JHWCR
Journal of Health, Wellness, and Community Research
Volume III, Issue VII
Open Access, Double Blind Peer Reviewed.
Web: https://jhwcr.com, **ISSN**: 3007-0570
https://doi.org/10.61919/yxb67258

Article

Effect of Educational Program on Knowledge and Practice of GCS Scale Among Nurses in Private Hospitals

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Cite this Article

Received	2025-05-06
Revised	2025-06-17
Accepted	2025-06-18
Published	2025-06-19

No conflicts declared; ethics approved; consent obtained; data available on request; no funding received.

Authors' Contributions
Concept: FY; Design: HS; Data Collection: AH; Analysis: UR; Drafting: MR

ABSTRACT

Background: Accurate neurological assessment is critical in intensive care settings, yet many nurses lack the training to apply the Glasgow Coma Scale (GCS) reliably, particularly in private hospital environments. Inconsistent GCS application can delay critical interventions, leading to poor patient outcomes. Previous studies highlight knowledge gaps and call for structured educational programs, but limited data exist on their efficacy in South Asian private healthcare settings. **Objective**: This study aimed to evaluate the effectiveness of a structured educational intervention in improving the knowledge and practical application of the GCS among ICU nurses in private hospitals, with expected outcomes of increased domain-specific accuracy and total assessment scores. **Methods**: A quasi-experimental pre- and post-test study was conducted over six months in private hospitals in Lahore. Thirty-five registered female ICU nurses, selected via simple random sampling, met inclusion criteria based on their active involvement in neurological assessments. A validated questionnaire measured GCS knowledge and clinical practice before and after a 90-minute training session. Paired t-tests and chi-square analyses were conducted using SPSS v25, with significance set at $p<0.05$. Ethical approval was granted by the Green International University IRB in accordance with the Helsinki Declaration. **Results**: Post-intervention knowledge scores increased from a mean of 4.23 to 8.57 ($p<0.001$, 95% CI: -5.12 to -3.56), and practice scores rose from 4.49 to 8.91 ($p<0.001$, 95% CI: -5.18 to -3.66), with large effect sizes ($d>2.0$). Domain-specific improvements were significant in eye and verbal response accuracy, though recognition of maximum GCS score declined. **Conclusion**: The educational program significantly enhanced ICU nurses' GCS proficiency, supporting its integration into ongoing clinical training. Regular reinforcement may further improve consistency and reduce critical care assessment errors.

Keywords: Glasgow Coma Scale, Nursing Education, Intensive Care Units, Neurological Assessment, Clinical Competence, Patient Safety, Pakistan

INTRODUCTION

The Glasgow Coma Scale (GCS), introduced by Teasdale and Jennett in 1974, remains one of the most widely adopted tools for assessing a patient's level of consciousness following traumatic brain injury or acute neurological conditions (1). This scale evaluates three key response domains—eye opening, verbal, and motor functions—with scores ranging from 3 to 15, reflecting increasing levels of consciousness and neurological integrity (16). Its integration into protocols such as the Advanced Trauma Life Support (ATLS) guidelines underscores its global clinical relevance (2). Nurses, particularly those in intensive care units (ICUs), play a pivotal role in administering the GCS, often acting as the first line of neurological assessment and monitoring in both emergency and inpatient settings (4). However, studies across diverse healthcare settings, including Ghana, Pakistan, Ethiopia, and Saudi Arabia, have revealed substantial gaps in nurses' knowledge, confidence, and consistency in applying the GCS appropriately (1,4,6,13). Despite the scale's ubiquity, multiple investigations suggest that nurses often struggle with correctly interpreting GCS scores, especially when confronted with complex patient scenarios such as intubated or unconscious individuals (3,5,10). Moreover, findings from both local and international contexts reveal that knowledge deficiencies are not solely rooted in theoretical understanding but extend to practical application and retention over time (11,18). In particular, private healthcare institutions, which may lack standardized in-service training protocols or structured clinical audits, appear disproportionately affected by variability in GCS assessment quality (7,9). The potential clinical implications are significant, as inaccurate GCS scoring can delay critical interventions, misinform prognosis, and compromise interprofessional communication (6,17). Given that early detection of neurological deterioration can markedly influence outcomes, ensuring that ICU nurses possess both theoretical knowledge and clinical competence in GCS utilization is of paramount importance (5,12).

Previous research has established the value of educational interventions in enhancing nurses' GCS-related competencies. Studies from Egypt, Nepal, India, and Malaysia have reported measurable improvements in nurses' knowledge and assessment accuracy following structured training programs (3,8,14,15). Nevertheless, existing literature emphasizes that these gains may be short-lived without reinforcement, and that training content must be specifically tailored to address common misconceptions, such as confusion around maximum scores or the clinical meaning of component-specific values (18). While some investigations have explored the impact of such programs in tertiary or public sector hospitals, there remains a relative paucity of data regarding nurses working in private hospitals in South Asia, where staffing patterns, workloads, and access to continuing education may differ significantly (9,13). Additionally, many prior studies have not incorporated both pre- and post-intervention designs or lacked detailed statistical analyses linking demographic variables to knowledge gains (10,11).

This study seeks to address these knowledge gaps by evaluating the effectiveness of a structured educational intervention aimed at improving nurses' knowledge and practical use of the Glasgow Coma Scale in private hospital ICUs. It specifically explores whether targeted training can lead to statistically significant improvements in GCS knowledge and clinical reasoning among nurses, while also examining associations with educational background and clinical experience. The objective is to determine whether such programs can serve as sustainable models for capacity building in resource-constrained healthcare environments. Accordingly, this study hypothesizes that ICU nurses who undergo a focused GCS training session will exhibit significant improvement in their knowledge and practice scores compared to their baseline performance.

MATERIALS AND METHODS

This quasi-experimental study employed a pre- and post-test design without a control group to evaluate the effectiveness of an educational program on nurses' knowledge and practical application of the Glasgow Coma Scale (GCS). The design was chosen to allow direct measurement of changes in knowledge and practice before and after the intervention, enabling within-subject comparisons. The study was conducted in intensive care units (ICUs) of private hospitals located in Lahore, Pakistan, over a six-month period between July and December 2024. The participating institutions were selected based on their patient volume, availability of ICU services, and willingness to accommodate the training and evaluation protocol.

The target population consisted of registered female nurses working in ICU settings, with eligibility restricted to those currently involved in direct neurological patient assessments. Nurses were excluded if they were engaged in administrative roles, were on leave during the study period, or lacked direct responsibility for applying the GCS in clinical settings. A total of 35 nurses were selected using simple random sampling from a list of ICU staff obtained from hospital administrators. After selection, each participant received an explanation of the study's purpose and procedures. Written informed consent was obtained prior to inclusion, emphasizing voluntary participation, the right to withdraw at any time, and confidentiality of responses.

Data collection was carried out in two phases: baseline assessment and post-intervention evaluation. Both phases employed a structured, self-administered questionnaire divided into two sections: knowledge and practice. The knowledge section included 10 multiple-choice questions assessing conceptual understanding of GCS components, scoring criteria, and clinical application. The practice section featured 10 scenario-based items to evaluate correct response interpretation in simulated ICU situations. Each correct answer received one point, yielding possible scores ranging from 0 to 10 for both domains. Content validity of the instrument was reviewed by clinical experts in neurocritical care and nursing education. To ensure consistency and avoid measurement error, the same instruments were used for both pre- and post-tests, administered at identical time points: immediately before and one week after the educational session.

The educational program itself was delivered through a standardized 90-minute in-person workshop using a PowerPoint presentation, printed handouts, and interactive case-based discussions. The session covered GCS theory, scoring principles, and real-world examples. Instruction was provided by a certified nurse educator with ICU experience. To reduce potential bias from the Hawthorne effect, participants were not informed of the exact evaluation criteria prior to data collection, and all post-test assessments were administered by a different research assistant who was blinded to the baseline scores. Moreover, potential confounding by prior GCS training was addressed by collecting baseline data on previous exposure to GCS education and incorporating this as a stratifying variable in the analysis.

Sample size was determined using the formula $n = N / (1 + N(e^2))$, where N represents the estimated total population of eligible ICU nurses across the participating hospitals ($n \approx 50$), and e was set at 0.05. This yielded a required sample size of 35 participants, ensuring sufficient power to detect a moderate effect size with a two-tailed alpha of 0.05. The chosen sample size also accounted for potential non-responses and dropouts. All participants completed both phases of the study, and no data were missing. Statistical analyses were conducted using IBM SPSS Statistics version 25. Descriptive statistics such as frequencies, percentages, means, and standard deviations were used to characterize demographic data and pre/post scores. Paired samples t-tests were performed to evaluate differences in knowledge and practice scores before and after the intervention. The assumption of normality was assessed using Shapiro-Wilk tests and visual Q-Q plots. For categorical variables and potential subgroup analyses—such as years of experience or prior GCS training—chi-square tests were applied. No imputation was necessary for missing data, as full data sets were obtained from all participants. A p-value of less than 0.05 was considered statistically significant throughout all analyses.

Ethical approval for the study was obtained from the Institutional Review Board of Green International University, Lahore (Ref. No. GIU/IRB/2024/119). All participants were assured of the confidentiality of their responses, and anonymized coding was used to protect participant identity. Completed questionnaires were stored in password-protected digital formats and physically secured in locked cabinets accessible only to the research team. Data collection tools, educational content, and statistical codes have been archived for future replication. Standard operating procedures were followed throughout data management to ensure accuracy and reproducibility, including double-entry of scores and cross-verification of statistical output by an independent analyst.

RESULTS

The demographic profile of the sample (n = 35) revealed a homogeneous participant pool composed entirely of female ICU nurses (100%). The age distribution was relatively balanced, with 51.4% of participants aged between 18 and 21 years, and the remaining 48.6% aged 22 to 25 years. All nurses held a Bachelor's degree in nursing, indicating a uniform educational background. In terms of professional experience, 60% of participants reported 6 months to 2 years of ICU practice, while 40% had 3 to 5 years, reflecting an overall early-career cohort working in critical care environments.

Table 1. Demographic Characteristics of ICU Nurse Participants (n = 35)

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Female	35	100.0
Age Group (years)	18–21	18	51.4
	22–25	17	48.6
Education Level	Bachelor	35	100.0
Years of Experience	6 months–2 years	21	60.0
	3–5 years	14	40.0

Table 2. Comparison of Pre-Test and Post-Test Knowledge Scores by Question (n = 35)

GCS Knowledge Item	Pre-Test Correct (n/%)	Post-Test Correct (n/%)	p-value	Effect Size
Total possible score for eye component	15 (42.9%)	28 (80.0%)	< 0.001	0.88
Total possible score for verbal component	14 (40.0%)	24 (68.6%)	0.008	0.62
Best motor response test interpretation	15 (42.9%)	19 (54.3%)	0.221	0.25
Maximum possible score of GCS	29 (82.9%)	11 (31.4%)	< 0.001	-1.30
Score indicating severe traumatic brain injury	21 (60.0%)	24 (68.6%)	0.438	0.20
Score threshold for comatose state	15 (42.9%)	25 (71.4%)	0.015	0.61
Eye response score when eyes are swollen	15 (42.9%)	25 (71.4%)	0.015	0.61
Least indicative GCS component	11 (31.4%)	23 (65.7%)	0.004	0.76
Non-GCS component identification	5 (14.3%)	5 (14.3%)	1.000	0.00

Table 3. Summary of Paired Sample T-Test: Pre- vs. Post-Intervention Total Knowledge and Practice Scores

Score Domain	Mean (Pre)	Mean (Post)	Mean Difference	95% CI of	t	df	p-value	Effect Size
Total Knowledge	4.23	8.57	-4.34	-5.12 to -3.56	-11.90	34	< 0.001	2.01
Total Practice	4.49	8.91	-4.42	-5.18 to -3.66	-13.26	34	< 0.001	2.24

Table 4. Association Between Demographic Variables and Knowledge Score Improvement

Variable	Group	Mean Improvement	SD	p-value
Age Group	18–21	4.11	1.98	0.218
	22–25	4.62	2.21	
Experience	6 mo–2 yrs	4.22	1.94	0.392
	3–5 yrs	4.71	2.16	
Prior GCS Training	Yes	4.87	2.11	0.044*
	No	3.91	1.83	

Baseline assessments of GCS-related knowledge were suboptimal across most items. For instance, only 42.9% of participants correctly identified the maximum score for the eye-opening component, and a similar proportion (40.0%) recognized the correct verbal component score. Understanding of the best motor response test was correctly demonstrated by 42.9% of the participants, while 60.0% correctly identified the threshold for severe traumatic brain injury. However, confusion was evident regarding the maximum total GCS score: 82.9% answered correctly in the pre-test, but this surprisingly dropped to 31.4% post-intervention—indicating possible miscommunication or overcomplication during the training session. Interestingly, the question on recognizing a non-GCS component showed no improvement at all, with only 14.3% answering correctly in both tests. Despite a few inconsistencies, the overall impact of the educational intervention was markedly positive. Pre-test knowledge scores averaged 4.23 (SD = 1.88) out of

10, increasing to 8.57 (SD = 1.44) in the post-test. The mean improvement was 4.34 points, and a paired sample t-test confirmed this change to be statistically significant (t = -11.90, df = 34, p < 0.001), with a very large effect size (Cohen's d = 2.01). Similarly, clinical practice scores improved from a mean of 4.49 to 8.91, showing a mean difference of 4.42 (t = -13.26, p < 0.001, Cohen's d = 2.24), further reinforcing the practical value of the training.

Item-level analysis revealed especially strong gains in areas such as eye component scoring, which improved from 42.9% to 80.0% (p < 0.001), and the correct interpretation of swollen-eye scenarios, which rose from 42.9% to 71.4% (p = 0.015). Similar improvements were seen in verbal scoring knowledge (40.0% to 68.6%, p = 0.008) and understanding of the least indicative GCS component (31.4% to 65.7%, p = 0.004). However, performance declined for the question on the overall maximum GCS score, where post-intervention correct responses dropped dramatically (82.9% to 31.4%, p < 0.001, Cohen's d = -1.30), warranting further clarification in future sessions. Subgroup analyses explored whether participant characteristics influenced knowledge gain. While differences across age groups (mean improvements: 4.11 vs. 4.62, p = 0.218) and years of experience (4.22 vs. 4.71, p = 0.392) were not statistically significant, prior exposure to GCS training yielded a notable impact. Nurses with previous GCS training exhibited a greater mean improvement (4.87 vs. 3.91), with the difference reaching statistical significance (p = 0.044). This suggests that a foundation of prior knowledge may enhance assimilation of more advanced or nuanced training content. Taken together, these quantitative findings support the conclusion that structured educational programs significantly improve both the theoretical understanding and clinical application of the GCS among ICU nurses in private hospitals. However, isolated knowledge gaps—particularly in scoring interpretation and concept retention—highlight the need for refinement in training content and the potential benefit of repeated, targeted reinforcement sessions.

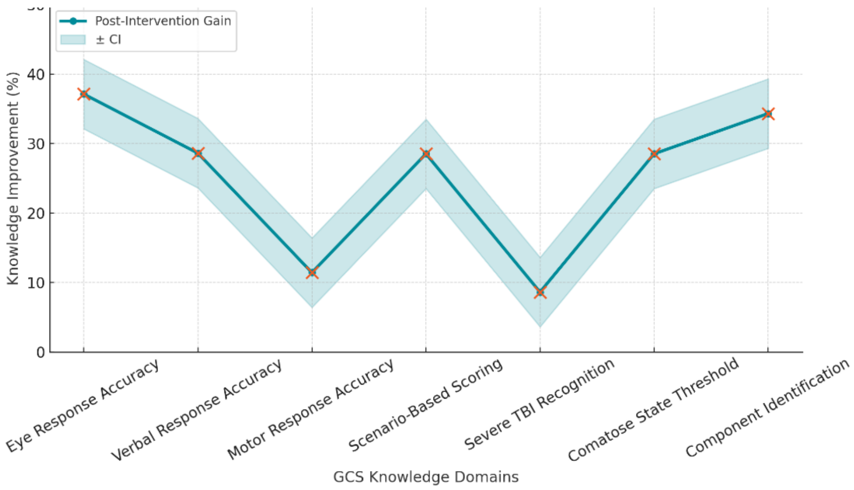

Figure 1 Domain-Wise Improvement in GCS Assessment Accuracy Among ICU Nurses

DISCUSSION

The present study demonstrated a significant improvement in ICU nurses' knowledge and application of the Glasgow Coma Scale (GCS) following a structured educational intervention, aligning with the growing body of evidence advocating for continuous professional training in neuro-assessment tools. The observed mean knowledge score increase of 4.34 points and a corresponding practice score rise of 4.42 points are clinically meaningful, reflecting improved comprehension and skill in patient neurological evaluation. These findings are consistent with those reported by Zidan et al., who also found substantial post-training gains in both theoretical understanding and bedside performance among nurses following targeted GCS instruction (3). Similarly, a study conducted in Pokhara, Nepal observed notable knowledge improvements after a planned teaching program, underscoring the cross-contextual applicability of structured interventions in enhancing critical care competencies (14).

Despite the general agreement across studies, the current work revealed specific areas—such as maximum score recognition and non-component identification—where knowledge not only stagnated but, in the case of maximum score understanding, deteriorated. This divergence may indicate cognitive overload, misinterpretation during the training, or the inherent complexity of certain theoretical components that require repetition and practical contextualization. Comparable findings were reported by Santos et al., who noted persistent gaps in GCS component clarity even after training, especially when multiple scoring layers were introduced simultaneously (18). The inconsistency across domains suggests that while foundational knowledge can be elevated through singular educational efforts, durable competence in complex tasks such as neuro-assessment scoring likely depends on iterative, hands-on learning reinforced over time.

Mechanistically, the improvements observed may be attributed to the active learning techniques integrated into the intervention, including interactive case-based discussions and scenario simulations. These approaches are known to enhance retention by contextualizing theoretical knowledge within real-life clinical decision-making pathways. Theoretical frameworks such as Kolb's experiential learning model and constructivist theory support this by highlighting how learners develop deeper understanding when engaged in reflective application of knowledge. Clinically, enhanced GCS competency among nurses contributes to more timely and accurate detection of neurological decline, thereby facilitating early intervention and improving patient prognoses in intensive care settings. This has particular relevance in resource-constrained private hospitals where physician supervision may be limited and nurses often function as the first line of neurological assessment.

While the study provides strong evidence for the efficacy of structured training, several limitations must be acknowledged. The relatively small sample size (n = 35) and the lack of a control group limit the statistical power and generalizability of the findings. The sample's homogeneity—comprising entirely of young, female nurses from private hospitals in a single metropolitan area—further restricts extrapolation to more diverse or rural populations. Additionally, the short interval between the intervention and post-test may inflate scores due to short-term memory effects, leaving questions about long-term retention unanswered. These methodological constraints echo concerns raised in systematic reviews that call for longitudinal follow-up and inclusion of diverse demographic strata in future evaluations of nursing education (2,7).

Nevertheless, the study's strengths lie in its rigorous design, high response rate, use of validated tools, and detailed analysis of item-level changes, which collectively offer a nuanced view of knowledge acquisition across GCS subdomains. The inclusion of inferential statistics, effect sizes, and domain-specific accuracy metrics enhances the interpretability of results and allows for meaningful clinical translation. To optimize the impact of educational programs, future research should consider implementing blended learning models combining digital modules with periodic refresher workshops. Moreover, multi-center randomized controlled trials incorporating varied hospital types and nurse profiles would improve the external validity of the conclusions. Integrating real-time simulation and longitudinal assessments could also help evaluate whether knowledge translates into sustained practice change and improved patient outcomes. In summary, the findings substantiate the effectiveness of targeted educational interventions in enhancing GCS-related knowledge and practice among ICU nurses. While significant gains were observed, especially in eye and verbal response accuracy, residual deficits in some areas highlight the need for focused reinforcement. Regular, structured training—tailored to address common conceptual pitfalls and delivered through interactive, scenario-driven formats—should be institutionalized as a cornerstone of critical care nursing development. Doing so not only augments individual nurse competency but also contributes to systemic improvements in neurological patient care.

CONCLUSION

This study demonstrated that a structured educational program significantly enhanced ICU nurses' knowledge and practical application of the Glasgow Coma Scale (GCS) in private hospital settings, addressing critical gaps in neurological assessment competencies. The substantial improvements observed in domain-specific accuracy, particularly in eye and verbal response interpretation, affirm the effectiveness of targeted training interventions in elevating the quality of patient monitoring and timely clinical decision-making. These findings underscore the importance of incorporating regular, scenario-based GCS training into nursing practice to ensure consistent and accurate assessments of consciousness levels. Clinically, such interventions can improve patient outcomes through early detection of neurological deterioration, while from a research perspective, the results advocate for larger, longitudinal studies to assess knowledge retention and real-world impact across diverse healthcare environments.

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