FOUR score failed to accurately predict death upon admission, according to Abira [3]. The FOUR scores, however, performed marginally better than the GCS in predicting survival rate, with a sensitivity of 68% compared to the GCS's sensitivity of 48%. The FOUR score is therefore more reliable than the GCS. The FOUR score demonstrated 100% sensitivity for predicting mortality after 48 hours. The FOUR score had 100% sensitivity, while the GCS had 98% sensitivity in predicting survival after the examination. The FOUR score displayed discrimination similar discrimination to the GCS in a different investigation, according to the findings of a study conducted by Amirtharaj et al. [27]. Additionally, a study performed by Sepahvand et al. [38] reported that the GCS exhibited a lower specificity but greater sensitivity (85% vs. 76%, respectively) compared to the FOUR score.

For the benefit of both nurses and patients, a comparison of the GCS and FOUR score to forecast patient outcomes with neurological disorders in ICUs is highly significant. It aids in education and training, improves communication, strengthens assessment abilities, encourages better clinical decision-making, and maximizes resource allocation for nurses. For patients, it results in better outcomes, higher standards of care, increased safety, higher levels of satisfaction from patients and their families, and better recuperation and rehabilitation are the results for patients. All things considered, the study advances nursing practice and enhances patient care in critical care environments.

In light of the study findings, it is recommended to conduct a training session for nurses and healthcare professionals to share the most recent recommendations regarding the usefulness of both scales in critical care settings, offer healthcare practitioners instruction and training on how to use both scales effectively, educate nurses on how to evaluate a patient's neurological state, so that outcomes can be predicted more accurately in healthcare facilities.

Strengths and Limitations

The therapeutic relevance, real-time data collection, and direct comparison of assessment tools in a prospective cross-sectional study comparing the GCS and the FOUR score to predict patient outcomes with neurological disorders in ICUs include its therapeutic relevance, real-time data collection, and direct comparison of assessment tools. However, limitations include the cross-sectional design, inherent biases, patient population variability, difficulties with outcome measurement, and generalizability.

Conclusion

The findings show that the GCS and the FOUR scales both have strong prediction values for patient outcomes and help identify the level of consciousness. For evaluating patients in the ICU, the FOUR scale is a more accurate tool than the GCS due to its high sensitivity and specificity. Even though most ICU patients are intubated and/or under general anesthesia, the FOUR scale is more comprehensive because it lacks a verbal component and may assess respiration and brainstem reflexes. As a result, the FOUR score was better at forecasting ICU patient death.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

FUNDING

None.

ACKNOWLEDGMENTS

The authors would like to thank all the participants in this study.

ORCID

Imad Rasheed Abu Khader https://orcid.org/0000-0001-9675-9078
Salam Bani Hani https://orcid.org/0000-0003-0848-5615
Mohammed ALBashtawy https://orcid.org/0000-0002-6107-7605

AUTHOR CONTRIBUTIONS

Conceptualization: WMO. Formal analysis: IRAK. Data curation: WMO. Visualization: IRAK, SBH. Writing - original draft: MA. Writing - review & editing: SBH. All authors read and agreed to the published version of the manuscript.

REFERENCES

1. Cooksley T, Rose S, Holland M. A systematic approach to the unconscious patient. Clin Med (Lond) 2018;18:88-92.
2. Abdo WF, Broerse CI, Grady BP, Wertenbroek AA, Vijlbrief O, Buise MP, et al. Prolonged unconsciousness following severe COVID-19. Neurology 2021;96:e1437-42.
3. Abira DK. A comparison of the Glasgow Coma Scale with full outline of unresponsiveness scale in prediction of patient outcomes in the critical care unit at Kenyatta National Hospital. [dissertation]. University of Nairobi; 2020.
4. Demirbilek H, Vuralli D, Haris B, Hussain K. Managing severe hypoglycaemia in patients with diabetes: current challenges and emerging therapies. Diabetes Metab Syndr Obes 2023;16:259-73.
5. Marino MH, Whyte J. Treatment trials in disorders of consciousness: challenges and future directions. Brain Sci 2022;12:569.
6. Wiberg S, Hassager C, Stammet P, Winther-Jensen M, Thomsen JH, Erlinge D, et al. Single versus serial measurements of neuron-specific enolase and prediction of poor neurological outcome in persistently unconscious patients after out-of-hospital cardiac arrest: a TTM-Trial Substudy. PLoS One 2017;12:e0168894.
7. Ramazani J, Hosseini M. Comparison of full outline of unresponsiveness score and Glasgow Coma Scale in medical intensive care unit. Ann Card Anaesth 2019;22:143-8.
8. Reith FC, Van den Brande R, Synnot A, Gruen R, Maas AI. The reliability of the Glasgow Coma Scale: a systematic review. Intensive Care Med 2016;42:3-15.
9. Kornbluth J, Bhardwaj A. Evaluation of coma: a critical appraisal of popular scoring systems. Neurocrit Care 2011;14:134-43.
10. Foo CC, Loan JJM, Brennan PM. The relationship of the FOUR score to patient outcome: a systematic review. J Neurotrauma

2019;36:2469-83.
11. Anestis DM, Tsitsopoulos PP, Tsonidis CA, Foroglou N. The current significance of the FOUR score: a systematic review and critical analysis of the literature. J Neurol Sci 2020;409:116600.
12. Jain S, Iverson LM. Glasgow coma scale. StatPearls Publishing; 2024.
13. Wahlster S, Wijdicks EF, Patel PV, Greer DM, Hemphill JC 3rd, Carone M, et al. Brain death declaration: practices and perceptions worldwide. Neurology 2015;84:1870-9.
14. Kanwal NA, Inayat AM, Zarnigar AJ, Anjum SA, Anjum NA, Latif WA. Knowledge & practice of GCS among nurses working at ICU: cross sectional study. Pak J Med Health Sci 2022;16:131-3.
15. Jalali R, Rezaei M. A comparison of the Glasgow Coma Scale score with full outline of unresponsiveness scale to predict patients' traumatic brain injury outcomes in intensive care units. Crit Care Res Pract 2014;2014:289803.
16. Wijdicks EF, Bamlet WR, Maramattom BV, Manno EM, McClelland RL. Validation of a new coma scale: the FOUR score. Ann Neurol 2005;58:585-93.
17. Almojuela A, Zeiler FA, Hasen M, Honey CM. P.059: A systematically conducted review of the Full Outline of UnResponsiveness (FOUR) score and its use in outcome prediction. Can J Neurol Sci 2018;45(s2):S31.
18. Dwivedi A, Singh NK, Mehta A, Singh AK, Chaudhary PK. A comparative study to evaluate prognostic value of Glasgow Coma Score and Full Outline of Unresponsiveness Scale to predict the outcome of unconscious child in the paediatric intensive care unit. J Med Evid 2003;4:207-12.
19. Abdallah A, Demaerschalk BM, Kimweri D, Aden AA, Zhang N, Butterfield R, et al. A comparison of the Full Outline of Unresponsiveness (FOUR) and Glasgow Coma Scale (GCS) scores in predicting mortality among patients with reduced level of consciousness in Uganda. Neurocrit Care 2020;32:734-41.
20. Hassan AA, Ahmed H, Kandeel NA. Evidence related to predictive scales for trauma patients' outcome: literature review. Mansoura Nurs J 2022;9:163-76.
21. Alhassan A, Fuseini AG, Musah A. Knowledge of the Glasgow Coma Scale among nurses in a tertiary hospital in Ghana. Nurs Res Pract 2019;2019:5829028.
22. Aleid A, Alzahrani BS, Alameer MH, Alhassan AJ, Alahmed I. Bilateral spontaneous resolution of traumatic epidural hematoma: a case report and literature review. Cureus 2023;15:e39379.
23. Bayraktar YS, Sahinoglu M, Cicekci F, Kara I, Karabagli H, Duman A, et al. Comparison of Glasgow Coma Scale and Full Outline of Unresponsiveness (FOUR) score: a prospective study. Turk Neurosurg 2019;29:285-8.
24. Bailey CS, Fisher CG, Dvorak MF. Type II error in the spine surgical literature. Spine (Phila Pa 1976) 2004;29:1146-9.
25. Israel GD. Determining sample size. University of Florida Cooperative Extension Service, Institute of Food and Agriculture Sciences, EDIS; 1992.
26. Basak D, Chatterjee S, Attergrim J, Sharma MR, Soni KD, Verma S, et al. Glasgow coma scale compared to other trauma scores in discriminating in-hospital mortality of traumatic brain injury patients admitted to urban Indian hospitals: a multicentre prospective cohort study. Injury 2023;54:93-9.
27. Amirtharaj AD, Balachandran S, Gujjar AR, Arulappan J, Jaypal SK. Comparison of Full Outline of Unresponsiveness (FOUR) and Glasgow Coma Scale (GCS) in determining outcome among patients in critical care units: a prospective study. Int J Nutr Pharm Neurol Dis 2023;13:145-51.
28. Yan X, Xiao L, Liao M, Huang J, He Z, Yan T. The validity, reliability and feasibility of four instruments for assessing the consciousness of stroke patients in a neurological intensive care unit compared. BMC Med Res Methodol 2022;22:102.
29. Qasem Surrati AM, Mohammedsaeed W, Shikieri AB. Cardiovascular risk awareness and calculated 10-year risk among female employees at Taibah University 2019. Front Public Health 2021;9:658243.
30. Özçelik EE, Celik S. Comparison of the Turkish versions of the Glasgow coma scale and four score used by intensive care nurses for neurological evaluation. J Clin Nurs 2022;31:1397-406.
31. Bani Hani S, Ahmad M. Effective prediction of mortality by heart disease among women in Jordan using the chi-squared automatic interaction detection model: retrospective validation study. JMIR Cardio 2023;7:e48795.
32. Wilberforce C, Odero W, Menya D. Commercial bicyclist injuries in Kisumu City, Kenya: an epidemiology of a neglected problem. Int J Innov Sci Res 2015;14:228-35.
33. Erkabu SG, Agedie Y, Mihretu DD, Semere A, Alemu YM. Ischemic and hemorrhagic stroke in Bahir Dar, Ethiopia: a retrospective hospital-based study. J Stroke Cerebrovasc Dis 2018;27:1533-8.
34. Vaisi raygani AA, Darabi M, Jalali R, Beiki O, Abdi A. Investigating RTS, TRISS, GCS, and FOUR as measures for predicting the mortality in trauma patients: a prospective study. J Emerg Med Trauma Acute Care 2023;1:2.
35. Olsen HT, Nedergaard HK, Strøm T, Oxlund J, Wian KA, Ytrebø LM, et al. Nonsedation or light sedation in critically ill, mechanically ventilated patients. N Engl J Med 2020;382:1103-11.
36. Mortensen CB, Kjær MN, Egerod I. Caring for non-sedated mechanically ventilated patients in ICU: a qualitative study com-

paring perspectives of expert and competent nurses. Intensive Crit Care Nurs 2019;52:35-41.
37. Abd Elrazek Baraka A, Shalaby SA. Effect of training sessions about Full Outline of Un-Responsiveness scale compared to Glasgow Coma Scale on nurses' performance, perception and its reliability. Egypt J Health Care 2021;12:54-72.
38. Sepahvand E, Jalali R, Mirzaei M, Ebrahimzadeh F, Ahmadi M, Amraii E. Glasgow Coma Scale versus Full Outline of UnResponsiveness Scale for prediction of outcomes in patients with traumatic brain injury in the intensive care unit. Turk Neurosurg 2016;26:720-4.