Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 11s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Impact of Educational Interventions on Nurses' Knowledge and Practice of the Glasgow Coma Scale: A Systematic Review

Shahi Dawran[1], Dr. Santhna Letchmi Panduragan[2]

[1]MSN Scholar, Lincoln University College, Malaysia

Email ID: shahidawran74@gmail.com

[2]PhD in Community Education and Development, Dean, Faculty of Nursing, University of Cyberjaya, Malaysia

Email ID: david.withford@cyberjaya.edu.my

***Corresponding Author:**

Shahi Dawran,

MSN Scholar, Lincoln University College Malaysia

Email ID: shahidawran74@gmail.com

Cite this paper as: Shahi Dawran, Dr. Santhna Letchmi Panduragan, (2025) Impact of Educational Interventions on Nurses' Knowledge and Practice of the Glasgow Coma Scale: A Systematic Review. *Journal of Neonatal Surgery*, 14 (11s), 868-876.

ABSTRACT

Background: The Glasgow Coma Scale (GCS) is a critical neurological assessment tool used by nurses to evaluate patient consciousness levels. However, inconsistencies in nurses' knowledge and practical application of the GCS have been reported in various studies. This meta-analysis aims to assess the level of GCS knowledge among nurses, identify gaps in practical application, and evaluate the effectiveness of educational interventions.

Methods: A systematic review of studies on nurses' GCS knowledge and competency was conducted. A total of 16 studies were included, covering various study designs, including descriptive cross-sectional (50%), quasi-experimental (25%), and cross-sectional (25%) methodologies. Key findings related to GCS knowledge levels, application accuracy, and the impact of training interventions were synthesized.

Results: The analysis revealed that while 65% to 71% of nurses demonstrated good theoretical knowledge of GCS, practical application remained inconsistent. A significant proportion (43.75%) of studies reported inadequate GCS knowledge among nurses, while 37.5% found that nurses had moderate to good knowledge but poor assessment accuracy. Studies showed a positive correlation ($r = 0.33$ to $r = 0.52$, $p < 0.05$) between GCS knowledge and assessment accuracy, reinforcing the need for continuous training. Educational interventions significantly improved GCS competency, with post-training improvements reported in 80.6% of nurses in some studies. Persistent challenges were identified in motor response assessment, documentation, and practical application.

Conclusion: The findings underscore the urgent need for structured GCS training, competency-based assessments, and curriculum integration. While nurses often possess foundational knowledge, hands-on training, reflective practice, and simulation-based learning are essential for bridging the knowledge-practice gap. Future research should focus on innovative educational strategies and long-term retention of GCS skills to enhance patient safety and neurological assessment accuracy.

Keywords: *Knowledge, Practice, Glasgow Coma Scale, Nurses, Systematic Review*

1. INTRODUCTION

The Glasgow Coma Scale (GCS) is a widely used neurological assessment tool that evaluates a patient's level of consciousness, playing a crucial role in patient management, especially in emergency and critical care settings (1). Accurate GCS assessment is essential for timely interventions and effective clinical decision-making (2). However, studies indicate that nurses often have inadequate knowledge and inconsistent application of the GCS, which can compromise patient outcomes (3). Developed by Teasdale and Jennett in 1974, the GCS provides a standardized approach for assessing brain injury severity based on three key components: eye-opening response, verbal response, and motor response (4).

Given its critical role in patient assessment and management, accurate and consistent application of the GCS by healthcare professionals, particularly nurses, is essential for ensuring optimal patient outcomes (5). Nurses play a pivotal role in

neurological assessment, as they are often the first to monitor and document changes in a patient's consciousness level (6).

However, existing literature highlights significant gaps in nurses' knowledge and practical application of the GCS. Studies have reported varying levels of proficiency, with some nurses demonstrating inadequate understanding of GCS scoring and its interpretation (7). This inconsistency in knowledge and application can lead to misinterpretations, delays in critical interventions, and potential adverse patient outcomes (8). To address these knowledge gaps, educational interventions have been widely implemented to enhance nurses' competence in GCS assessment (1).

These interventions include structured training programs, simulation-based learning, interactive workshops, and competency-based assessments (9). Research suggests that such training programs contribute significantly to improving nurses' confidence, knowledge retention, and clinical decision-making skills (1).

However, the effectiveness of different educational strategies varies, and there is a need to systematically evaluate their impact on nursing practice (10). Therefore, the GCS is most effective when used in conjunction with other diagnostic tools and assessments to form a holistic view of the patient's neurological function (11).

In tertiary hospitals, where patients require complex care, nurses play a vital role in managing their health (12). Their proficiency in using assessment tools like the GCS is critical for accurate diagnosis, efficient team communication, and prompt medical interventions. (2). Research indicates that nursing staff, as primary caregivers for neurological patients, often face difficulties in consistently applying the GCS accurately, potentially leading to variations in patient outcomes. (13). The GCS plays a crucial role in managing patients with neurological impairments in tertiary care settings. Educational interventions significantly improve nurses' knowledge and confidence, resulting in more accurate patient assessments and improved outcomes. (14). This systematic review aims to synthesize existing research on the impact of educational interventions on nurses' GCS knowledge, skill acquisition, and assessment accuracy. By analyzing studies that evaluate different training methodologies, this review seeks to determine the most effective educational strategies and identify persisting challenges that hinder optimal GCS application. Understanding the nuances of the GCS becomes essential, as it empowers nurses to contribute significantly to the multidisciplinary approach required in tertiary healthcare settings.

2. MATERIAL AND METHODS

This systematic review adhered to a structured approach to identify and analyze relevant studies on the Glasgow Coma Scale (GCS) knowledge and practice among nurses. All relevant studies published until the end of 2023 were considered. A comprehensive literature search was conducted using keywords such as "GCS scale," "Knowledge," "Practice," and "Nursing" across multiple databases, including PubMed, CINAHL, Google Scholar, and other online sources.

The initial search yielded 12,110 articles, which were filtered to include only studies published between 2018 and 2024, reducing the count to 4,110. Further screening based on patents and citations brought the number down to 2,910. A selection process based on study design refined the pool to 795 studies. Finally, to maintain a quantitative research focus, 23 studies were included in this review.

3. RESULTS

Table No 1: Number of studies included in this Systematic review

Study Design	n	%
Descriptive Cross-Sectional Study	8	50%
Correlational Study	2	12.5%
Cross-Sectional Study	4	25%
Quasi-Experimental Study	4	25%
Intervention-Based Study	1	6.25%
Descriptive Exploratory Study	1	6.25%
Analysis by frequency 'n' and percentage '%'		

Table 1 summarizes the study designs included in this meta-analysis. Descriptive Cross-Sectional Studies were the most common (50%), followed by Cross-Sectional and Quasi-Experimental Studies (25% each). Correlational Studies made up 12.5%, while Intervention-Based and Descriptive Exploratory Studies accounted for 6.25% each. The data reflects a predominant use of observational designs to assess GCS knowledge and application.

Table NO 2: Summary of Key Studies on Nurses' Knowledge and Application of Glasgow Coma Scale (GCS) Assessment

Study	Study Design	Sample Size & Setting	Key Findings	Recommendations
Al Sinan & Mansour (2020)	Descriptive Correlational Cross-Sectional	Prince Sultan Military Medical City, Riyadh	Moderate correlation ($r = 0.33$, $p = 0.03$) between nurses' knowledge and GCS assessment accuracy. 71% had good knowledge.	Ongoing in-service training and integration of GCS assessment into nursing curricula.
Sedain & Bhusal (2019)	Descriptive Cross-Sectional	Tertiary University Hospital, Nigeria	65% of nurses had good GCS knowledge, but only 45% applied it accurately.	Regular training to reinforce GCS skills.
Mohamed et al. (2019)	Descriptive Research	Pediatric ICUs, Three Hospitals	69.2% of nurses had good knowledge, but practical application was inadequate.	Formal training programs to improve GCS application.

Table 2 presents studies included in this meta-analysis, detailing their design, sample settings, key findings, and recommendations. Most studies indicate that while nurses demonstrate good theoretical knowledge of the Glasgow Coma Scale (GCS) (ranging from 65% to 71%), their practical application remains inconsistent. Findings highlight a moderate correlation ($r = 0.33$, $p = 0.03$) between knowledge and assessment accuracy. The studies emphasize the need for ongoing training, curriculum integration, and structured educational programs to enhance GCS proficiency.

Table NO 3: Summary of Key Studies on Nurses' Knowledge and Application of Glasgow Coma Scale (GCS) Assessment

Study	Study Design	Sample Size & Setting	Key Findings	Recommendations
Kashif et al. (2022)	Cross-Sectional	1,300 Participants (Govt & Pvt Hospitals, Physiotherapists & Nurses)	84.1% of physiotherapists had good GCS knowledge, compared to 2.9% of nurses. Significant associations with age, gender, education.	Targeted interventions to bridge the knowledge gap among nurses.
Al Ansari et al. (2021)	Cross-Sectional	279 Final-Year Medical Students, Saudi University	Limited confidence in critical care concepts; PBL students had better knowledge but gaps persisted.	Increased institutional support for critical care education.
Ayoub et al. (2018)	Descriptive Cross-Sectional	Dhafra Hospitals, Abu Dhabi	50.6% of nurses had good knowledge, while 49.4% had poor understanding.	Continuous education, specialized GCS courses.

Table 3 outlines studies included in this meta-analysis, summarizing their design, sample characteristics, key findings, and recommendations. The studies reveal significant disparities in Glasgow Coma Scale (GCS) knowledge across different healthcare professionals. Kashif et al. (2022) found physiotherapists had significantly better GCS knowledge (84.1%) compared to nurses (2.9%), emphasizing the need for targeted interventions. Al Ansari et al. (2021) highlighted limited confidence in critical care concepts among final-year medical students, with problem-based learning (PBL) students

performing better. Ayoub et al. (2018) reported 50.6% of nurses had good GCS knowledge, while 49.4% lacked understanding, recommending continuous education and specialized GCS training.

Table NO 4: Summary of Key Studies on Nurses' Knowledge and Application of Glasgow Coma Scale (GCS) Assessment

Study	Study Design	Sample Size & Setting	Key Findings	Recommendations
Gulzada et al. (2023)	Cross-Sectional	PNS Shifa Hospital, Karachi	63.33% of nurses had high GCS knowledge; students' proficiency varied widely.	Targeted educational interventions needed.
Kc & Adil (2022)	Cross-Sectional	91 Nurses, Tertiary Care Center	52.70% of nurses had inadequate GCS knowledge.	Ongoing professional development programs.
A. Alhassan et al. (2019)	Cross-Sectional	Teaching Hospital, Kenya	56% of nurses exhibited inadequate GCS knowledge.	More frequent GCS training and updates.
Thakur (2023)	Descriptive Study	Tertiary Hospital, South India	49% of nurses had inadequate knowledge.	In-service training needed.

Table 4 presents studies analyzing Glasgow Coma Scale (GCS) knowledge among nurses across various settings. Findings indicate inconsistent proficiency levels, with a significant proportion of nurses demonstrating inadequate knowledge. Gulzada et al. (2023) found 63.33% of nurses had high GCS knowledge, but student proficiency varied, highlighting the need for targeted educational interventions. Kc & Adil (2022) and A. Alhassan et al. (2019) reported that 52.70% and 56% of nurses, respectively, lacked sufficient GCS knowledge, emphasizing the importance of ongoing professional development and frequent training. Thakur (2023) observed that 49% of nurses had inadequate knowledge, recommending in-service training programs to improve competency.

Table NO 5: Summary of Key Studies on Nurses' Knowledge and Application of Glasgow Coma Scale (GCS) Assessment

Study	Study Design	Sample Size & Setting	Key Findings	Recommendations
Shinde & Kulkarni (2020)	Descriptive Cross-Sectional	Krishna Hospital & Medical Research Centre	72% of nurses had poor GCS knowledge; 8.7% applied knowledge correctly.	Structured teaching approach with expert-led practical sessions.
Özçelik & Celik (2022)	Cross-Sectional	ICU, Private University, Turkey	High interrater reliability ($\kappa = 0.935$, $p < 0.001$) between GCS & FOUR Score assessments.	Both scales are reliable for neurological assessments.
Mohamed et al. (2022)	Descriptive Exploratory	Neurosurgical ICU, Egypt	GCS, Pupil Age Charts, and CT findings valid for TBI patient outcomes.	Educational programs for ICU nurses on GCS-Pupil Age charts.

Table 5 presents studies examining Glasgow Coma Scale (GCS) knowledge and assessment reliability among nurses in different healthcare settings. Shinde & Kulkarni (2020) found that 72% of nurses had poor GCS knowledge, with only 8.7% correctly applying it, recommending a structured, expert-led teaching approach. Özçelik & Celik (2022) reported high interrater reliability ($\kappa = 0.935$, $p < 0.001$) between GCS and FOUR Score assessments, confirming both as reliable neurological assessment tools. Mohamed et al. (2022) highlighted the validity of GCS, Pupil Age Charts, and CT findings

in traumatic brain injury (TBI) outcomes, suggesting educational programs for ICU nurses to enhance proficiency in GCS-Pupil Age chart assessments.

Table NO 6: Summary of Key Studies on Nurses' Knowledge and Application of Glasgow Coma Scale (GCS) Assessment

Study	Study Design	Sample Size & Setting	Key Findings	Recommendations
Patel & HN (2019)	Correlational Study	Teaching Hospital, India	Strong positive correlation ($r = 0.52$, $p < 0.01$) between GCS knowledge and patient outcomes.	Incorporate GCS training into nursing education.
Yousef et al. (2021)	Quasi-Experimental	70 Nurses, Tertiary Care Hospital	Post-training, 80.6% of nurses gained competent GCS skills.	Implement educational pedagogy for neurological assessment.
Zidan & El Sayed Ibrahim (2019)	Quasi-Experimental	Emergency Dept, Egypt	Significant improvement in GCS assessment accuracy post-training ($p < 0.01$).	Ongoing GCS training programs.

Table 6 summarizes studies exploring the impact of GCS knowledge and training on nursing competence and patient outcomes. Patel & HN (2019) found a strong positive correlation ($r = 0.52$, $p < 0.01$) between GCS knowledge and patient outcomes, recommending its integration into nursing education. Yousef et al. (2021) reported that 80.6% of nurses demonstrated competent GCS skills post-training, highlighting the need for structured educational pedagogy in neurological assessment. Zidan & El Sayed Ibrahim (2019) observed a significant improvement in GCS assessment accuracy post-training ($p < 0.01$), advocating for ongoing GCS training programs to enhance clinical proficiency.

Table NO 7: Summary of Key Studies on Nurses' Knowledge and Application of Glasgow Coma Scale (GCS) Assessment

Study	Study Design	Sample Size & Setting	Key Findings	Recommendations
Timothy et al. (2024)	Intervention-Based Study	University Hospital, Australia	Post-training, only 15% had insufficient GCS knowledge.	Targeted educational interventions enhance GCS application.
Zhang et al. (2024)	Cross-Sectional	Private Hospital, UK	20.8% of emergency nurses had inadequate knowledge—lower than other studies.	Regular GCS training within professional development programs.
Dawran, S., & Panduragan, 2024	Quasi-experimental study	Sample Size: 150 nurses Setting: Tertiary care hospital, Buner, Pakistan	Pre-intervention knowledge score: Mean = 4.39 - Post-intervention knowledge score: Mean = 7.19 ($p = 0.000$) - 83.3% male, 16.7% female - 42.7% worked in ICU, 24.7% in Emergency - Over 60% of nurses faced challenges in motor	Continuous and targeted training programs on GCS - Practical skill enhancement to improve assessment and documentation - Reflective practice initiatives for better clinical application

Table 7 presents studies on GCS knowledge and training effectiveness among nurses. Timothy et al. (2024) found that post-training, only 15% of nurses had insufficient GCS knowledge, emphasizing the role of targeted educational interventions. Zhang et al. (2024) reported that 20.8% of emergency nurses had inadequate knowledge, lower than in other studies, highlighting the need for regular GCS training within professional development programs. Dawran & Panduragan (2024) conducted a quasi-experimental study, showing a significant improvement in GCS knowledge post-intervention (Mean score: 4.39 to 7.19, p = 0.000). They recommended continuous training, practical skill enhancement, and reflective practice initiatives to improve assessment and documentation.

Table No 8: Aspects of the Quasi experimental study respectively its findings

Aspect	Findings
Training Effectiveness	All studies show a significant improvement in nurses' GCS knowledge and assessment accuracy post-intervention.
Challenges Identified	Dawran & Panduragan (2024) reported persistent difficulties in motor response identification, documentation, and assessment preparation.
Sample Size & Setting	Dawran & Panduragan (2024) had the largest sample (150 nurses), whereas Yousef et al. (2021) had 70 nurses and Zidan & El Sayed Ibrahim (2019) focused on the emergency department.
Recommendations	All studies emphasize the need for continuous GCS training. Dawran & Panduragan (2024) further highlight the importance of reflective practice for skill retention.

Table 8 summarizes key aspects of quasi-experimental studies on GCS training effectiveness. Findings indicate a significant improvement in nurses' GCS knowledge and assessment accuracy post-intervention. However, Dawran & Panduragan (2024) identified persistent challenges in motor response identification, documentation, and assessment preparation. Sample sizes varied, with Dawran & Panduragan (2024) having the largest cohort (150 nurses), followed by Yousef et al. (2021) with 70 nurses, and Zidan & El Sayed Ibrahim (2019) focusing on emergency department nurses. Across all studies, continuous GCS training is strongly recommended, with Dawran & Panduragan (2024) further emphasizing reflective practice for long-term skill retention.

Table No 9: Major findings and number of the study with percentage

Major Findings	Number of Studies	Percentage
Nurses had inadequate GCS knowledge	7	43.75%
Moderate to good GCS knowledge but poor application	6	37.5%
Educational interventions significantly improved GCS skills	4	25%
GCS knowledge correlated positively with assessment accuracy	2	12.5%
Physiotherapists had better GCS knowledge than nurses	1	6.25%
GCS and other assessment tools were reliable for neurological evaluation	1	6.25%
Analyzed by frequency ''n'' and percentage ''%''		

Table 9 presents the major findings across the studies included in this Systematic review. A significant proportion (43.75%) of studies reported inadequate GCS knowledge among nurses, while 37.5% noted moderate to good knowledge but poor practical application. Educational interventions were found to significantly improve GCS skills in 25% of the studies, reinforcing the importance of structured training programs. Additionally, two studies (12.5%) found a positive correlation between GCS knowledge and assessment accuracy. A smaller subset of studies highlighted that physiotherapists demonstrated better GCS knowledge than nurses (6.25%), and that GCS, along with other assessment tools, was reliable for

neurological evaluation (6.25%). These findings underscore the critical need for ongoing education and training to enhance GCS competency among nurses.**DISCUSSION**

The meta-analysis included a variety of study designs, with a predominant reliance on observational studies. As indicated in Table 1, Descriptive Cross-Sectional Studies constituted 50% of the included studies, followed by Cross-Sectional and Quasi-Experimental Studies (25% each). The use of these study designs suggests a focus on assessing existing knowledge levels and evaluating the impact of educational interventions on Glasgow Coma Scale (GCS) proficiency among nurses. The limited number of intervention-based studies (6.25%) highlights a potential gap in research exploring long-term impacts of structured training programs.

Findings across the included studies (Tables 2–7) suggest a recurring pattern: while nurses often possess moderate to good theoretical knowledge of the GCS, their practical application remains inconsistent. Studies such as those by Al Sinan & Mansour (2020) and Mohamed et al. (2019) identified that a substantial proportion of nurses demonstrated good GCS knowledge (ranging from 65% to 71%), yet their assessment accuracy was suboptimal (5). These findings align with Kashif et al. (2022), who reported that physiotherapists had significantly better GCS knowledge (84.1%) than nurses (2.9%), emphasizing the need for targeted interventions to enhance nursing competency in neurological assessments (3).

Moreover, Tables 4 and 5 reveal that a considerable number of nurses lacked sufficient GCS knowledge. Studies by Kc & Adil (2022) and Alhassan et al. (2019) reported inadequate knowledge levels in 52.70% and 56% of nurses, respectively (15). Similarly, Shinde & Kulkarni (2020) found that 72% of nurses had poor GCS knowledge, with only 8.7% applying it correctly (16). These findings highlight the necessity of structured training approaches, including expert-led practical sessions, continuous professional development, and competency-based assessments to bridge the knowledge-practice gap.

Educational interventions demonstrated significant improvements in GCS competency. As shown in Table 6, Yousef et al. (2021) reported that 80.6% of nurses exhibited competent GCS skills post-training, and Zidan & El Sayed Ibrahim (2019) found a significant improvement in GCS assessment accuracy after structured educational programs (17). Patel & HN (2019) identified a strong positive correlation ($r = 0.52$, $p < 0.01$) between GCS knowledge and patient outcomes, further reinforcing the importance of integrating GCS training into nursing education curricula (10). Additionally, intervention-based studies, such as Timothy et al. (2024), showed that post-training, only 15% of nurses had insufficient GCS knowledge, supporting the efficacy of targeted educational interventions (18).

Table 8 highlights challenges associated with GCS training, particularly in motor response identification, documentation, and assessment preparation. The study by Dawran & Panduragan (2024) reported persistent difficulties in these areas despite significant improvements in knowledge scores post-training ($p = 0.000$)(19). This suggests that while knowledge acquisition may be effective through didactic teaching methods, hands-on practical training, reflective practice, and simulation-based learning are necessary to ensure competency in real-world clinical settings (20).

The overall findings of the meta-analysis (Table 9) indicate that 43.75% of studies reported inadequate GCS knowledge among nurses, and 37.5% identified moderate to good theoretical knowledge but poor application. Educational interventions significantly improved GCS skills in 25% of the studies, underscoring the effectiveness of structured training programs. Furthermore, studies found a positive correlation between GCS knowledge and assessment accuracy (12.5%), emphasizing the need for continuous education and competency assessments.

5. CONCLUSION

The meta-analysis underscores the critical need for ongoing GCS education and training among nurses. While many nurses demonstrate foundational knowledge of the GCS, gaps in application persist, necessitating frequent refresher courses, hands-on training, and curriculum integration to improve competency. Future research should explore long-term retention of GCS skills post-training and the impact of innovative educational methodologies, such as simulation-based learning and case-based discussions, on nursing proficiency in neurological assessments.

Clinical Implications:

- Ongoing Training: Regular refresher courses and hands-on practice enhance GCS assessment accuracy.
- Curriculum Integration: Embedding GCS training in nursing education improves long-term skill retention.
- Innovative Methods: Simulation-based learning and case discussions strengthen clinical proficiency.

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