

# Effectiveness of a FOUR Consciousness Assessment Workshop on Nurses' Knowledge and Competence in Managing Head Trauma: A Pre-Experimental Study

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## ABSTRACT

Based on global epidemiological trends over the years, traumatic brain injury (TBI) remains one of the most common neurological disorders and continues to pose a substantial public health burden worldwide. The FOUR Scale, which is more comprehensive than the GCS because it evaluates brainstem reflexes and respiratory patterns and is applicable to both intubated and non-intubated patients, remains underutilized in several hospitals due to limited nurse knowledge and insufficient training, highlighting the need for structured educational interventions. This study aimed to evaluate the effectiveness of a FOUR Scale consciousness assessment workshop in improving nurses' knowledge and competence in managing head trauma patients at RSUD Syech Yusuf, Gowa Regency. A quantitative approach using a pre-experimental one-group pretest–posttest design was applied, involving 40 nurses selected through total sampling. Data were collected using a validated and reliable knowledge questionnaire and competence observation sheet (Cronbach's  $\alpha$  0.738) and analyzed using the Wilcoxon Signed Rank Test based on Z-scores, p-values, and effect sizes. The findings demonstrated a significant increase in knowledge ( $Z = -5.231$ ;  $r = 0.827$ ;  $p = 0.001$ ) and competence ( $Z = -6.325$ ;  $r = 0.99$ ;  $p = 0.001$ ) after the workshop. The large effect sizes indicate that the workshop had a strong positive impact on participants' clinical abilities. These results confirm that training incorporating theoretical instruction, simulation, case discussions, and reflective learning can effectively enhance clinical competence. The FOUR Scale workshop proved effective and is recommended for routine implementation as part of emergency care quality improvement and as a component of hospital Standard Operating Procedures (SOPs).

Keywords: Competence; FOUR Scale; traumatic brain injury; knowledge; workshop

## INTRODUCTION

Traumatic head injury is one of the leading causes of disability and mortality worldwide, with a continuously increasing prevalence, particularly in developing countries<sup>1</sup>. According to the World Health Organization (WHO), millions of deaths each year are associated with traumatic head injuries, which commonly result from traffic accidents, interpersonal violence, and falls from height<sup>2</sup>. Accurate neurological assessment is essential in the management of patients with head trauma because it guides clinical decision-making and early treatment, which may significantly influence patient outcomes.

The Full Outline of UnResponsiveness (FOUR) Scale has been developed as a more comprehensive tool for assessing neurological status compared with the Glasgow Coma Scale, as it evaluates brainstem reflexes, respiratory patterns, and motor responses. Despite these advantages, the use of the FOUR Scale in clinical practice remains limited. One of the major barriers is the insufficient knowledge and practical skills among nurses in performing standardized neurological assessments. In Indonesia, particularly in regional public hospitals, evidence regarding structured educational interventions aimed at improving nurses' competence in applying the FOUR Scale is still limited. Therefore, effective educational strategies are needed to enhance nurses' knowledge and clinical skills in performing accurate neurological assessments<sup>2</sup>. Workshops incorporating simulation-based learning have been widely recognized as effective educational strategies for improving psychomotor skills and clinical assessment abilities among healthcare professionals. Simulation enables nurses to practice clinical procedures and decision-making in a controlled environment that closely resembles real clinical situations, thereby facilitating the integration of theoretical knowledge with practical skills. Previous studies have shown that simulation-based education improves knowledge acquisition, clinical skills, and learning motivation among nursing students compared with conventional lecture-based learning methods<sup>3,4</sup>. In this study, the FOUR Scale workshop is expected to increase nurses' knowledge, which subsequently enhances their skills in performing neurological assessments and ultimately improves the quality of patient assessment.

Globally, approximately 20.84 million cases of Traumatic Brain Injury (TBI) were reported in 2021, indicating a substantial public health burden associated with head trauma. In Indonesia, data from the 2018 Basic Health Research (Riskesdas) showed that the prevalence of head injury reached 11.9%, making it the third most common type of injury after lower extremity injuries (67.9%) and upper extremity injuries (32.7%)<sup>5</sup>. Despite the high incidence of head injuries, the quality of neurological assessment in emergency care settings remains a

challenge. To date, studies examining structured educational interventions, such as workshops, to improve nurses' knowledge and competence in neurological assessment in Indonesian regional public hospitals are still limited. Therefore, evaluating training approaches that can strengthen nurses' competence in performing standardized neurological assessments for patients with TBI is necessary.

In South Sulawesi, an increasing trend in head trauma cases has also been observed. Data from the Makassar Health Office reported an increase from 519 cases in 2022 to 637 cases in 2023. At Syech Yusuf Hospital Gowa, head trauma is among the most frequently managed emergency cases, with severity ranging from mild to severe. In January 2025, there are 14 new head trauma cases were recorded. This situation highlights the urgent need for effective clinical systems to accurately assess patient severity, particularly during the initial phase of management.

Clinically, head trauma is classified as mild, moderate, or severe based on the Glasgow Coma Scale (GCS) <sup>2</sup>. Severe head injury is associated with a high risk of serious complications, including cognitive, motor, and sensory impairments, as well as permanent neurological damage <sup>6</sup>. Accurate neurological assessment is therefore critical for determining prognosis and guiding appropriate clinical interventions. Early and precise assessment of consciousness is also essential to prevent complications such as increased intracranial pressure, cerebral edema, and brainstem death <sup>7</sup>.

During the time, the assessment of consciousness in head trauma patients has predominantly relied on the Glasgow Coma Scale (GCS), which evaluates eye, verbal, and motor responses. However, GCS has notable limitations, particularly in intubated patients or those unable to communicate verbally <sup>2</sup>. In addition, GCS does not assess brainstem reflexes or respiratory patterns, both of which are crucial indicators of neurological status <sup>8</sup>.

To address these limitations, the Full Outline of UnResponsiveness (FOUR) Scale was developed. Unlike GCS, the FOUR Scale consists of four components: eye response, motor response, brainstem reflexes, and respiration pattern. Its principal advantage lies in its ability to evaluate brainstem function and respiratory status, aspects not included in the GCS assessment <sup>8</sup>. These strengths make the FOUR Scale particularly suitable for patients with severe head trauma, especially those who are intubated or unable to provide verbal responses <sup>9</sup>.

Numerous international studies support the superiority of the FOUR Scale. A study conducted in India demonstrated that the FOUR Scale has higher accuracy in predicting patient prognosis compared with the Glasgow Coma Scale (GCS). Similarly, research conducted in Nepal found that the FOUR Scale is more effective for assessing intubated patients. Other studies have also emphasized the advantages of the FOUR Scale in evaluating brainstem function and reported that it may serve as a better predictor of mortality in patients with traumatic brain injury. Overall, the FOUR Score may be superior in predicting case severity and mortality, although the Glasgow Coma Scale (GCS) remains the standard assessment tool used in many clinical settings <sup>10,11,12,13,8</sup>.

Despite its advantages, the implementation of the FOUR Scale in Indonesia remains limited <sup>14</sup>. Many nurses are unfamiliar with and do not routinely apply the FOUR Scale in clinical practice <sup>15</sup>. This is particularly concerning given that nurses are frontline healthcare providers who perform continuous neurological monitoring in head trauma cases. Limited exposure to and training in the FOUR Scale may result in inaccurate consciousness assessment, inappropriate interventions, and an increased risk of complications and mortality among head trauma patients. One contributing factor to this issue is the lack of structured competence-based training related to the FOUR Scale.

Educational interventions such as training programs or workshops are therefore essential to enhance nurses' knowledge and competence in using the FOUR Scale. Based on this context, this study aims to examine the effectiveness of a FOUR Scale workshop on nurses' knowledge and competence in consciousness assessment for head trauma cases at Syech Yusuf Hospital, Gowa Regency.

## MATERIALS AND METHODS

This study employed a pre-experimental one-group pretest–posttest design to evaluate changes in nurses' knowledge and competence before and after participation in a FOUR Scale consciousness assessment workshop. The study was conducted at RSUD Syech Yusuf, Gowa Regency, in June 2025. The population consisted of all emergency department nurses involved in the management of head trauma patients, totaling 40 respondents. A total sampling technique was applied, in which all members of the population who met the inclusion criteria were included as research participants <sup>16</sup>.

The inclusion criteria were emergency department nurses who were actively involved in the assessment and management of head trauma patients, were willing to participate in the study, and attended the FOUR Scale workshop. The exclusion criteria included nurses who were on leave during the study period, were not directly involved in the care of head trauma patients, or did not complete the pretest or posttest assessment.

The workshop began with a pretest to assess baseline knowledge using a structured questionnaire, followed by the delivery of core FOUR Scale material by an expert facilitator. Participants then engaged in simulation-based learning activities using standardized head trauma scenarios in a controlled workshop setting. During these sessions, they performed neurological assessments using the FOUR Scale. Competence was assessed exclusively within these simulation scenarios, where participants were observed by trained evaluators using a

structured observational checklist. No competence assessment was conducted through direct practice on real patients.

The session continued with group presentations and structured feedback to reinforce participants' understanding and skills. The workshop concluded with a posttest administered via Google Forms. The research instruments included a FOUR Scale knowledge questionnaire and an observational checklist used to assess participants' competence during simulation scenarios.

The knowledge questionnaire consisted of 20 multiple-choice items covering definitions, objectives, assessment components, and score interpretation of the FOUR Scale. Knowledge scores were categorized as poor ( $\leq 7$ ), moderate (8–14), and good ( $\geq 15$ ). Validity and reliability testing showed item correlation coefficients ranging from 0.425 to 0.682 with a Cronbach's alpha of 0.738. Competence was assessed separately through direct observation using a validated checklist consisting of 10 items related to the steps of performing neurological assessment using the FOUR Scale. Each item was scored on a three-point scale (0–2), resulting in a possible total score range of 0–20. Competence levels were categorized as not competent ( $\leq 13$ ) and competent ( $\geq 14$ ). The competence assessment was conducted by two trained senior nurses who had undergone prior inter-rater agreement to ensure consistency of evaluation. Knowledge and competence scores were analyzed separately, while the overall competence outcome of the workshop was interpreted based on improvements in both knowledge and observed assessment skills. Data analysis was performed using Microsoft Excel and SPSS version 29, including univariate analysis and bivariate analysis using the Wilcoxon Signed Rank Test. Ethical approval was obtained from the Health Research Ethics Committee of Universitas Islam Negeri Alauddin Makassar (No. C.141/KEPK/FKIK/2025).

## RESULTS

The study involved 40 nurses from Syech Yusuf Hospital, Gowa Regency. The demographic characteristics of the respondents and the other results, showed as summarized in table as below:

**Table 1.** Characteristics of Responden

Characteristics	Frequency	Percentage (%)
Gender		
Female	36	90,0
Male	4	10,0
Age		
17-25 years	0	0
26-35 years	13	32,5
36-45 years	20	50,0
46-55 years	7	17,5
Education		
Diploma (DIII)	13	32,5
Bachelor (S1)/Ners	24	60,0
Master (S2)	3	7,5
Training Experience		
Yes	27	67,5
No	13	32,5
Work Experience		
<5 years	11	27,5
>5 years	29	72,5
<b>Total</b>	<b>40</b>	<b>100</b>

Table 1 presents the demographic characteristics of the 40 nurses who participated in the study at Syech Yusuf Hospital, Gowa Regency. Overall, the respondent profile was predominantly female and represented a relatively experienced nursing workforce. In terms of gender, the participants were largely female, indicating that the nursing staff involved in the study reflects the typical gender distribution commonly found in nursing practice. Regarding age distribution, most respondents were in the productive and mature working age groups, particularly those aged 36–45 years, followed by nurses aged 26–35 years. This pattern suggests that the majority of participants were in a stable professional stage with sufficient clinical maturity. Educationally, most respondents had completed professional nursing education (Bachelor/Ners level), while a smaller proportion held diploma or master's degrees. This indicates that the sample was largely composed of professionally qualified nurses. The respondents also demonstrated considerable professional experience. Most nurses reported having participated in professional training, suggesting ongoing professional development among the staff. In addition, the majority of participants had more than five years of work experience, indicating that the sample was dominated by nurses

with substantial clinical exposure. Overall, the characteristics presented in Table 1 indicate that the respondents were predominantly experienced female nurses with professional-level education and significant clinical tenure.

**Table 2.** Nurses' Knowledge Regarding FOUR Scale Consciousness Assessment Before and After Intervention in Head Trauma Cases at Syech Yusuf Hospital, Gowa Regency

Knowledge Category	Pre-Intervention Frequency	Pre-Intervention (%)	Post-Intervention Frequency	Post-Intervention (%)
Less	3	7.5	0	0
Sufficient	37	92.5	12	30
Good	0	0	28	70
<b>Total</b>	<b>40</b>	<b>100</b>	<b>40</b>	<b>100</b>

The results in table 2 show a change in nurses' knowledge regarding the FOUR Scale consciousness assessment before and after the intervention. Before the workshop, most respondents were categorized as having sufficient knowledge (37 nurses; or 92.5%), while 3 nurses (7.5%) were categorized as having less knowledge, and none were classified as having good knowledge. After the intervention, the majority of respondents (28 nurses; or 70.0%) achieved good knowledge, while 12 nurses (30.0%) remained in the sufficient knowledge category, and no respondents were categorized as having less knowledge. These findings indicate that the workshop improved nurses' knowledge of the FOUR Scale assessment.

**Table 3.** Nurses' Competence Regarding FOUR Scale Consciousness Assessment Before and After Intervention in Head Trauma Cases at Syech Yusuf Hospital, Gowa Regency

Competence Category	Pre-Intervention Frequency	Pre-Intervention (%)	Post-Intervention Frequency	Post-Intervention (%)
Incompetent	40	100	0	0
Competent	0	0	40	100
<b>Total</b>	<b>40</b>	<b>100</b>	<b>40</b>	<b>100</b>

The results in table 3 show a clear change in nurses' competence in performing FOUR Scale consciousness assessments before and after the intervention. Before the workshop, all respondents (40 nurses; or 100%) were categorized as incompetent, and none met the criteria for the competent category. After the intervention, the results showed a complete shift, with all respondents (40 nurses; or 100%) classified as competent, while no respondents remained in the incompetent category. These findings indicate that the workshop significantly improved nurses' practical competence in applying the FOUR Scale for consciousness assessment in head trauma cases.

**Table 4.** Comparison of Pre- and Post-Intervention Knowledge Items on FOUR Scale Consciousness Assessment Among Nurses at Syech Yusuf Hospital, Gowa Regency (n = 40)

Items	Pre Test				Post Test			
	True		False		True		False	
	Frequency (n)	%	Frequency (n)	%	Frequency (n)	%	Frequency (n)	%
The <i>FOUR Scale</i> is an acronym for	16	40,0	24	60,0	40	100	0	0
The main objective of consciousness assessment using the <i>FOUR Scale</i>	40	100	0	0	40	100	0	0
One of the main indications for using the <i>FOUR Scale</i>	39	97,5	1	2,5	40	100	0	0
The main components of the <i>FOUR Scale</i>	37	92,5	3	7,5	40	100	0	0
The maximum total score	29	72,5	11	27,5	40	100	0	0

Items	Pre Test				Post Test			
	True		False		True		False	
	Frequency (n)	%	Frequency (n)	%	Frequency (n)	%	Frequency (n)	%
of the <i>FOUR Scale</i>								
The <i>FOUR Scale</i> is superior to GCS in patients	39	97,0	1	2,5	40	100	0	0
If the nurse incorrectly assesses the <i>FOUR Scale</i> score in head trauma cases	40	100	0	0	40	100	0	0
<i>FOUR Scale</i> evaluation should be combined with Head trauma patient gets a total <i>FOUR Scale</i> score of 4	31	77,5	9	22,5	23	57,5	17	42,5
Based on this assessment, what is the correct eye response score	20	50,0	20	50,0	32	80,0	8	20,0
Based on this assessment, what is the correct <i>motor</i> response score	12	30,0	28	70,0	36	90,0	4	10,0
Based on these findings, what is the correct brainstem reflex score according to the <i>FOUR Scale</i>	15	37,5	25	62,5	33	82,5	7	17,5
What is the most appropriate combination of the <i>FOUR Score</i> and its interpretation result	11	27,5	29	72,5	40	100	0	0
What is the most appropriate combination of the <i>FOUR Score</i> and its interpretation result	7	17,5	33	82,5	29	72,5	11	27,5
What is the most appropriate combination of the <i>FOUR Score</i> and its interpretation result	6	15,0	34	85,0	10	25,0	30	75,0
What is the most appropriate combination of the <i>FOUR Score</i> and its interpretation result	24	60,0	16	40,0	32	80,0	8	20,0
What is the correct total <i>FOUR Scale</i> score for this patient	5	12,5	35	87,5	14	35,0	26	65,0
What is the correct total <i>FOUR Scale</i> score for this patient	19	47,5	21	52,5	40	100	0	0
What is the correct total <i>FOUR Scale</i> score for this patient	12	30,0	28	70,0	13	32,5	27	67,5
What is the correct total <i>FOUR Scale</i> score for this patient	9	22,5	31	77,5	21	52,5	19	47,5
What is the correct total <i>FOUR Scale</i> score for this patient	20	50,0	20	50,0	3	7,5	37	92,5

The combined item-level analysis of pre- and post-test results demonstrates considerable changes in nurses' knowledge of the FOUR Scale following the intervention. Prior to the workshop, there was substantial variation in baseline knowledge. Most respondents demonstrated good understanding of fundamental aspects of the FOUR Scale, including its main objective (100.0%), indications for use (97.5%), core components (92.5%), and its superiority over the Glasgow Coma Scale (97.5%). In addition, all respondents (100.0%) correctly recognized the consequences of incorrect FOUR Scale scoring, indicating strong awareness of its clinical importance.

However, important knowledge gaps were identified in items requiring score calculation, interpretation, and application in clinical scenarios. Less than half of the respondents correctly identified the acronym of the FOUR Scale (40.0%) and the maximum total score (72.5%). More pronounced deficiencies were observed in scenario-based items, particularly those involving eye response (30.0%), motor response (37.5%), and brainstem reflex scoring (27.5%). Furthermore, items related to the correct combination of FOUR Scale scores and their clinical interpretation showed low correct response rates, ranging from 15.0% to 60.0%. Similarly, items requiring calculation of total FOUR Scale scores across different case scenarios were correctly answered by only 12.5%–50.0% of respondents.

Following the intervention, a marked improvement in knowledge was observed across most components of the FOUR Scale. All respondents (100.0%) answered correctly on items related to the acronym, main objectives, indications, components, maximum score, superiority over the GCS, consequences of incorrect scoring, and brainstem reflex assessment, indicating complete mastery of fundamental theoretical concepts. Substantial improvements were also observed in applied and scenario-based items, including eye response scoring (90.0%), motor response scoring (82.5%), interpretation of a total score of 4 (80.0%), and several total score calculations reaching 100.0% correct responses. Items related to the interpretation of FOUR Scale scores also demonstrated moderate improvements, with correct response rates ranging from 72.5% to 80.0%.

Nevertheless, some items continued to demonstrate relatively lower correct response rates, particularly those requiring complex integration and calculation across multiple components. Items related to combining FOUR Scale evaluation with other assessments (57.5%), certain interpretation scenarios (25.0%), and selected total score calculations (7.5%–52.5%) remained challenging for some respondents. Several items achieved perfect accuracy (100.0%), particularly in fundamental concepts and specific total score calculations, while others showed moderate improvements ranging from 72.5% to 80.0%. However, certain items remained low, with correct responses as low as 7.5%, indicating persistent challenges in complex clinical interpretation.

Overall, these findings indicate that the workshop was effective in substantially enhancing nurses' theoretical understanding and applied knowledge of the FOUR Scale. However, the persistence of lower accuracy in complex scoring and interpretation tasks highlights the need for continued practice and reinforcement through repeated simulation or advanced training.

**Table 5.** Comparison of Pre- and Post-Intervention Competence Items in FOUR Scale Assessment Among Nurses at Syech Yusuf Hospital, Gowa Regency (n = 40)

Items	Pre Test				Post Test			
	True		False		True		False	
	Frequency (n)	%	Frequency (n)	%	Frequency (n)	%	Frequency (n)	%
Assessment eye responses	38	95.0	2	5.0	40	100	0	0
Interpretation eye responses	29	72.5	11	27.5	40	100	0	0
Assessment motor responses	29	72.5	11	27.5	40	100	0	0
Interpretation motor responses	25	62.5	15	37.5	40	100	0	0
Assessment brainstem reflexes	27	67.5	13	32.5	34	85.0	6	15.0
Interpretation brainstem reflexes	22	55.0	18	45.0	33	82.5	7	17.5
Assessment respiratory pattern	23	57.5	17	42.5	36	90.0	4	10.0
Interpretation respiratory patterns	21	52.5	19	47.5	35	87.5	5	12.5
Calculate and record the total <i>FOUR Scale</i> score	24	60.0	16	40.0	40	100	0	0
Interpretation the level of consciousness and	20	50.0	20	50.0	40	100	0	0

Items	Pre Test				Post Test			
	True		False		True		False	
	Frequency (n)	%	Frequency (n)	%	Frequency (n)	%	Frequency (n)	%
comprehensive <i>FOUR SCALE</i> clinical assessment								

The combined analysis of nurses' competence before and after the intervention demonstrates a significant change in their practical ability to perform FOUR Scale assessments. Prior to the intervention, nurses' competence varied across different assessment components. Most respondents demonstrated adequate ability in assessing eye responses, with 38 nurses (95.0%) performing this component correctly. However, competence declined at the interpretation stage, as only 29 nurses (72.5%) correctly interpreted eye response findings. A similar pattern was observed in motor response assessment, where 29 nurses (72.5%) performed the assessment correctly, but only 25 nurses (62.5%) accurately interpreted the results.

Lower levels of competence were observed in more complex assessment domains. Correct assessment of brainstem reflexes was achieved by 27 nurses (67.5%), while interpretation accuracy decreased to 22 nurses (55.0%). Assessment of respiratory patterns was correctly performed by 23 nurses (57.5%), with only 21 nurses (52.5%) accurately interpreting the findings. Furthermore, only 24 nurses (60.0%) were able to correctly calculate and record the total FOUR Scale score, and only half of the respondents (50.0%) were able to accurately interpret the overall level of consciousness and perform a comprehensive FOUR Scale-based clinical assessment.

Following the intervention, a substantial improvement in competence was observed across nearly all components of the FOUR Scale assessment. All respondents (100.0%) correctly performed and interpreted eye and motor response assessments, accurately calculated and recorded the total FOUR Scale score, and correctly interpreted the overall level of consciousness through comprehensive clinical assessment. These findings indicate that the workshop was highly effective in strengthening nurses' practical skills and clinical judgment in applying the FOUR Scale.

Significant improvements were also observed in components that previously demonstrated lower performance. Correct assessment of brainstem reflexes increased to 34 nurses (85.0%), with interpretation accuracy reaching 82.5%. Similarly, respiratory pattern assessment improved to 36 nurses (90.0%), with correct interpretation achieved by 35 nurses (87.5%). Despite these improvements, these components still showed relatively lower accuracy compared to other domains, indicating that aspects requiring deeper physiological understanding and more complex clinical observation skills still require further reinforcement.

Overall, these findings indicate that the simulation-based workshop was effective in improving nurses' clinical competence in performing FOUR Scale assessments comprehensively, both in terms of observation and interpretation. However, the remaining variability in more complex components suggests the need for continuous practice, clinical supervision, and advanced training to ensure sustained competence in clinical practice.

**Table 6.** Comparison of Nurses' Knowledge Scores Before and After the FOUR Scale Workshop Using the Wilcoxon Signed-Rank Test

Variable	Min	Max	Mean	SD	Z	p-value
Pre-test knowledge score	5	14	10.78	2.178		
Post-test knowledge score	12	18	15.15	1.762	-5.231	0.001

The results showed that the mean knowledge score of nurses before the FOUR Scale workshop was  $10.78 \pm 2.178$ , with a minimum score of 5 and a maximum score of 14. After the workshop, the mean knowledge score increased to  $15.15 \pm 1.762$ , with a minimum score of 12 and a maximum score of 18.

The Wilcoxon Signed-Rank Test revealed a Z value of -5.231 with a p-value of 0.001 ( $p < 0.05$ ), indicating a significant difference in nurses' knowledge before and after the workshop. These findings suggest that the FOUR Scale workshop effectively improved nurses' knowledge in assessing the level of consciousness in patients with head trauma.

**Table 7.** Difference in Nurses' Knowledge Pre and Post Intervention the Workshop on FOUR Scale Consciousness Assessment in Head Trauma Cases at Syech Yusuf Hospital, Gowa Regency

Pre-Post Test Knowledge	Frequency	Mean Rank
Decreased	0	0
Increased	29	15.00

Pre-Post Test Knowledge	Frequency	Mean Rank
Unchanged	11	

The findings indicate that the majority of nurses (29 respondents) experienced an increase in knowledge following the workshop on FOUR Scale consciousness assessment. Meanwhile, 11 nurses showed no change in knowledge levels, and none of the respondents demonstrated a decrease after the intervention. Statistical analysis using the *Wilcoxon Signed Rank Test* revealed a significant difference in nurses' knowledge before and after the workshop. This result confirms that the educational intervention had a significant positive effect on improving nurses' knowledge related to FOUR Scale consciousness assessment in head trauma cases.

**Table 8.** Comparison of Nurses' Competence Scores Before and After the FOUR Scale Workshop Using the Wilcoxon Signed-Rank Test

Variable	Min	Max	Mean	SD	Z	p-value
Pre-test competence score	6	11	8.70	1.344		
Post-test competence score	11	20	15.95	1.753	-6.325	0.001

The results showed that the mean competence score of nurses before the workshop was  $8.70 \pm 1.344$ , with a minimum score of 6 and a maximum score of 11. After the workshop, the mean competence score increased to  $15.95 \pm 1.753$ , with a minimum score of 11 and a maximum score of 20.

The Wilcoxon Signed-Rank Test showed a Z value of -6.325 with a p-value of 0.001 ( $p < 0.05$ ), indicating a significant difference in nurses' competence before and after the workshop. This result demonstrates that the FOUR Scale workshop significantly improved nurses' competence in assessing the level of consciousness in patients with head trauma.

**Table 9.** Difference in Nurses' Competence Pre and Post Intervention the Workshop on FOUR Scale Consciousness Assessment in Head Trauma Cases at Syech Yusuf Hospital, Gowa Regency

Pre-Post Test Competence	Frequency	Mean Rank
Decreased	0	0
Increased	40	20.50
Unchanged	0	

The results indicate that all nurses (40 respondents) demonstrated an improvement in competence following the workshop on FOUR Scale consciousness assessment. No respondents experienced a decrease or remained unchanged in their competence levels after the intervention. Further analysis using the *Wilcoxon Signed Rank Test* showed a statistically significant difference in nurses' competence before and after the workshop. These findings confirm that the workshop was highly effective in enhancing nurses' competence in performing and interpreting FOUR Scale consciousness assessments in head trauma cases.

## DISCUSSION

### Improvement of Nurses' Knowledge Before and After the FOUR Scale Consciousness Assessment Workshop

The findings of this study indicate that prior to the workshop, most nurses had a moderate level of knowledge regarding the FOUR Scale. This suggests that although nurses possessed a basic understanding of consciousness assessment, they had not yet achieved comprehensive mastery of the more complex concepts and procedures of the FOUR Scale compared with the Glasgow Coma Scale (GCS)<sup>17</sup>. According to the Knowledge-to-Action Framework, conceptual knowledge alone is insufficient to ensure effective clinical practice without continuous and structured training<sup>18</sup>, particularly for instruments such as the FOUR Scale that require advanced cognitive and psychomotor skills in assessing brainstem reflexes and respiratory patterns.

This condition may be explained by limited exposure to the FOUR Scale, insufficient formal training, and the continued predominance of the GCS in routine clinical practice in Indonesia<sup>19</sup>. From the perspective of Tanner's Clinical Judgment Model, limited clinical exposure restricts nurses' progression beyond the early stages of noticing and interpreting, thereby hindering the development of more advanced clinical judgment required for accurate neurological assessment<sup>20</sup>. These findings are consistent with previous studies reporting moderate baseline knowledge among nurses prior to neurotrauma training<sup>18</sup>. In the context of Syech Yusuf Hospital, this situation is further influenced by the limited adoption of the FOUR Scale as a standard consciousness assessment tool in clinical practice, unlike in several countries such as Thailand and Egypt where the instrument has been

more widely implemented. Limited clinical exposure and the scarcity of locally available reference materials may also contribute to suboptimal baseline knowledge.

Further analysis of the knowledge items prior to the intervention revealed that most nurses had already understood the fundamental concepts of the FOUR Scale, including its primary purpose, its advantages compared with the Glasgow Coma Scale, and its core assessment components. This finding is consistent with previous studies indicating that trauma nurses generally possess adequate theoretical knowledge of basic neurological assessment principles and recognize the importance of the FOUR Scale in neuroprotective nursing care<sup>21</sup>. However, several fundamental aspects were not uniformly mastered by all respondents. Only a small proportion of nurses were able to correctly identify the FOUR Scale acronym and the maximum score of the instrument, suggesting gaps in the recall of specific conceptual details.

Greater variability was observed in knowledge related to component-level scoring and its application in clinical scenarios. Only a limited number of nurses were able to accurately determine eye response scores, and fewer than half correctly identified motor response scores based on case descriptions. Similarly, the assessment of brainstem reflexes showed relatively low accuracy. These findings are consistent with<sup>22</sup>, who reported that although nurses may understand the theoretical structure of the FOUR Scale, difficulties often arise when translating this knowledge into accurate scoring of individual components. This observation is further supported by findings showing that healthcare professionals frequently encounter challenges in understanding and operationalizing the FOUR Scale scoring system when applied in clinical situations<sup>23</sup>.

The most prominent knowledge gap was identified in items related to the calculation and interpretation of the total FOUR Scale score. The proportion of correct responses for items requiring total score calculation was relatively low, and only a small number of nurses were able to integrate total scores with appropriate clinical interpretations<sup>12</sup>. These findings are consistent with previous research showing reduced accuracy when nurses are required to perform more complex assessments involving the integration of multiple clinical indicators simultaneously<sup>13</sup>. Overall, these results indicate that although nurses possessed a relatively good theoretical understanding of the FOUR Scale, significant challenges remained in calculating and interpreting the total score, which requires a higher level of clinical reasoning.

Following the implementation of the workshop, a significant improvement was observed in nurses' knowledge regarding consciousness assessment using the FOUR Scale. This improvement indicates that educational interventions integrating theoretical learning with simulation-based practice can effectively enhance both conceptual understanding and the practical application of neurological assessment instruments. These findings are consistent with reports showing significant improvements in nurses' knowledge and skills in traumatic brain injury management following intensive educational interventions<sup>24</sup>.

Post-intervention analysis of knowledge items demonstrated clear improvement across most knowledge components. All nurses were able to identify key elements of the FOUR Scale, including the acronym, purpose, clinical indications, assessment components, maximum score, its advantages over the GCS, and the consequences of inaccurate scoring. Consistent knowledge was also observed in the assessment of brainstem reflexes, suggesting improved understanding of neurological aspects that were previously less familiar to some nurses<sup>25</sup>.

In addition to conceptual mastery, nurses also demonstrated improved knowledge in several applied assessment components. Most respondents were able to correctly identify eye response and motor response scores based on clinical scenarios and understand the clinical significance of low FOUR Scale scores in patients with head trauma. This finding indicates that the workshop not only improved theoretical knowledge but also enhanced the ability to apply the assessment in realistic clinical contexts. These results are consistent with findings indicating that case-based training can improve nurses' understanding of complex neurological assessments<sup>26</sup>.

Nevertheless, several challenges remained in aspects requiring more advanced clinical reasoning. Some nurses continued to experience difficulty integrating FOUR Scale findings with other neurological assessment tools and determining the most appropriate score combinations for clinical interpretation. These findings are consistent with previous studies reporting decreased accuracy in tasks requiring the integration of complex clinical information<sup>13</sup>. Interpretative complexity has also been reported to pose challenges for healthcare professionals when applying the FOUR Scale in conjunction with other neurological assessment instruments<sup>23</sup>.

The most prominent knowledge deficit remained in items related to the calculation and interpretation of the total FOUR Scale score. Only a small proportion of nurses were able to accurately calculate combined component scores and correctly interpret their clinical meaning. This finding highlights a discrepancy between strong theoretical understanding and limitations in applying complex score interpretation<sup>27</sup>. Overall, although nurses demonstrated significant improvement in knowledge and recognized the clinical advantages of the FOUR Scale, difficulties in total score interpretation remain a challenge that may influence the accuracy of neurological assessment and clinical decision-making in patients with head trauma<sup>14</sup>.

Overall, the changes in knowledge observed before and after the intervention in this study were likely influenced by several key factors. Limited exposure to the FOUR Scale in previous clinical practice meant that nurses were not accustomed to using the instrument systematically, resulting in a basic level of conceptual understanding. In addition, the continued predominance of the Glasgow Coma Scale in routine clinical practice

in Indonesia contributed to nurses' limited familiarity with the additional components of the FOUR Scale, such as brainstem reflex and respiratory pattern assessment<sup>19</sup>. Limited formal training on the FOUR Scale may also have created a gap between theoretical knowledge and its practical application in clinical settings. Furthermore, the complexity of interpreting the total score, which requires the integration of multiple neurological indicators, may have contributed to the difficulty nurses experienced in performing comprehensive assessments<sup>23</sup>. Following the intervention, the improvement in knowledge was likely influenced by the learning approach used in the workshop, which integrated theoretical instruction, clinical case simulations, and direct facilitator feedback. This approach enabled participants to connect theoretical concepts with clinical practice more effectively<sup>28</sup>. Therefore, practice-based workshops may represent an effective educational strategy for improving nurses' understanding of consciousness assessment using the FOUR Scale in patients with head trauma.

### **Improvement of Nurses' Clinical Competence Before and After the FOUR Scale Consciousness Assessment Workshop**

The findings of this study indicate that prior to the workshop, all nurses were classified as not competent in performing consciousness assessments using the FOUR Scale. This result suggests that both theoretical knowledge and practical skills related to the instrument were still limited among participants. Such a condition is understandable considering that the FOUR Scale is a relatively new neurological assessment tool and has not yet been widely adopted as a clinical standard in Indonesia. Most nurses were more familiar with the Glasgow Coma Scale (GCS), resulting in minimal exposure to the more complex and specific components of the FOUR Scale.

The low level of pre-intervention competence may also be attributed to several structural and educational factors. These include limited continuing education opportunities related to contemporary neurological assessment, the absence of standard operating procedures regulating the use of the FOUR Scale in routine clinical practice, and limited clinical exposure to severe traumatic brain injury cases requiring comprehensive neurological evaluation<sup>24</sup>. Consequently, nurses' theoretical knowledge did not fully develop into practical clinical competence.

These findings are consistent with previous studies reporting low baseline competence among nurses prior to neurotrauma training. Studies have shown that many intensive care unit nurses demonstrated inadequate competence in traumatic brain injury care before receiving training, and similar findings were reported among nurses in other clinical settings. Furthermore, significant improvements in knowledge and skills following Brain Health Workshops suggest that baseline competence among healthcare professionals is often relatively basic before targeted educational interventions are implemented<sup>24,28,29</sup>. The researchers assume that the low pre-workshop competence observed in this study was not due to individual limitations in motivation or ability, but rather due to systemic barriers such as limited access to specialized training, delayed adoption of updated neurological assessment tools, and restricted exposure to complex neurological cases. These conditions highlight the importance of competence based continuing education programs to ensure accurate neurological assessment in patients with traumatic brain injury.

Further analysis of competence indicators before the intervention revealed variations in nurses' abilities across different components of the FOUR Scale assessment. Overall, nurses demonstrated relatively stronger competence in basic neurological observation tasks compared with tasks requiring deeper clinical interpretation. For instance, nurses showed better performance in identifying eye responses and motor responses, which are also routinely assessed through the Glasgow Coma Scale. In contrast, lower competence was observed in the assessment of brainstem reflexes and respiratory patterns, which represent additional and more complex components of the FOUR Scale.

Competence related to score interpretation and calculation was also limited. Although more than half of the nurses were able to interpret individual assessment components, only 60.0% were able to correctly calculate and document the total FOUR Scale score, and only 50.0% were able to comprehensively interpret the patient's level of consciousness. This finding is consistent with previous research indicating that nurses often perform better in assessing isolated neurological responses than in interpreting total scores that require more advanced clinical reasoning<sup>13</sup>.

From the perspective of Kolb's Experiential Learning Theory, competence develops through a cyclical process consisting of concrete experience, reflective observation, abstract conceptualization, and active experimentation<sup>30</sup>. The pre-intervention findings suggest that nurses' learning experiences had largely remained at the early stages of this cycle, where knowledge is mainly based on recognition and limited clinical exposure. Higher-level reflective and integrative processes, particularly those related to interpreting complex neurological findings, had not yet been optimally developed<sup>31</sup>. The researchers therefore assume that these limitations were influenced by the lack of structured learning opportunities and insufficient case-based training related to the FOUR Scale in the clinical environment.

Following the implementation of the workshop, a substantial improvement in nurses' clinical competence was observed. The findings of this study conducted at Syech Yusuf Hospital, Gowa Regency, demonstrate that all nurses achieved competence after participating in the FOUR Scale consciousness assessment workshop. This

result indicates that the workshop was effective in strengthening nurses' clinical skills compared with their pre-intervention performance. It also confirms that structured educational interventions combining theoretical instruction with hands-on practice can significantly enhance nurses' ability to perform neurological assessments accurately and systematically in accordance with clinical standards.

The improvement in competence can largely be attributed to the use of simulation-based learning methods incorporated into the workshop. The training involved interactive discussions, guided practice sessions, and repeated simulation scenarios focusing on all FOUR Scale components, including eye response, motor response, brainstem reflexes, and respiratory patterns. Through repeated exposure to realistic clinical scenarios, nurses were able to integrate conceptual knowledge with psychomotor skills and apply the assessment comprehensively in simulated head trauma cases<sup>32</sup>. This learning process also strengthened nurses' clinical reasoning and supported more appropriate clinical decision-making based on neurological assessment findings.

The effectiveness of the workshop was further enhanced by its learner-centered educational design. The training encouraged active participation, critical thinking, and reflective clinical practice. Facilitators acted as mentors rather than passive instructors by providing immediate feedback during simulation sessions, enabling participants to identify and correct assessment errors in real time. Additionally, the incorporation of evidence-based practice principles helped nurses connect neurological physiology with practical assessment procedures, thereby improving the quality of clinical decision-making<sup>23</sup>. Post-intervention analysis of competence indicators confirmed this improvement. Most competence indicators achieved very high levels of accuracy, with several components reaching 100% correct performance. Nurses were able to accurately assess eye and motor responses, and the majority demonstrated high competence in evaluating brainstem reflexes and respiratory patterns. This improvement reflects enhanced consistency and reliability in neurological assessments using the FOUR Scale and supports previous findings indicating that structured neurological training programs can improve systematic assessment skills and reduce inter-rater variability among healthcare professionals<sup>31</sup>.

Nurses also demonstrated substantial improvement in the interpretation and integration of assessment findings. All participants were able to correctly calculate and document the total FOUR Scale score and determine the patient's level of consciousness with high accuracy. These results align with previous studies reporting improved reliability of FOUR Scale assessments following structured training and highlighting the effectiveness of interactive and case-based learning in strengthening clinical interpretation and decision-making skills<sup>33,34</sup>. Overall, the improvement in nurses' competence observed in this study was likely influenced by several key factors. First, the workshop addressed previous gaps in knowledge and clinical exposure by providing structured training specifically focused on FOUR Scale assessment. Second, simulation-based learning allowed nurses to practice neurological assessment skills in a safe and controlled environment, facilitating the development of psychomotor competence and clinical reasoning. Third, the integration of theoretical explanation, case-based simulations, and immediate facilitator feedback enabled participants to translate conceptual knowledge into practical clinical skills more effectively. Finally, the contextual relevance of the training to nurses' daily responsibilities in managing head trauma patients may also have contributed to the high level of learning engagement and competence improvement observed in this study. Collectively, these findings suggest that structured workshops incorporating simulation and guided clinical practice represent an effective educational strategy for improving nurses' competence in performing comprehensive FOUR Scale consciousness assessments in patients with traumatic brain injury.

### **Analysis of Challenges in Complex Interpretation of the FOUR Scale**

Although the findings of this study demonstrate improvements in nurses' knowledge and competence after participating in the FOUR Scale consciousness assessment workshop, several assessment components remained relatively challenging, particularly those requiring more complex clinical interpretation. These challenges were mainly observed in tasks involving the integration of total scores, the interpretation of combinations of component scores, and clinical decision-making based on neurological assessment findings. This indicates that improvements in foundational knowledge and basic clinical skills do not always directly translate into the ability to perform comprehensive clinical interpretation, especially when healthcare professionals are required to integrate multiple neurological indicators simultaneously<sup>13</sup>.

One of the primary challenges identified in this study was the calculation and interpretation of the total FOUR Scale score. Some nurses experienced difficulty integrating scores from the four components eye response, motor response, brainstem reflexes, and respiratory patterns to produce a comprehensive clinical interpretation. This finding suggests that although understanding of individual components improved following training, the integration of complex clinical information still requires advanced clinical reasoning. Previous research has noted that interpretative complexity often presents challenges for healthcare professionals when applying the FOUR Scale, particularly when the instrument is used alongside other neurological assessment tools<sup>23</sup>. Compared with the Glasgow Coma Scale, the FOUR Scale is designed to provide a more comprehensive neurological assessment because it includes evaluation of brainstem reflexes and respiratory patterns, components that are not present in the GCS. The GCS primarily focuses on three domains eye response, verbal response, and motor response whereas

the FOUR Scale expands neurological evaluation by incorporating brainstem reflexes and respiratory patterns as key indicators of deeper neurological function, particularly in patients with severe consciousness impairment or those receiving mechanical ventilation. While this expanded structure increases the sensitivity of the FOUR Scale in detecting neurological deterioration, it also increases the complexity of clinical interpretation.

In this study, particular difficulties were observed in the assessment of brainstem reflexes and respiratory patterns. The evaluation of brainstem reflexes, such as pupillary and corneal reflexes, requires a deeper understanding of neurological physiology and more precise clinical observation skills. Similarly, respiratory pattern assessment requires clinicians to recognize abnormal breathing patterns associated with neurological dysfunction, such as Cheyne Stokes respiration or irregular breathing patterns related to brainstem injury. These components are less familiar to many nurses who have primarily relied on the GCS in routine clinical practice, requiring additional cognitive and clinical adaptation when transitioning to the FOUR Scale.

Although the simulation-based workshop effectively improved participants' basic understanding and observational skills, this training approach may not fully optimize complex clinical interpretation. This limitation may be related to the relatively short duration of the training and the limited variety of clinical scenarios that can be simulated within a workshop setting. In real clinical practice, neurological interpretation often requires repeated exposure to diverse patient conditions and the ability to relate assessment findings to the dynamic progression of a patient's neurological status.

From the perspective of clinical learning theory, complex interpretative skills generally develop progressively through repeated clinical experience. Kolb's Experiential Learning Theory explains that clinical competence evolves through a cycle consisting of concrete experience, reflective observation, abstract conceptualization, and active experimentation<sup>31</sup>. Simulation-based training may accelerate learning during the early stages of this cycle; however, deeper interpretative competence typically develops through sustained clinical exposure in real patient care settings.

Another factor contributing to the observed challenges may be the established clinical habits associated with the use of previously adopted assessment tools. Nurses who have long relied on the GCS may have developed established neurological assessment patterns, and transitioning to a new instrument such as the FOUR Scale requires cognitive adjustment to understand the relationships among its different components. This adaptation process may influence both the speed and accuracy of score interpretation, particularly during the early phases of implementation.

To address these challenges, the use of cognitive aids may be beneficial in supporting the clinical application of the FOUR Scale. Practical tools such as FOUR Scale scoring cards or quick-reference guides available in emergency departments may assist nurses in recalling assessment components, scoring procedures, and interpretation steps more efficiently during neurological assessments. Visual cognitive aids can also reduce cognitive load in high-pressure clinical environments and improve consistency in neurological assessment among healthcare providers.

In addition to these challenges, the interpretation of the study results should also consider the possibility of a ceiling effect in the competence outcomes observed after the intervention. In this study, all participants achieved competence following the workshop, indicating a substantial improvement in their ability to perform FOUR Scale assessments. While this finding may reflect the effectiveness of the training, uniformly high performance immediately after training may also be influenced by evaluation conditions conducted shortly after the educational intervention. In clinical education research, this phenomenon is often associated with the Hawthorne effect, where participants perform better because they are aware they are being observed or evaluated. Furthermore, the testing effect may also contribute to short-term improvements, as intensive exposure to new knowledge and skills during training sessions can temporarily enhance performance.

However, improvements observed immediately after training may not necessarily reflect long-term clinical competence. Previous studies in health professional education indicate that newly acquired clinical skills may decline over time a phenomenon known as skill decay if they are not reinforced through continuous clinical practice, supervision, or periodic refresher training. Therefore, although simulation-based workshops appear effective in improving nurses' initial competence in performing FOUR Scale assessments, ongoing training programs, clinical audits, and case-based practice may be necessary to ensure that these competencies are sustained in routine clinical practice.

### Study Limitations

This study has several limitations that should be considered when interpreting the findings. First, the study employed a pre-experimental design without a control group, which limits the ability to establish strong causal relationships between the intervention and the observed improvements in knowledge and competence. The absence of a comparison group represents a design limitation that may influence the interpretation of the intervention's effectiveness.

Second, the sample size was relatively small and limited to nurses from a single hospital, which may restrict the generalizability of the findings to broader healthcare settings. Differences in institutional protocols,

clinical experience, and training opportunities across healthcare facilities may influence the applicability of the results in other contexts.

Another limitation relates to the timing of competence assessment, which was conducted immediately after the workshop. Consequently, the results primarily reflect the short-term impact of the training intervention. Although the findings demonstrated substantial improvements in competence, the possibility of a ceiling effect should be considered, as many participants achieved high performance levels immediately following the training. Further research is therefore necessary to evaluate the long-term retention of these skills and determine whether the observed competence can be sustained over time in real clinical practice.

Potential evaluation bias may also have occurred because competence assessments were conducted by evaluators who were involved in the training process. This condition may influence the objectivity of the evaluation, despite efforts to standardize the assessment procedures.

Finally, although the training improved overall knowledge and competence, the study findings indicate that the interpretation of the total FOUR Scale score remains challenging for some participants. This observation highlights an important scientific contribution of the study, suggesting that short-term simulation-based training may improve procedural competence but may not fully address the complexity of integrated clinical interpretation. Future research should therefore explore educational strategies that emphasize advanced clinical reasoning and long-term skill retention to enhance the practical implementation of the FOUR Scale in neurological assessment.

## **CONCLUSION AND RECOMMENDATIONS**

This study conducted at Syech Yusuf Hospital, Gowa Regency demonstrates that a structured FOUR Scale workshop improved nurses' knowledge and clinical competence in performing neurological assessments for patients with head trauma. Prior to the intervention, nurses showed moderate knowledge and limited competence, particularly in interpreting total FOUR Scale scores, whereas after the workshop, clear improvements were observed in both theoretical understanding and practical assessment skills. These findings highlight the effectiveness of simulation-based training in enhancing nurses' clinical performance and support its integration into continuing nursing education programs to ensure sustained competence development. In addition, periodic competence evaluations are recommended to monitor skill retention and maintain consistent application of the FOUR Scale in clinical practice, while the use of structured scoring tools, such as FOUR Scale scoring cards in emergency departments, can further support accurate, standardized, and efficient neurological assessment. Future studies using randomized controlled trial (RCT) designs with larger samples are recommended to further confirm these findings and assess long-term competence retention.

## **AUTHOR'S CONTRIBUTION STATEMENT**

Eva Yustilawati: Conceptualization, Writing-Original Draft, Validation, Manuscript review

Ardian Adhiwijaya: Conceptualization, Review, Editing, Validation, Manuscript review

Ilhamsyah: Tabulating, Manuscript review

A. Inda Fadhillah Ramadhani: Writing original research, Data analysis, Manuscript review, Validation.

## **CONFLICT OF INTEREST**

In this research, there were no conflicts of interest with the parties involved during the study, namely the nurses at RS Syech Yusuf Gowa. The researchers conducted all stages of the research transparently, professionally, and responsibly, and confirmed that the procedures were in accordance with research ethics. No conflicts arose during the preparation and submission of the manuscript by the researchers.

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