

## Comparative Study between Glasgow Coma Scale and Full Outline of Unresponsiveness Scale in Clinical Outcomes Prediction of Neurological Disorders Patients

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### ABSTRACT

**Background:** Neurological disorders (NDs) that affect the nervous system as trauma to the brain as well as spinal cord. NDs are the main cause of disability and death in the world, and they affect consciousness. Assessment level of consciousness are done through Glasgow coma scale (GCS) and Full Outline of Unresponsiveness Scale (FOUR).  
**Objective:** The present study aimed to compare between FOUR and GCS.

**Patients and methods:** A comparative exploratory study was conducted at Intensive Care Unit and surgical emergency at Elminya University Hospitals. A purposeful sampling yielded a total of 126 patients with traumatic brain injury (TBI) or traumatic spinal cord injury (TSCI) in adults. All participants were subjected to structured interview questionnaire, GCS, FOUR, and Glasgow Outcome Scale Extended (GOSE).

**Results:** GCS and FOUR scores of the studied patients had a proper cut-off predictive value  $\leq 12$ , but GCS was more specific and accurate than FOUR in the predictability of full recovery. Both scores were similar for the prediction of loss of consciousness (LOS) in hospital with the same cut-off  $\leq 13$  at the 24 hours. There was a statistically significant correlation between GOSE, GCS, and FOUR.

**Conclusion:** GCS is the same as FOUR score in predicting clinical outcomes but FOUR can assess patients on mechanical ventilation and predict clinical outcomes for intubation, weaning of ventilator, and speech impairment. Predicting death and full recovery using the FOUR score is more accurate than using the GCS. Continuous Educational programs should be planned to ICU and using GCS and FOUR.

**Keywords:** Clinical Outcomes, Extended Glasgow Outcomes scale, Full Outline of Unresponsiveness Scale, Glasgow Coma Scale, Neurological Disorders.

### INTRODUCTION

Debilitating conditions affecting the brain, spinal cord, or nerves are classified as neurological disorders. As a result, the central nervous system, the peripheral nervous system, the cranial nerves, the nerve roots, the vegetative nervous system, the neuromuscular junction, and the muscles are all negatively impacted. Infections of the nervous system, brain tumors, traumatic disorders of the nervous system (such as head injuries), and neurological disorders (NDs) caused by malnutrition are all included in this category, as are epilepsy, Alzheimer's disease, dementias, and cerebrovascular diseases like stroke, migraine and other headaches, multiple sclerosis, and Parkinson's disease. Not only are ND the leading cause of disability, but they are also the second leading cause of death worldwide <sup>(1)</sup>.

An external mechanical force can cause temporary or permanent secondary injuries in the brain, a condition known as traumatic brain injury. Consciousness can be altered to the point where cognitive, somatic, and social processes are impaired. Traumatic brain injuries are a primary cause of death, disability, and morbidity

globally, with an estimated 5.3 million Americans living with the effects of one <sup>(2)</sup>.

The term "spinal cord injury" (SCI) refers to any damage to the spinal cord that results in either a temporary or permanent impairment of the cord's ability to perform its normal functions. Causes of spinal cord injuries can be either traumatic or non-traumatic. A traumatic spinal cord injury (SCI) occurs when the spinal cord is suddenly and severely damaged by an external physical impact, such as in a car accident, a fall, while playing sports, or as the result of violence, and a non-traumatic SCI occurs when the spinal cord is damaged by an acute or chronic disease process, such as a tumor, an infection, or degenerative disc disease <sup>(3)</sup>.

The Glasgow coma scale (GCS) was originally created in 1974 to evaluate patients' degree of consciousness after traumatic brain injury. Since then, it has been widely used to evaluate patients' level of consciousness after admission to Intensive Care Units. Multiple scales to evaluate consciousness have been developed because of the GCS's inability to accurately assess intubated patients' verbal replies and brainstem reflexes <sup>(4)</sup>.

Although the GCS evaluates eye movement, verbal response, and motor response, it cannot differentiate between a patient in a vegetative state and one with a mildly impaired degree of consciousness; the full outline of unresponsiveness scale does <sup>(5)</sup>.

Glasgow Outcome Scale Extended (GOSE) used as a global scale for functional outcomes that categorizes patient into levels of disability ranging from Good recovery, disability, vegetative state and death which is used by the researcher for recording the clinical outcome of patients with neurological impairment <sup>(6)</sup>.

The nurse should conduct a thorough assessment, record any shifts in the patient's state of consciousness, pay close attention to the patient's diagnosis and medication regimen, and look over any prior neurologic exams to spot any anomalies. It is important to remind the nurse that numerous drugs, including sedatives and opioids, can have an impact on loss of consciousness (LOS) <sup>(7)</sup>.

According to the Global Burden of Diseases study, neurological illnesses were the leading cause of disability and the second leading cause of death worldwide in 2010. More than a billion people worldwide suffer from neurological illnesses, says the World Health Organization. Neurodegenerative diseases have been on the rise as people live longer, which explains this phenomenon. Due to reasons such as a shortage of medical professionals and infrastructure, developing countries bear a disproportionately high burden of traumatic neurologic illnesses <sup>(8)</sup>.

According to data collected by the CDC, around 1.5 million Americans experience a traumatic brain injury each year (TBI). About 230,000 of them are receiving medical care in hospitals. In 2000, 10,958 people were identified as having a traumatic brain injury. In 2015, this figure hit an all-time high of 344,030. Regardless of degree of TBI severity, mortality hovers around 3% <sup>(23)</sup>. In the MENA region, traumatic SCI occurred at a rate of 23.24 per one million people each year. The average age of traumatic SCI patients was 31.32 years old, and 77 percent of patients were males <sup>(10)</sup>. A total of 11,098 traffic accidents were reported in Egypt in 2017, a drop of 24.6% from the 2016 total of 14,710. A total of 3,747 individuals were killed, 13,998 were injured, and 17,201 vehicles were damaged as a result of these incidents, making them a significant public health issue and accounting for 17.2 percent of trauma patients in Egypt <sup>(11)</sup>. At Elminya University Hospitals (Egypt), the flow rate of adult trauma admissions at 2019 was 307 cases of the total ICU admissions in neuro ICU <sup>(12)</sup>.

The purpose of this study was to evaluate the accuracy of the Glasgow coma scale versus the full outline of unresponsiveness scale in predicting clinical outcomes for patients with neurological diseases: (1) Assess clinical outcomes of neurological disorders patients using GCs.

(2) Assess clinical outcomes of neurological disorders patients using FOUR scale. (3) Compare between GCS and FOUR scale in predicting clinical outcomes of neurological disorder patients.

## PATIENTS AND METHODS

**Study design:** A comparative exploratory design. A randomized, controlled clinical trial was conducted on 126 adult patients with neurological problems.

**Study setting:** Elminya University Hospitals' Intensive Care Unit and Surgical Emergency Department served as the study's site.

### Operational definitions:

**Neurological disorders** are disorders and diseases that affect the nervous system and affect people of all ages, in our study it was included traumatic neurologic injury as traumatic (TBI) and traumatic (SCI).

**Clinical outcomes** are a term means transfer patient from traumatic intensive care unit to general surgical unit and patient condition with neurological disorders as TBIs & SCIs at the time of shifting to the ward or discharge after a period of up to 2 weeks that measured by (GOSE).

**Tools for data collection:** The following methods were used to gather information for this study:

**Tool I (A Structured Interview questionnaire):** It was adapted from **Suresh et al.** <sup>(13)</sup> and it was modified by the investigator after reviewing the relevant literature to be suitable for the present study. It was consisted of two parts:

**Part (1) Patients' demographic data:** which included; sex, age, place of residence, occupation, marital status and mode of transportation.

**Part (2) Medical characteristics:** It was included past and present medical characteristics, including; diagnosis, length of hospital stay, Cause of injury, intubation, vital signs on admission, diagnostic studies and vital signs before discharge.

**Tool II (GCS):** This system, called the GCS, was originally developed by **Teasdale and Jennett** <sup>(14)</sup> to assess patients level of consciousness.

**Tool III (FOUR):** It was adopted from **Wijdicks et al.** <sup>(15)</sup> to assess patients with an impaired level of consciousness.

**Tool IV (GOSE):** It was adopted from **Jennett and Bond** <sup>(16)</sup> and evaluated the clinical results of severe brain injury. GOSE scale score, which reflects functional limits at 2 weeks due to injury across many life domains.

**Operational steps:**

It involved three phases namely, preparatory phase, validity and reliability, pilot study and field work.

**A- Preparatory phase:** During this stage, the researcher not only visited the site to become acquainted with the personal and study settings, but also reviewed relevant literature and theoretical knowledge from books, papers, the internet, periodicals, and magazines to develop methods for data collection.

**Validity:** Five specialists from the faculty of nursing at Helwan University assessed the generated tools for completeness, accuracy, clarity, relevance, and applicability before they were submitted for approval.

**Reliability:** Internal reliability was calculated using Cronbach's Alpha. Cronbach alpha for A Structured Interview questionnaire 0.738, GCS 0.720, FOUR 0.71 and GOSE 0.872.

**B- Pilot study:** Thirteen patients, or 10% of the total sample, participated in the pilot study to evaluate the study's efficiency and ensure that all questions were understandable. Changes were made in light of the findings. The pilot study participants were not continued in the full study, but rather replaced by other patients.

**Field Work:**

- The Helwan University School of Nursing Research Ethics Committee gave their approval.
- Elminya University Hospitals' directors gave their official approval for the study to be undertaken before it began.
- First, the investigator introduce herself to the studied subjects or families if they were present, and give brief explanation about the study and its purpose before any data collection. Also, patient medical records at hospital to collected patient data.
- Within six months, from September 2021 to February 2022, we were able to start and finish collecting data.
- The average assessment by the investigator utilizing the GCS and FOUR scales takes between 20 and 30 minutes.
- During the six-month data collection of cases, it was found that the cases in the ICU were all traumatic brain injuries, only with one case of traumatic spinal cord injury admitted and less than 18 years old, so all patients' TBIs.

- For the purpose of assessing clinical outcome data using GOSE, the investigators followed the patients until they were transferred out of the intensive care unit or were discharged. This process typically takes 20-30 minutes.

**Administrative steps:**

Access to the sample elements and the beginning of data collection were made possible thanks to a letter explaining the study's goal and method that was sent to the Dean of the college of Nursing at Helwan University and the directors of Elminya University Hospitals. The proper authorities granted approval for the research to be conducted.

**Ethical considerations:**

**The Scientific Research Ethics Committee of Helwan University has approved this study to proceed. All patients were provided with all relevant information prior to participating voluntarily (patients' family) before giving an informed consent, including the purpose of the study and the participant's expected contributions.**

**Ethical considerations included providing participants with information about the study's goals and methods, outlining their right to withdraw at any time, and guaranteeing that their personal data would not be shared without their consent. There was a respect for morality, culture, and religion.**

**Statistical analysis**

Statistical information was displayed as mean, standard deviation (SD), and range. Frequencies (n) and percentages (%) were used to display qualitative data (percent). Cronbach's alpha reliability coefficient was used to determine the survey's credibility. Typically, the value of Cronbach's alpha, a measure of reliability, falls somewhere between 0 and 1.

Values of Cronbach's alpha above 0.7 indicate sufficient reliability. Values for full recovery and death were predicted using a ROC curve test based on the relationship between FOUR and GCS. Correlations between variables were calculated using Spearman's correlation coefficient. The cutoff point for significance was determined to be P 0.05. IBM1 ® SPSS® Statistics Version 24 for Windows was used for the statistical analysis.

**RESULTS**

Table 1 summarizes the demographic characteristics of the participants.

**Table (1): Demographic characteristics of the studied patients (n=126)**

Variables	Studied Patients	
	N	%

<b>Age group:</b>		
18 < 30 yrs.	39	31
30 < 40 yrs.	44	<b>34.9</b>
40 < 50 yrs.	25	19.8
50 ≥ 60 yrs.	18	14.3
<b>Mean± SD</b>	37.46 ± 13.97	
<b>Place of residence:</b>		
Urban	77	<b>61.1</b>
Rural	49	38.9
<b>Occupation:</b>		
Employee	22	17.5
Worker	48	<b>38.1</b>
House wife	40	31.7
Student	16	12.7
<b>Marital Status:</b>		
Single	30	<b>23.8</b>
Married	92	73
Divorced	2	1.6
Widow	2	1.6
<b>Mode of transportation:</b>		
Self/ Family	6	4.8
Ambulance	120	<b>95.2</b>

Figure 1 reveals that regarding to gender 65.1% of the studied patients were male.

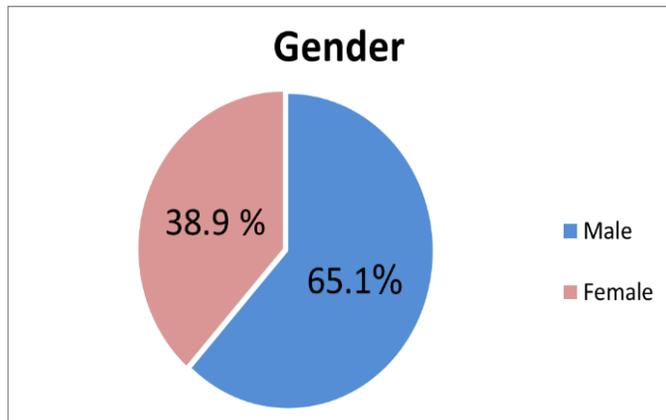


Figure (1): The sex distribution of the patients analyzed in percentage (n=126).

Table 2 illustrates the medical characteristics of the studied patients.

Table (2): Frequency distribution of the medical characteristics of the studied patients (n=126).

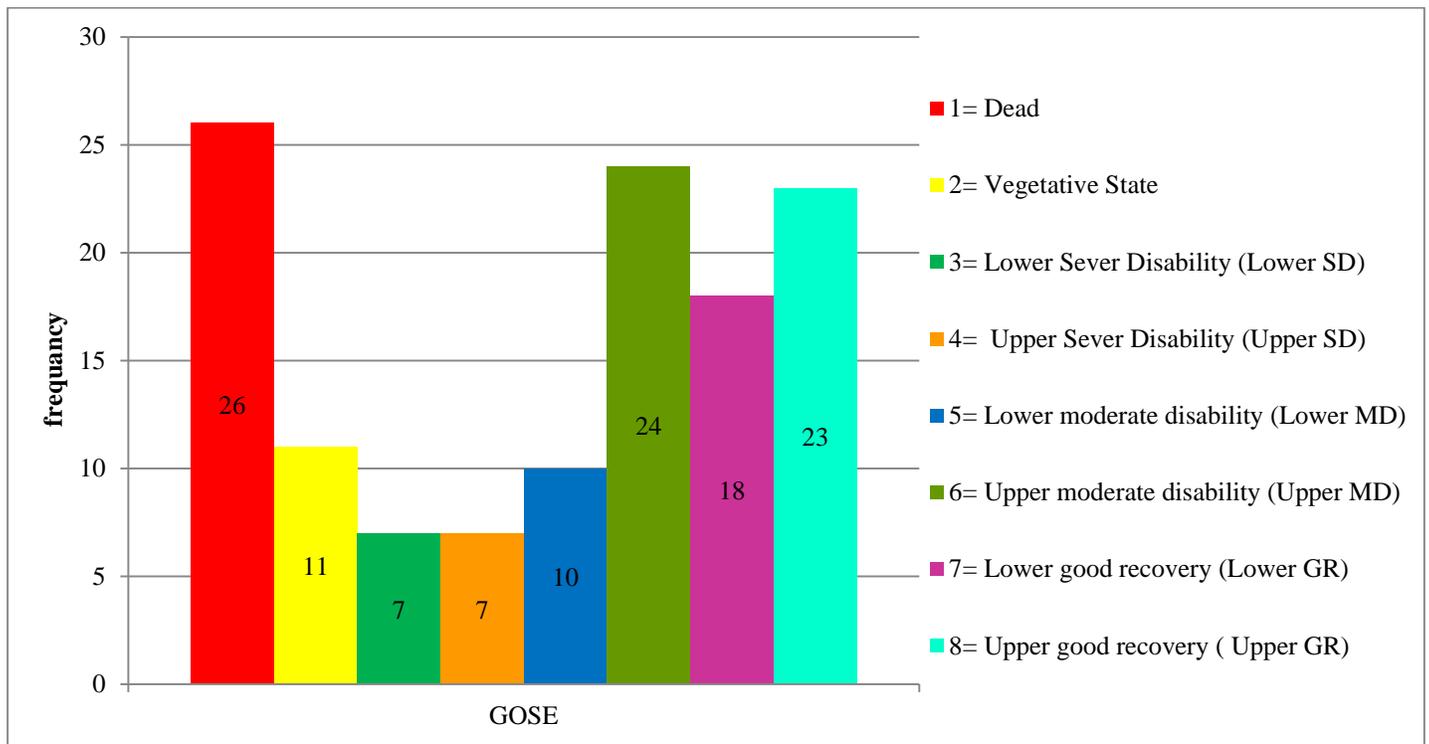
Variables	Studied Patients	
	N	%
<b>Diagnosis:</b>		
Mild TBI	30	23.8
Moderate TBI	60	<b>47.6</b>
Severe TBI	36	28.6
<b>Length of stay in hospital/ days (Mean ± SD)</b>	13.16 ± 7.039	
<b>Cause of injury:</b>		
Direct trauma	18	14.3
Motor vehicle traffic	58	<b>46</b>
Fall from height	25	19.8
Transport/Other	2	1.7
Fire/Burn	9	7.1
Struck by/ against (Scrimmage)	9	7.1
Infantry (traffic accident)	5	4
<b>Intubation</b>		
Yes	78	<b>61.9</b>
No	48	38.1
<b>Diagnostic studies</b>		
CT	125	<b>99.2</b>
MRI	1	0.8

Table 3 shows scoring interpretations for GCS and FOUR.

Table (3): Comparison between total scoring interpretation between GCS and FOUR of the studied patients (n=126).

Scoring Interpretation for GCS	GCS		Scoring Interpretation for FOUR	FOUR	
	Studied Patients	N		Studied Patients	N
Minor brain injury 13-15.	26	20.6	Minor brain injury 12-16	42	<b>33.3</b>
Moderate brain injury 9-12.	47	<b>37.3</b>	Moderate brain injury 8-11	49	<b>38.9</b>
Severe brain injury 3-8.	53	<b>42.1</b>	Severe brain injury 3-7	35	27.8

Figure 2 shows that 26 of the studied patients were dead, while 23 were discharged with upper good recovery and 18 with lower good recovery according to GOSE.



**Figure (2): Frequency of Extended Glasgow Outcomes scale of the studied patients (n=126)**

Table 4 reveals GCS and FOUR diagnostic accuracies of the studied patients at cut-off predictive value  $\leq 12$  to discriminate in hospital full recovery within 24 hours from admission. The test shows a sensitivity of 82.6 and test specificity of 90.3. Diagnostic accuracy for GCS in predicting full in-hospital recovery is 0.927, whereas diagnostic accuracy for FOUR is 0.884 (82.6% sensitivity and 86.4% specificity).

**Table (4): Diagnostic accuracies of Glasgow Coma Scale and full outline of unresponsiveness scale in predicting full recovery of the studied patients within 24 hrs from admission.**

ROC curve in full recovery as regard GCS and FOUR within 24 hrs from admission.						
Variable	Cut off	Sensitivity	Specificity	PPV	NPV	Accuracy
GCS	$\leq 12$	82.6	90.3	97.8	87.6	0.927
FOUR	$\leq 12$	82.6	86.4	94.8	82.1	0.884

Table 5 shows predicting in-hospital mortality of the examined patients using GCS and FOUR diagnostic accuracies is demonstrated.

**Table (5): Accuracy of the Glasgow coma scale and the whole outline of unresponsiveness scale in predicting 24-hour mortality after hospital admission.**

ROC curve in predicting mortality as regard GCS and FOUR within 24 hours from admission.						
Variable	Cut off	Sensitivity	Specificity	PPV	NPV	Accuracy
GCS	$\leq 7$	88.5	78	96.6	82.4	0.895
FOUR	$\leq 9$	88.5	76	96.7	84.6	90.7

Table 6 shows the GCS and FOUR diagnostic accuracies were used to forecast the length of hospital stay of the study participants, with a cut-off predictive value of 13 used to differentiate between patients' lengths of stay within the first 24 hours after admission.

**Table (6): Predicting a patient's length of stay in the hospital within the first 24 hours of admission using the Glasgow Coma Scale and the Full Outline of Unresponsiveness Scale.**

ROC curve in predicting length of hospital stay as regard GCS and FOUR within 24 hours from admission						
Variable	Cut off	Sensitivity	Specificity	PPV	NPV	Accuracy
GCS	≤13	100	88.6	93.1	76.5	0.848
FOUR	≤13	100	81.6	92.6	77.8	0.852

\*: Significant at  $P \leq 0.05$

Table 7 clarifies that there was a highly statistically significant correlation between GCS scale and GOSE and a highly statistically significant correlation between Four scale and GOSE with p-value =0.000\*\*.

**Table (7): Correlation between GCS, FOUR and GOSE of the studied patients.**

Items	Mean± SD	GOSE	
		Correlation Coefficient ( r )	P-value
GCS	9.58±3.703	0.728	0.000*
FOUR	10.71±3.77	0.755	0.000*

\*: Significant at  $P \leq 0.05$

## DISCUSSION

Approximately two-thirds of the patients in this investigation were found to be male. This could be because men in general tend to be more aggressive and competitive than women do, and because men are disproportionately affected by road traffic accidents (RTAs) in Egypt, where they account for the vast majority of both workers and drivers.

Nearly three quarters were male, and one fifth were female, which was in line with the findings of **Khoshfetrat and colleagues** <sup>(17)</sup>, who investigated "The ability of GCS, FOUR, and APACHE II in predicting the fate of patients with traumatic brain injury: comparative research."

The result was inconsistent with **Ramazani and Hosseini** <sup>(18)</sup> reported that over half of the patients in the medical ICU were females.

One-third of the patients in this study were classified as being between the ages of 18 and 30, according to their chronological age., and more than one third were in age group between 30- <40, and mean and standard deviation of age 37.46 (SD 13.97) years.

The finding was consistent with **Ansari and Rai** <sup>(19)</sup> who studied the full outline of unresponsiveness scale and the GCS to evaluate patients with TBI, found that young male Egyptians are disproportionately affected by TBI with their mean age was 26.57 (SD 18.4) years.

These results not supported by **Peters and Gardner** <sup>(20)</sup> whose study entitled "Traumatic brain injury in older adults: do we need a different approach? " and reported that old age was predominantly affected and represented.

The present study showed that nearly two-thirds of patients evaluated were urban residents. The results concurred with **Belchev et al.** <sup>(21)</sup> who studied "More than two-thirds of traumatic brain injury patients were from urban areas, according to a study protocol for a randomized controlled trial of a remote environmental enrichment intervention for TBI.

Our results were inconsistent with **Graves et al.** <sup>(22)</sup> who studied rural- urban disparities in health care costs and health service utilization following mild traumatic brain injury and reported that less than one fifth of studied patients residing in rural areas.

Regarding to occupation, near than half of studied patients were not employed (worker but doesn't have fixed work), and two fifth were housewives, It's possible that the difference in income between the capital, Cairo, and the poorer, terminal governorate of Elminya explains these results. In 2016, CAPMAS recorded 13% unemployment across the country; in Elmina governorate, this percentage was somewhat higher, at 14% (9.6% among men and 24.6% among women) <sup>(11)</sup>.

The results of present study goes with **De Oliveira** <sup>(23)</sup> who studied TBI in Luanda, Angola who

reported that being a housewife was a victim of road traffic injury.

The current study found that more than a third of the patients are married, which may place an additional strain on TBI patients' families, and that more than a fifth were single.

The result of the present study goes with **Kasem et al.** <sup>(5)</sup> who revealed more over half of the sample were married when they compared the accuracy of the GCS and the full outline of unresponsiveness scale in predicting the discharge outcomes of TBI. The majority of the patients in this study were taken to the hospital via ambulance, according to the findings.

Our results are in accordance with **Purcell et al.** <sup>(24)</sup> whose research, titled "Epidemiological comparisons and risk factors for pre-hospital and in-hospital mortality following traumatic injury in Malawi" found that the majority of trauma patients in Malawi were taken by ambulance.

On the other hand, our results are in disagreement with **De Oliveira** <sup>(23)</sup> who said more than a third of all hospital admissions involved the use of a car or truck.

In terms of the patients' health histories, over half of those analyzed had moderate TBIs at the time of hospital admission; this finding goes with **Ansari and Rai** <sup>(19)</sup> who revealed that more than two thirds of the cases suffered from moderate brain damage.

The current study results are inconsistent with **De Oliveira** <sup>(23)</sup> where it was discovered that 50%+ of the participants in the study had had a serious traumatic brain injury.

Regarding to length of stay in hospital, the study results revealed that the length of stay in hospital/day was 13.16 (SD 7.039) days. These results are in agreement with **Ramazani and Hosseini** <sup>(18)</sup> who revealed that the average hospital stay amounted to 10.51 (SD 6.67) days.

This result is inconsistent with **Naz et al.** <sup>(25)</sup> who studied traumatic brain injury patients in the intensive care unit of a public hospital in Karachi, Pakistan: demographics and prognosis, and found that the ICU mean duration of stay was 16.9 (SD 11.0) days while the typical time spent in an emergency room was 1.7 (SD 3.36) days.

Regarding to cause of injury, More than two-fifths of the patients in the study had been injured in road accidents, and roughly the same proportion had been injured in falls from great heights, according to the findings.

According to investigator view, poor road maintenance, inadequate lighting, population density, vehicle density, and speeding are all potential causes of accidents in the desert, leading to these outcomes. This finding in the same line with **Mohammed et al.** <sup>(26)</sup> who studied management and outcome of moderate head trauma: our experience, and showed that the leading

causes of traumatic brain injury were being hit by a car or falling from a great height.

This finding is incongruent with **Attia et al.** (27) who examined the pattern and outcome of TBI in the geriatric population at the Emergency Department of Mansoura University Hospital found that falls from great height accounted for more than two thirds of the cases and that automobile accidents accounted for less than a fifth of the cases.

More over two-thirds of the patients in this study were found to have an endotracheal tube in place.

According to our of view, patients needed to intubation because of insufficient oxygenation or ventilation for brain, protect the airway from vomit or blood, protected from agitation and needed general anesthesia with intubation in order to protect themselves. This results concurs with **Sauter et al.** (28) who studied "Intubation in acute alcohol intoxications at the emergency department." and found that more than two third were intubated.

Almost all hospitalized patients with TBIs underwent a CT scan, according to the results of the current study. According to the research team, this is because CT scans can quickly show evidence of intracranial, extracranial, epidural, subdural, subarachnoid hemorrhage, inflammation of brain tissue, and cerebral edema, as well as fractures.

This finding is consistent with that of **Mohammed et al.** (26), who reported that all hospitalized patients with head injuries underwent a CT scan of the head.

Regarding to total scoring interpretation between GCS and FOUR, the current study revealed that scoring interpretation of GCS, slightly more than two fifth of the studied patient were classified as a severe brain injury, while more than one third were classified as moderate brain injury and one fifth were classified as a minor brain injury. And revealed that scoring interpretation of FOUR, about one third of the studied patient had minor brain injury, and more than one third had moderate brain injury, while less than one third had a severe brain injury.

According to the investigator point of view, this difference could be explained by the fact that the study was conducted on patients intubated with an endotracheal tube, because FOUR score assess respiration and brain stem reflex.

Contradicting with the results of the present study, **Khoshfetrat et al.** (47) found a strong positive association between the GCS and the Functional Independence Measure, but substantial discrepancies between these two measures and the APACHE II in predicting the fate of patients with traumatic brain injury: a comparative study.

One-fifth of the patients investigated died, and fewer than one-fifth were discharged with upper excellent recovery without impact on daily living, as measured by GOSE clinical outcomes.

The findings are consistent with those of **Foo et al.** (29), who conducted a systematic study titled "The connection of the FOUR score to patient outcome: a meta-analysis".

Concerning the predictability full recovery for GCS and FOUR score of the studied patients, the proper cut-off predictive value of GCS and FOUR scores  $\leq 12$ , but GCS is more specific and accuracy than FOUR.

This result is inconsistent with **Anestis et al.** (30) who conducted research about the significance of the FOUR Score, and found that GCS and FOUR scores are comparably predictive, with their own advantages and disadvantages.

Regarding mortality, the study results revealed that diagnostic accuracy in predicting hospital mortality of the studied patients for two scales. GCS shows sensitivity of 88.5 and test specificity of 78 with diagnostic accuracy in predicting mortality 0.895 at cut off predictive value  $\leq 7$  to discriminate in hospital mortality.

While the GCS's diagnostic accuracy in predicting hospital mortality was 0.895 at cut off predictive value 7, the results showed that the FOUR's diagnostic accuracy was 90.7 at cut off predictive value 9 to discriminate in hospital mortality within 24 hours of admission.

This result goes with **Ramazani and Hosseini** (18) who reported that the developer of the FOUR score validated the 9 threshold for mortality from admission and the 7 threshold for GCS in their study about prediction of mortality in the medical ICU with serial FOUR Score in elderly patients.

These results concur with **Abdallah et al.** (31) who compared FOUR score to GCS in predicting death among patients with reduced state of awareness in Uganda found that the FOUR score had a mortality prediction of 0.68 and the GCS score had a prognosis of 0.67.

In the current study, the proper cut-off point for GCS  $\leq 7$  and FOUR was  $\leq 9$  at 24 hours from admission which is similar to **Zappa et al.** (32) who studied imminent brain death using FOUR score and GCS, and reported that GCS score validated the cut-off point of 5 and 6, and FOUR score validated the cut-off point of 6 and 7. While, the result are not similar to **Ramazani and Hosseini** (18) who found that the proper cut off point 10.5.

According to the present study, the variation may result from patient situations and the hospital's setting. As a result of not being able to evaluate verbal outcomes in intubated patients, it is believed that GCS loses its discriminatory value for predicting results.

Concerning the predictability of GCS and FOUR score for length of hospital stay, the study result reveals that GCS and FOUR score are similar for the prediction of length of hospital stay with the same cut-off  $\leq 13$  and sensitivity 100 at the 24 hours.

Our result is supported by **Zappa et al.** (32) who observed that both scales were 100% sensitive in

predicting ICU stay for patients with IBD, but that FOUR may be preferable because it includes pupillary, corneal, cough, and spontaneous breathing assessments that may be made in the ICU.

Four of the patients had a statistically significant connection with GOSE, which is in line with the findings of **Suresh *et al.*** <sup>(13)</sup>, who compared the FOUR Score to GCS in critically sick patients with impaired sensorium; Patients with higher GCS and FOUR scores at ICU discharge had better recovery profiles, and both the GCS and FOUR scores were substantially linked with survival in a study comparing inter-observer variability and outcomes..

Our results showed a statistically significant relationship between the patients' GOSE and GCS scores. **Rowell *et al.*** <sup>(33)</sup>, authors of "Effect of out-of-hospital tranexamic acid versus placebo on 6-month functional neurologic outcomes in patients with moderate or severe traumatic brain injury," found a statistically significant correlation between GCS and GOSE.

In conclusion, despite the fact that the FOUR score is better at assessing patients on mechanical ventilation and predicting clinical outcome for intubation and weaning of ventilators in the case of trauma patients, the study found that the Glasgow Coma Scale (GCS) is equivalent in predicting clinical outcome for patients with neurological disorders. The ability to predict motor disability and sensory impairment in patients with severe injuries is equivalent between the two. FOUR score is more accurate than GCS at predicting death and recovery. Patients' clinical outcomes in the ICU can be predicted with equal accuracy using either GCS or FOUR score.

Our study recommends continuous educational programs to be planned to ICU nurses to assess and manage traumatic injuries patients and using GCS and FOUR score. Also, developing a procedure guide to ICU nurses to use FOUR score and GOSE instructions in their work is needed.

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**Conflict of interest:** Nil.

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