

The effectiveness of FOUR Score versus GCS scale in predicting mortality and morbidity in traumatic brain injured (TBI) patients

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Background

Glasgow Coma Scale (GCS) scale has been the benchmark for assessing the patients' level of consciousness. However, despite its extensive use, it holds several limitations (Ramazani and Hosseini, 2019).

The FOUR Score

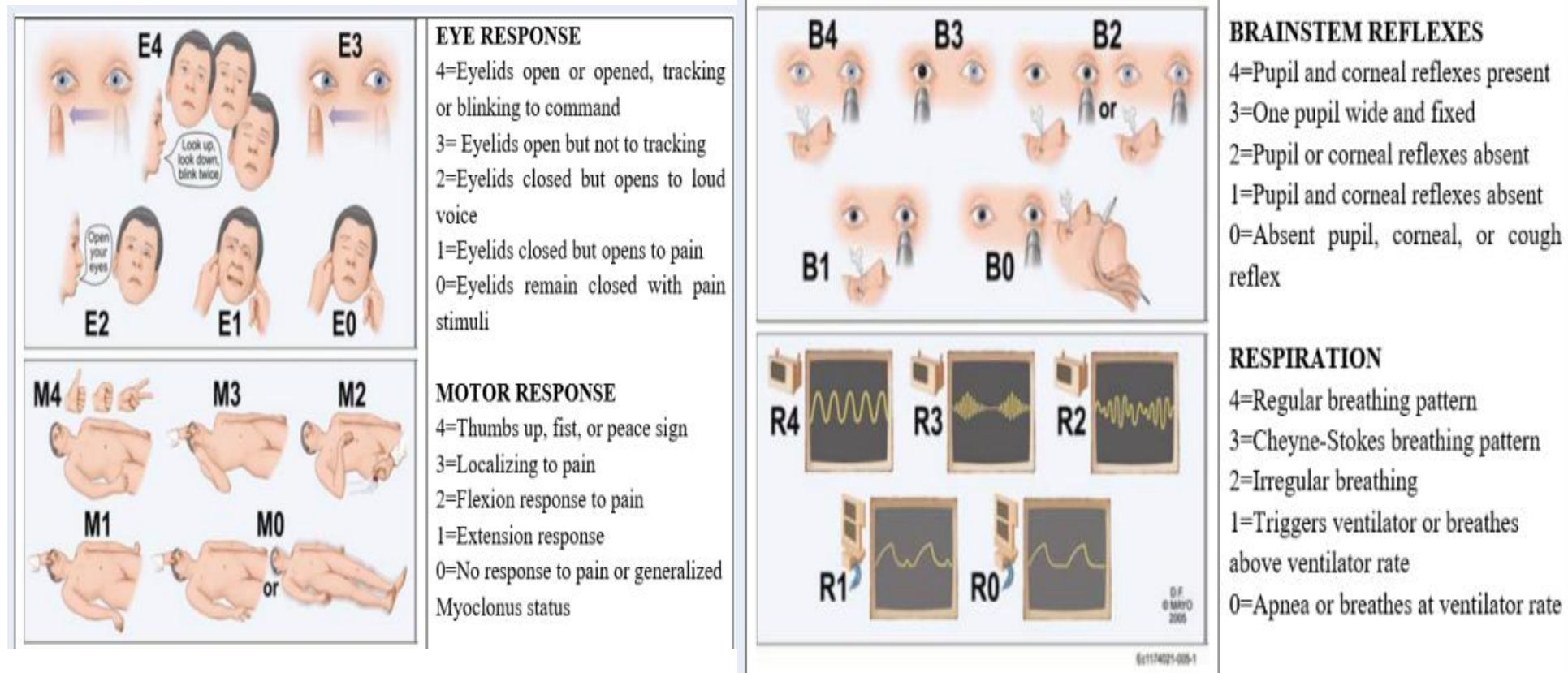


Figure 1: The Four score
(Wijdicks et al., 2005)

FOUR Score versus GCS

FOUR Score

- Brainstem reflexes, visual tracking, breathing patterns and respiratory drive (Oh *et al.*, 2019);
- Not dependent on the verbal response (Ramazani and Hosseini, 2019);
- Detect a locked-in state and determine the presence of a vegetative state (Sadaka *et al.*, 2012).

GCS

- Skewed towards motor evaluation (Sadaka *et al.*, 2012);
- Unable to assess the verbal score in intubated or aphasic patients (Bayraktar *et al.*, 2019);
- GCS shows inconsistent inter-rater reliability (Ramazani and Hosseini, 2019).

Aim & Objectives

Aim:

To assess how effective the FOUR score neurological assessment tool is in predicting mortality and morbidity in critically ill patients with TBI in intensive care unit (ICU) compared to GCS.

Objectives:

- Explore the effectiveness of FOUR score and GCS scale in predicting mortality and morbidity in critically ill patients in intensive care;
- Explore the sensitivity and specificity of FOUR score compared to GCS scale in critically ill patients in intensive care.

Research Question

Is the FOUR Score neurological assessment tool effective in predicting mortality and morbidity in critically ill patients with TBI in ICU compared to GCS?

Methodology

- Systematic Review with Narrative Synthesis (Campbell *et al.*, 2020);
- Joanna Briggs Institute (JBI) Manual for Evidence Synthesis (2021);
- Reported in accordance to PRISMA 2020 checklist (Page *et al.*, 2021);
- Informed by Synthesis Without Meta Analysis (SWiM) in systematic review guidelines (Campbell *et al.*, 2020).



Eligibility Criteria

Inclusion criteria	Exclusion criteria
Articles published only in English	Patients' age under 16
Articles comparing exclusively the FOUR score vs GCS scale	Patients whose needs were ward based
TBI patients located in ICU	Patients who suffered any other brain-conditions
Time frame: 2005 – September 2023	
Patients aged 16 and above	
Care settings: only in ICU or those whose needs are level 2 or level 3 of critical care	

Search Strategy - PIRD

- **P** (Population): Patients with TBI in ICU
- **I** (Index Test): FOUR Score assessment
- **R** (Reference Test): GCS assessment
- **D** (Diagnostic of Interest): Prediction of mortality and morbidity

(JBI, 2021)

Literature Search Strategy

1	ICU.ti OR ICU.ab OR ITU.ti OR ICU.ab OR intensive care.ti OR intensive care.ab OR critical care.ti OR critical care.ab OR Neuroscience.ti OR Neuroscience.ab OR critical patient*.ti OR critical patient*.ab
2	exp/ intensive care/
3	1 OR 2
4	TBI.ti OR TBI.ab OR traumatic brain-injur*.ti OR traumatic brain-injur*.ab OR trauma brain-injur* OR trauma brain-injur*
5	exp traumatic brain injury/
6	4 OR 5
7	Full Outline of Unresponsiveness.ti OR Full Outline of Unresponsiveness.ab OR FOUR Score.ti OR FOUR Score.ab
8	GCS.ti OR GCS.ab OR Glasgow coma scale.ti OR Glasgow coma scale.ab
9	exp Glasgow coma scale/
10	8 OR 9
11	3 AND 6 AND 7 AND 10
12	limit 11 to (english language and yr="2005-current")



Search Strategy

Medline, Embase, CINAHL, Scopus and Cochrane

+

MeSH concepts for Medline and Cochrane,

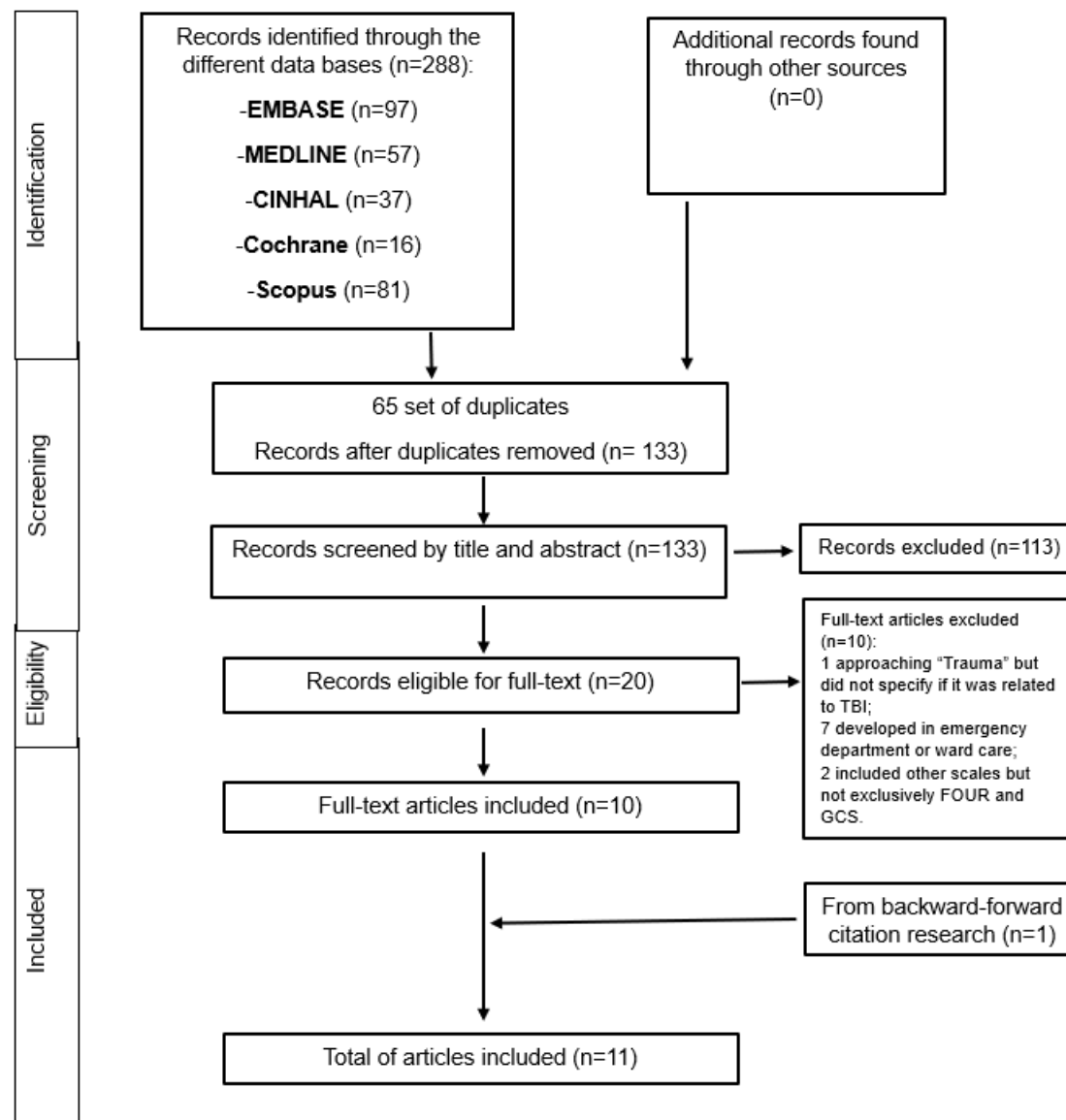
+

Subject Headings for CINAHL

+

Emtree terms for Embase

Screening Eligibility



Quality Appraisal of the Studies

10 Questions
“Yes” – Scored 1
“No” – Scored 0

Independently appraised

JBIC Critical Appraisal Checklist for Case Series

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

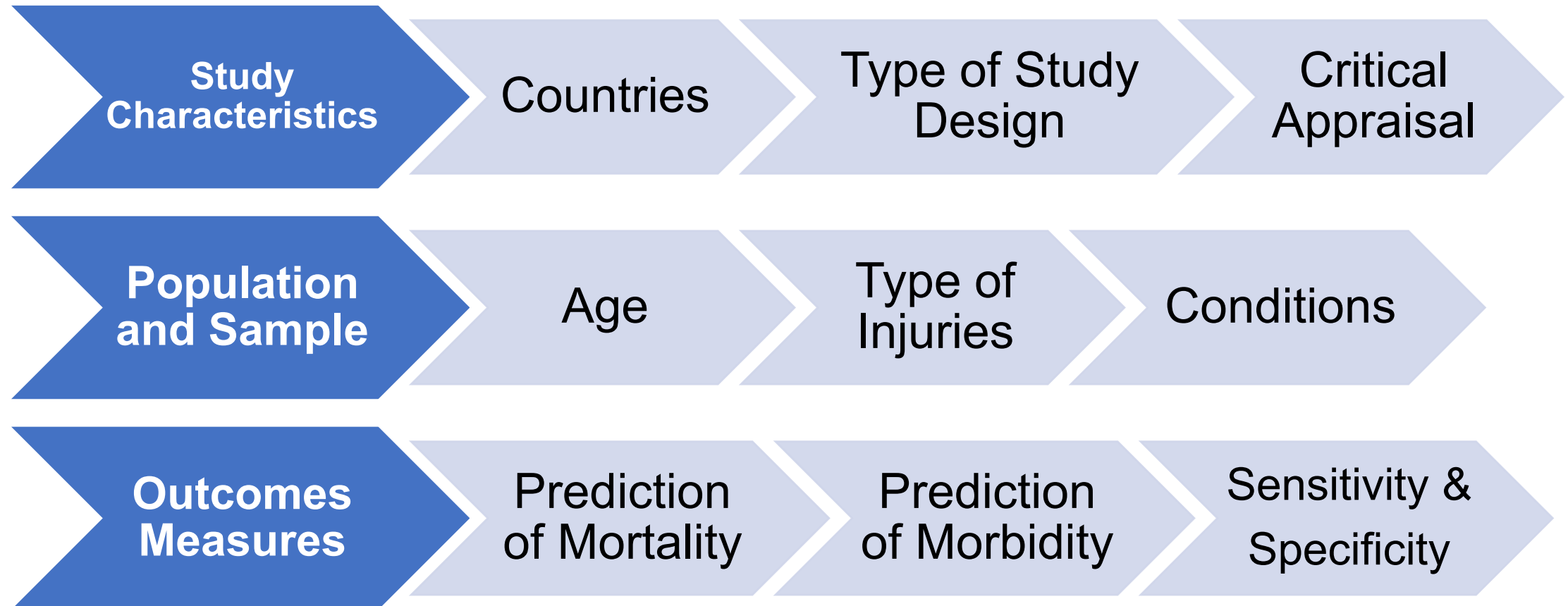
	Yes	No	Unclear	Not applicable
• Were there clear criteria for inclusion in the case series?	☐	☐	☐	☐
• Was the condition measured in a standard, reliable way for all participants included in the case series?	☐	☐	☐	☐
• Were valid methods used for identification of the condition for all participants included in the case series?	☐	☐	☐	☐
• Did the case series have consecutive inclusion of participants?	☐	☐	☐	☐
• Did the case series have complete inclusion of participants?	☐	☐	☐	☐
• Was there clear reporting of the demographics of the participants in the study?	☐	☐	☐	☐
• Was there clear reporting of clinical information of the participants?	☐	☐	☐	☐
• Were the outcomes or follow up results of cases clearly reported?	☐	☐	☐	☐
• Was there clear reporting of the presenting site(s)/clinic(s) demographic information?	☐	☐	☐	☐
• Was statistical analysis appropriate?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

Reference: Munn *et al.*, (2020)

Results/Findings



Study Characteristics – Countries

Countries of Design:

Mostly developed in west Asia (n=6), Europe (n=1), USA (n=2) and Egypt (n=2).

Literature:

- FOUR score has been already tested in different settings and countries as well as its inter-reliability (Sharshar *et al.*, 2014).



Study Characteristics – Type of Study Designs

10 prospective studies
1 comparative research design



Study Characteristics – Critical Appraisal

Mean score of 5.2/10, ranging between 1 to 6 points.

Nature of the hospitals is poorly described by **all** studies.

Population and Sample – Age

Sample of 1079 participants: 830 are men and 249 are women.

Mean age is 42.31 years, age range from 26 to 63 years.

Literature:

- TBIs are more prevalent in younger ages;
- Taha and Barakat (2016) which shows that in a sample of 2124 patients, 82.7% were males and the means age was 26.57 ± 18.4 years.

Population and Sample – Type of Injuries

Motorcycle RTAs the most prevalent cause of TBIs, followed by car accidents, falls and violence.

Most prevalent TBIs were severe then, mild and last, moderate injuries.

Literature:

- A sample size of 49 patients, 18 suffered motorcycle injury, followed by 10 car accidents and 9 falls (Joosse *et al.*, 2009). The same sample, 39 were males and a mean age of 28.7 ± 10.7 years (Joosse *et al.*, 2009).
- The study of Kafle *et al.*, (2018) describes 88 patients (72.1%) who had a moderate injury.



Population and Sample - Conditions

4 studies reported excluding patients in receipt of sedatives and neuromuscular blocking agents

7 studies did not report if patients received neuromuscular blocking agents or not

3 studies excluded patients if receiving sedation

2 studies mentioned the amount of sedation was reduced to a minimum

Outcome Measures

Prediction of Mortality = in-hospital mortality, in-ICU mortality, prediction of death and alive patients, prediction of EM and DM.

Prediction of Morbidity = poor neurologic outcome, prediction of unfavourable outcomes, sensory impairment and full recovery.

Sensitivity and Specificity: included in some prediction of mortality/morbidity results.

Prediction of Mortality

Results ranging from good (AUC= 0.80-0.89) to excellent (AUC= 0.90-1).

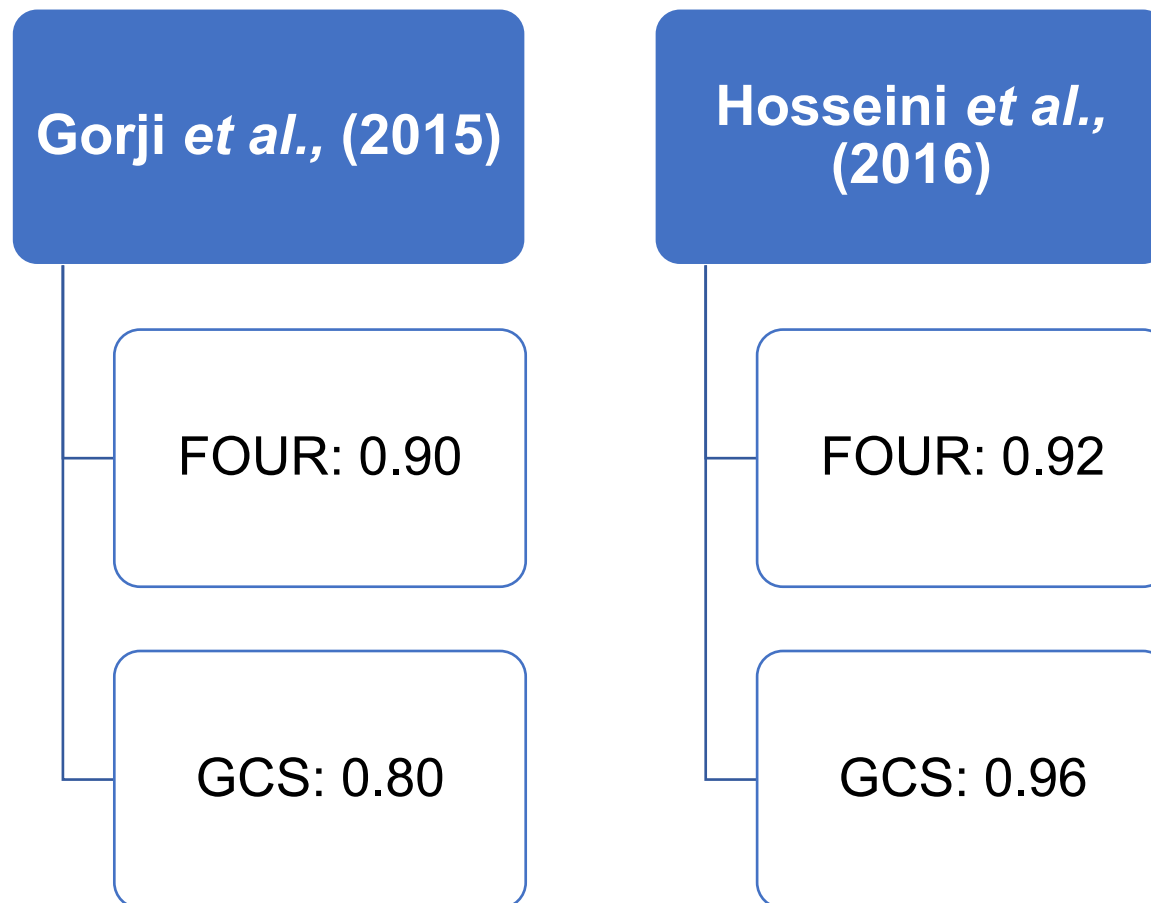
No significant statistical differences between the FOUR score and GCS.

6/11: Mentioned results related to sensitivity and specificity.

FOUR score performed better in predicting EM.



Prediction of Mortality – Early Mortality AUCs:





Prediction of Morbidity

More heterogeneous results and no main differences found.

6/11: Mention this outcome measure.

Prediction of Morbidity

Sadaka <i>et al.</i> , (2012)	Poor neurologic outcomes
Gorji <i>et al.</i> , (2014)	Poor Neurologic Prediction
McNett <i>et al.</i> , (2014)	Functional outcomes and Cognitive status at 24hr/72hrs
Okasha <i>et al.</i> , (2014)	Unfavourable outcomes at 1 month
Kasprowicz <i>et al.</i> , (2016)	Unfavourable outcomes at 3 months
Kasem <i>et al.</i> , (2019)	Sensory Impairment and Full recovery at 24hr/72hrs

Prediction of Morbidity

Age, gender and
reason of admission
are not correlated with
outcomes ($P > 0.05$).

Gorgi *et al.*, (2014)

FOUR score demonstrated
better discriminative ability in
predicting poor outcomes
(AUC 0.850 versus 0.796;
 $p = 0.025$).

Okasha *et al.*, (2014)

There is an association between FOUR score and
GCS regarding functional outcomes:
 $p = 0.05$ and $p = 0.02$, respectively.

McNett *et al.*, (2014)

Sensitivity and Specificity

Prediction of Mortality

In-hospital mortality:
FOUR score > GCS: greater
accuracy and higher
sensitivity.

Prediction of Morbidity

Kasem et al., (2019)

**Motor disability and sensory
impairment:**
FOUR score = GCS

Full recovery at 24hr/72hrs:
GCS > FOUR score: higher
sensitivity and accuracy.

Clinical Implications

- Implications of Mortality and Morbidity prediction;
- Importance of Morbidity in the clinical practice.

Strengths and Limitations

Strengths:

- Broaden and comprehensive research literature strategy
Plus, a backward-forward citation research;
- JBI (2021);
- Two-step review process work lessened the possibility of bias.

Strengths and Limitations

Limitations:

- Low JBI/CAT score;
- Single-centre studies;
- Diversity of the studies and heterogeneous data included;
- JBI (2021) $\Rightarrow$ JBI (2024): Cochrane Methods of Systematic Review of Diagnostic Test Accuracy (2023).

Conclusion

In light of these findings, it is difficult to accept that the GCS score - a tool with a long history of use in intensive care - will be replaced.

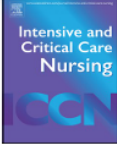
Next Steps



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Review Article

The effectiveness of FOUR score versus GCS scale in predicting mortality and morbidity in traumatic brain injured patients in intensive care: A systematic review

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Traumatic brain-injury

ABSTRACT

Background: Traumatic brain-injury (TBI) is one of the leading causes of death and disability worldwide. In intensive care, the Glasgow coma scale (GCS) is widely used to assess severity of brain injury. An alternative tool is the Full Outline of UnResponsiveness (FOUR) score which assesses stages of locked-in syndrome and brain herniation. The purpose of this study is to evaluate the effectiveness of both assessment tools in predicting mortality and morbidity in critically ill patients with TBI.

Methodology: Systematic review guided by the Joanna Briggs Institute (JBI) Manual for Evidence Synthesis (2021). A comprehensive database search was conducted for the period January 2005–September 2023. Searches repeated in February 2025. Primary research comparing FOUR with GCS, published in English, including adults aged 16 and over and patients with TBIs in intensive care were included. Studies were appraised using JBI critical appraisal tools. Data was narratively synthesised.

Results: Eleven studies were included. No study reported significant statistical differences between GCS and FOUR score in predicting mortality. Area under the curve and receiving operating characteristic curve values for both tools were rated good to excellent (Range 0.80–0.96) in predicting mortality. Morbidity was only reported in 6/11 studies. Neither tool appeared to effectively predict morbidity however, there was great variability in which and how morbidity outcomes were assessed.

Conclusions: Both assessment tools perform similarly in predicting mortality and morbidity in TBI in intensive care.

Implications for clinical practice: Further research to determine the additional clinical benefits of FOUR assessment in this population is recommended. The development of core morbidity outcome measures in patients with TBI is required to evaluate if these tools effectively predict morbidity. Effective prognostication may assist healthcare providers in managing resources as well as providing patients and families with realistic expectations of long-term recovery.

Background

Traumatic brain-injury (TBI) is one of the leading causes of death and disability worldwide [1]. An estimated 1.5 million individuals world-

following an injury [2]. Annually in the UK, there are 900,000 traumatic brain injuries with 1.3 million people enduring ongoing disabilities [3]. Initial medical treatment of patients with TBI is based on the early assessment of the severity of injury, which can also help predict the

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Thank You!

..... and Questions

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