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Educational Intervention Effect on Clinical Nurses' Skills Regarding the Use of Glasgow Coma Scale in Neurological Assessment of Patients in Tertiary Hospitals, Edo State, Nigeria

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ABSTRACT

Background: There is an increase in neurological cases in Nigeria, requiring close monitoring using the Glasgow Coma Scale (GCS). Although nurses are key health personnel managing these patients, evidence suggests that they lack adequate skills in carrying out neurological assessment. ***Purpose*****:** This study assessed the educational intervention effect on nurses' skills regarding GCS neurological assessment of patients in selected hospitals in Edo State, Nigeria. ***Methods*****:** The study adopted a quasi-experimental, pre-post-test control research design. The sample was comprised of 98 nurses purposely selected from neurological wards of the selected hospitals. Researcher-developed observational check list with inter-rater reliability rho (ρ) of 0.942 and degree of agreement (kappa) of 0.792 was used for data collection. Data was analyzed using descriptive statistics and inferential statistics, such as Chi-square test, Mann-Whitney, and U Friedman's test, at 5% level of significance. ***Results*****:** Skill demonstrated by the participants increased from a pre-test of 1 (2.0%) to a post-test of 48 (100.0%) in the interventional group, whereas the control group had 0% over the assessment time significant difference (p=0.000) over the assessment times found in the intervention group. *Post hoc* (Bonferroni) test revealed the differences between Pre-test *versus* post-test one/post-test two. Multivariate analysis showed no association between socio-demographic characteristics and level of GCS skills demonstrated among participants before and after treatment for both groups (p≤0.05). ***Conclusion*****:** This educational intervention package was effective in improving treatment group GCS skills. Nurses improvement in GCS skills is likely to increase the confidence in eliciting correct patient responses, leading to more accurate GCS scores and more accurate clinical decision-making. However, the small sample size may not adequately represent the broader population of nurses. ***Implications for Nursing***: Training programs should be customized to target specific skill gaps across different settings. Cost-effective models are both effective and can be scaled to other regions. To maintain these improved skills, follow-up sessions and initiatives to build local capacity through staff training are crucial, ultimately leading to better nursing care and patient outcomes.

Keywords: Nurses' skills, Glasgow coma scale, Educational intervention, Effect, Neurological assessment.

What does this paper add?

1. Confirmation of self-directed learning for GCS assessment: While self-directed learning is a recognized educational approach, this study

specifically demonstrates its effectiveness in improving nurses' GCS assessment skills. This adds to the body of knowledge about suitable learning methods for this critical nursing competency.

2. Empowerment and ownership in skill development: The study highlights the potential of self-directed learning to empower nurses. By taking ownership of their learning pace and format, nurses might be more engaged and motivated, leading to a deeper understanding and stronger practical application of the GCS assessment. This adds a new perspective to the benefits of self-directed learning, going beyond just knowledge acquisition.

Introduction

The Glasgow Coma Scale (GCS) is employed to evaluate the degree of awareness in patients. Over the past 40 years, medical professionals—including nurses—have utilized it to assess the neurological status of patients with conditions like stroke or traumatic brain injuries. The GCS evaluations also show how the injury has changed over time, which represents crucial information for making decisions (Teasdale et al., 2014a). It is also an essential research tool (Teasdale et al., 2014a). The three primary components of the GCS are verbal response (V), motor response (M), and eye opening (E).

Three is the least score and fifteen is the maximum score (de Souse & Woodward et al., 2016). Each component's score must be derived from the GCS score. As an illustration, a nurse assesses a patient who has a GCS score of 11; the patient opens his eyes on his own (E4), reacts poorly to questions (V3), and withdraws in response to pain when a central pain stimulus is applied (M4). The patient's neurological vital signs reflect this outcome, which needs to be shared with the doctors (Catangui, 2019). In the past, individuals who have experienced traumatic brain injury (TBI) have been treated with the GCS divided into three severity groups: moderate (GCS 9-12), severe (GCS 3-8), and mild (GCS 13-15) (Braine & Cook, 2017; NICE, 2014). "These categories are useful markers of the severity of the injury; in the early phases of assessment, the degree of consciousness impairment combined with longer-term assessments of the length of time with lost consciousness can give a useful measure of the brain injury" (Braine & Cook, 2017).

The Glasgow Coma Scale (GCS), which offers a systematic evaluation of a patient's state of consciousness, is an essential tool in the management of a variety of neurological diseases. It assists in assessing the extent of the injury, directing the choice of treatment, and keeping track of modifications in neurological status in traumatic brain injury (TBI) (Teasdale et al., 2014b). GCS influences treatment plans by assisting stroke patients in predicting their prognosis and assessing their level of consciousness when there is an internal bleeding (Maher, 2016).

For surgical decision-making and prognostication, GCS values are essential. Furthermore, the GCS plays a crucial role in assessing the degree of care required for comatose patients, including whether they require intensive monitoring or other measures. Because of its ease of use and dependability, the GCS is essential for guaranteeing prompt and suitable care, which eventually improves patient outcomes for all of these disorders. (Solari et al., 2017; Vink et al., 2018). Notwithstanding, because the GCS's critical role in neurological assessment, its accurate application requires well-developed skills. The intricacies of neurological assessment of unconscious patients may be easier for nurses to handle if they possess solid knowledge and skills in the application of the GCS (Greenshields, 2019). In the neuro and general surgery departments, early patient recovery was found to be correlated with effective nurse assessment (Bae & Roh, 2020).

Patient outcomes and the burden on healthcare resources can be greatly impacted by incorrect Glasgow Coma Scale (GCS) performance in healthcare settings (Nawaz et al., 2020). Inaccuracies in GCS scoring may result in inaccurate patient evaluations, which may cause treatments to be delayed, interventions to be made inappropriately, or monitoring protocols not to be initiated. Patient outcomes may suffer as a result, particularly in critical care settings, where prompt and precise assessments are essential (Kebapçı et al., 2020). Recent studies highlighted that interobserver reliability in GCS scoring can be inconsistent, particularly among less experienced healthcare providers. For example, a study found that ICU nurses exhibited only moderate agreement with researchers in GCS scoring, particularly in the eye and verbal response components. Such variability can lead to inconsistent patient monitoring and potential miscommunication within the healthcare team, further complicating patient care and outcomes. (Kebapçı et al., 2020).

Additionally, Hein and Chae (2011) found that nurses struggled to perform GCS assessments effectively. Similarly, Nawaz et al. (2020) in Pakistan reported that a significant portion (65.7%) of the population lacked basic knowledge about GCS, and the majority of nurses exhibited poor skills in GCS assessments. These findings are further supported by Ehwarieme et al. (2021) and Yousef et al. (2021), who also identified weaknesses in nurses' practical performance and application of GCS in Pakistan and Edo State, Nigeria, respectively. Arsh et al. (2017) noted that, nurses who work in the neuro-surgery department lack proficiency in using the Glasgow Coma Scale (GCS) to assess patients who are unconscious. The study reported that around 40% of patients with traumatic brain injuries who are admitted to hospitals experience worsening of their disorders instead of improvement. This is because of inadequate assessment and poor care. Furthermore, it was discovered that nurses' inadequate knowledge and ineffective skill performance were linked to patients' hospital stays in intensive care units and emergency departments being longer (Yang et al., 2020).

Moreover, inaccurate GCS performance might affect available resources. It could result in longer hospital stays, unnecessary diagnostic tests, or the improper use of critical care resources. (Reith et al., 2016). Erroneous categorization of a patient's ailment may also result in the excessive or insufficient use of medical services, which can negatively affect overall effectiveness and raise expenses. Inaccurate GCS evaluations can also postpone the identification of individuals in need of prompt attention, which may result in unfavorable outcomes and higher expenses for addressing problems. (Reith et al., 2016). These inconsistencies raise questions about the adequacy of clinical nurses' skills and confidence in performing GCS neurological evaluations and accuracy in interpretation and application in patient care. Also, due to increasing cases of traumatic brain injury in addition to other neurological disorders necessitate the usage of Glasgow Coma Scale (GCS) in evaluating patients' degree of consciousness in Nigeria and particularly in Edo State (Adogu et al., 2015; Fente & Odjugo, 2014; Jasper et al., 2014; Oyedele et al., 2015). Therefore, assessment of nurses' skills on GCS remains essential towards ensuring consistency, dependability and accuracy of GCS application.

The deficiencies in GCS proficiency among nurses contribute to prolonged hospital stays and sub-optimal patient outcomes; thus, there is a persuasive need to enhance learning pedagogies. In addition, improving these pedagogies assist nursing practices to be aligned with the goal of ensuring the best possible patient outcomes. While existing research has explored nurses' theoretical knowledge of the Glasgow Coma Scale, there is a lack of studies in Nigeria, particularly in Edo State, that examine their practical skills' applications and the effectiveness of interventions to improve them. Therefore, this study aimed to assess educational interventional effect on clinical nurses' skills in performing the GCS in selected tertiary hospitals in Edo State, Nigeria.

To test the effect of the intervention package, the following null hypotheses were stated.

1. There is no significant difference in the level of skills demonstrated before and after intervention among the participants in both the intervention and the control groups.
2. There is no association between social demographic characteristics of the participants and the pre-test skills, as well as the post-test skills demonstrated in the performance of the GCS in both the intervention and the control groups.

MATERIALS AND METHODS

Research Design

A non-equivalent group, pre-test-post-test research design was adopted. Researchers often adopt a non-equivalent group pre-test-post-test design when they need to evaluate the effect of an intervention in a real-world setting, where random assignment to groups is not feasible. This design is commonly used in educational, clinical, and social science research for several reasons (Creswell & Creswell, 2017; Derue et al., 2012; Polit & Beck, 2012). This design was, therefore, considered appropriate by the researchers, because the study seeks to measure the effect of educational intervention on two similar groups of nurses working in different hospitals.

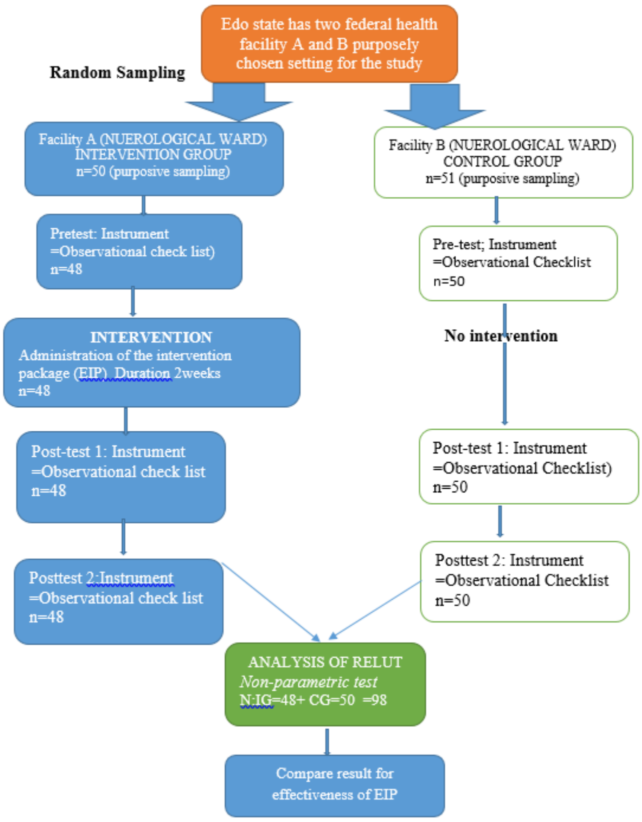

Figure 1. A flowchart summarizing the study procedures

Figure (1) shows a flowchart that summarizes the study procedures.

Study Setting

The study was conducted in Edo State, Nigeria. Two tertiary federal hospitals in the state were purposively selected for this study, being assigned as the intervention (Group A) and the control (Group B) groups. These hospitals serve as training institutions for health professionals, including nurses, and as referral centers with a high volume of neurological disorders, such as traumatic brain injury, cerebro-vascular accidents, and spinal cord injuries, with an average ranging from 40 to 45 admitted patients per month and an average hospitalization period of six weeks.

Sample of the Study

The target population of the study consist of all nurses (101) employed in the neurological units of the selected tertiary hospitals. The intervention group consisted of 50 participants, while the control group consisted of 51 participants. Due to the small or inadequate size of the target population, census was employed which implied studying all the target population members who met the inclusion criteria. Hence, sample size determination was not applied. Of the 101 participants initially recruited, three (3) did not complete the training due to dropout; two (2) from the intervention group and one (1) from the control group. This brought the final number of participants to 98.

Inclusion Criteria

1. Nurses who deal with neurological conditions either conscious, semi-conscious or unconscious patients in the designated units of the two hospitals.
2. Participants must have worked in the unit for at least 6 months.
3. Nurses may have or have not received training on GCS before.

Sampling Technique

Selection of Health Care Facilities: The hospitals were assigned into an intervention group and a control group using a random sampling technique (balloting).

This was considered, because simple random sampling ensures that every individual or unit in the population has an equal probability of being selected. This reduces the risk of selection bias, where certain groups might be overrepresented or underrepresented in the sample.

Selection of Participants: Participants in both groups were selected for the study using a purposive sampling technique, because it allows researchers to intentionally select individuals who have specific characteristics, experiences, or knowledge relevant to the research questions.

Data Collection Tools

Observational Checklist: The researchers developed an observational checklist with two sections: section one contained socio-demographic data of the respondents. Section two of the observational checklist contained three components in line with the three components of the GCS, and each component has different steps with the specific indicator or appropriate behaviors/actions to elicit the desired stimuli. There were eighteen (18) items with each items ranking in this order: very good (5), good (4), fair (3) and poor (2), depending on the respondents' ability to exhibit the right skills. Therefore, the highest possible score was 90, while the lowest possible score was 18. The score range for classification generally was; good (67-90), average (43-66), and poor (18-42).

For each component of the GCS scale; Eye-opening, based on five items, has a total highest score of 25 and a total lowest score of 5. Classification was; good (17-25), average (11-16), and poor (5-10). Verbal response, based on six items, has a total highest score of 30 and a total lowest score of 6. Classification was; good (24-30), average (15-23), and poor (6-14). Motor response, based on seven items, has a total highest score of 35 and a total lowest score of 7. Classification was; good (26-35), average (17-25), and poor (7-16).

Validity/ Reliability

Face validity and content validity were verified by five (5) experts; two (2) consultant neurologists, two (2) experienced clinician nurses working in the neurological ward and one (1) academician; a professor of neuro-anatomy/toxicology.

Inter-rater Reliability of the Observational Checklist and Proforma: The researchers subjected the observational checklist to an inter-rater reliability test by giving it to three professional nurses to score while observing other nurses performing the neurological assessment on a patient using the GCS simultaneously. The observation/scoring was carried out three times; the first two scores were discarded to allow the nurses performing the assessment to be used to being observed while the third score was used for the analysis. The scores obtained were analyzed using Spearman's rank correlation coefficient. Generally, the value of rho (ρ) was 0.942, and the measure of agreement (kappa) was 0.742. Each component of the GCS scored: eye-opening (ρ=0.946, kappa = 0.836), verbal response (ρ=0.751, kappa=0.775), and motor response (ρ=0.834, kappa=0.736).

Development of Educational Intervention Package (EIP)

There were five steps involved in the development of the EIP.

1. Conducting a needs' assessment among nurses on the neurological assessment of patients using a mixed method research design.
2. Reviewing literature on neurological assessment, and consulting experts in the field of neurology.
3. Preparation of the first draft of the EIP.
4. Preparation of the final draft of the EIP.
5. Editing of the modules of the EIP.

Content of the EIP

The educational intervention package (EIP) incorporated a self-instructional approach which demonstrates the value of self-directed learning for nurses. It was made up of five modules, as presented below:

Module One: historical/ overview of Glasgow coma scale.

Module Two: definition of concept and anatomical basis of Neurological assessment.

Module Three: comprehensive review of the Glasgow coma scale.

Module Four: practical demonstration of neurological assessment using the GCS with simulation and video clips.

Module Five: live practical session and clinical interpretations of the findings as well as other parameters to take note of during neurological assessment.

Procedure for Data Collection

Data collection for this study took a period of 2 weeks during the period from March to September 2020. The researchers recruited four (4) registered nurses, two from each of the hospitals who received training on the content of the observational checklist and how to use it, in order to validate the participants' skills during the neurological assessment of a patient. Data collection was carried out in phases;

Time One Data Collection Session: This involved the pre-test skill assessment of the participants. The researchers made three open/direct observations/scoring of each participant as he/she performed the neurological assessment of a patient. To mitigate the Hawthorne effect, the six stages as highlighted by Oswald et al. (2012) were followed. Also, each participant's observation of a patient assessment and scoring occurred over a long period (three times) to allow participants to settle into normal work patterns and get used to being observed (Harrell et al., 2013). The first two scores of the observation were discarded, while the last observation was used for data analysis, to ensure the purity of the data.

Delivery of Educational Intervention Package (EIP): The delivering of the educational intervention package by the researchers to the participants in the intervention group only lasted six (6) days with three days out of the six days dedicated to practical demonstration and hands on neurological assessment using the GCS. The delivering of the educational intervention package was carried out in two sessions; morning session (11 am - 12 noon) for those on afternoon duty and afternoon session (3 - 4 pm) for those on morning duty each day. A module was delivered each day for a maximum of 45 minutes excluding questions and answer time. During this period, a seminar was organized for the control group on the management of pressure conditions.

When considering the learning process, potential challenges, like participant fatigue, can significantly impact both engagement and the overall effectiveness of the training. Fatigue may lead to reduced concentration, lower motivation, and diminished retention of information. To mitigate these risks, the learning sessions were spaced out, allowing participants adequate time to absorb the material without feeling overwhelmed. Additionally, regular breaks during the sessions were incorporated to help maintain energy levels and focus, ensuring that the participants remain fully engaged throughout the learning process. These adjustments contributed to a more effective and positive training experience.

Time 2 Data Collection: Post-test 1: Two weeks after the intervention, post-test one skill assessment at the two study sitesusing the same instrument and procedure as used in the pre-test for both the intervention group and the control group. Two weeks were allowed before the first post-test data collection, because the novelty of the intervention itself can also lead to temporary changes. Waiting a bit after the intervention allows the initial excitement or awareness to wear off, providing a more accurate picture of the intervention's long-term impact.

Time 3 Data Collection: Post-test 2: Eight weeks after the first post-test, the researchers assessed again the skill of the respondents for both the intervention group and the control group using the same instrument and procedure used before. This became necessary, because the immediate effects of an educational package might be significant, but it's crucial to determine whether these effects persist over time. A second post-test, conducted after a certain period, helps evaluate whether the educational intervention program has a lasting impact or the effects diminish over time (Creswell & Creswell, 2017).

Methods of Data Analysis

The variables were subjected to normality test using Kolmogorov -Sminorv test as well as the Shapiro – Wilk's test. Variables that failed in the normality test were subjected to a non-parametric statistical test, while those that passed the normality test were analyzed using parametric statistics.

Descriptive Statistics Continuous data that followed normal distribution was analyzed and presented using means, while data not normally distributed was described using medians and interquartile ranges. **Inferential Statistics (*non-parametric test)***: Chi-square test for bivariate analysis. Mann-Whitney U test was used to compare medians between groups. Friedman's test was used to compare within groups (pre-, post-1 and post-2), along with *post hoc* (Bonferroni) test. All analyses were conducted at 5% level of significance. IBM Statistical Package for

Social Sciences (SPSS, version 26.0) for Windows was used for this purpose.

Ethical Considerations

The researchers obtained ethical clearance with protocol number ISTH/HREC/20202002/059 and ADM/E22/AVOL.VII/148271 from both hospitals. The researchers maintained confidentiality of the information and obtained informed consent from participants with the freedom to withdraw from the study. Additionally, the researchers upheld several ethical considerations during the study:

Confidentiality: All information provided by participants was kept strictly confidential. No personal identifiers, such as names or addresses, were requested in any data collection tools, including questionnaires, observation checklists, auditing documentation forms, or interview guides.

Self-determination/Voluntar Participation: Participants were informed of their right to voluntarily decide whether to participate in the study, without fear of penalty or prejudice. They were also allowed to withdraw or refuse to answer questions at any time during the study.

Informed Consent: The purpose and benefits of the study were clearly explained to the participants. They were required to review and understand the informed consent form before agreeing to participate, ensuring that they were aware of the study's processes and any associated risks before signing the form.

Results

Socio-demographic Characteristics of Participants in Both the Intervention and the Control Groups

The study showed that the modal age-groups were between 21 and 30 years, with a mean age of 35.23±9.56 and 30.22±6.12 for the intervention and control groups, respectively. The participants were mostly females, with 36 (75.0%) in the intervention group, while there were 35 (70.0%) females among the control group (Table 1).

Table 1. Socio-demographic characteristics of nurses in the intervention and the control groups

	INTERVENTION F=48 (%)	CONTROL F=50 (%)	χ^2	p
Gender				
Male	12(25.0)	15(30.0)	0.307	0.580
Female	36(75.0)	35(70.0)		
Age				
21- 30	20(41.7)	32(64.0)	12.200	0.000
31 – 40	14(29.2)	16(32.0)		
41 – 50	10(20.8)	2(4.0)		
51 – 60	4(8.3)	0(0.0)		
Mean (S.D.)	35.23(9.56)	30.22(6.12)	3.103‡	0.003
Academic Qualification				
Diploma	19(39.6)	29(58.0)	3.401	0.183
BSc/BNSc	24(50.0)	18(36.0)		
MSc/Ph.D	5(10.4)	3(6.0)		
Professional Cadre				
RN only	40(95.2)	45(93.8)	7.745	0.101
RN/RM	29(69.0)	35(72.9)		
RN/A&E	2(4.8)	11(22.9)		
RN/RICN	1(2.4)	4(8.3)		
Job Status				
Nursing officer II	13(27.1)	13(26.0)	18.908	0.002
Nursing officer I	15(31.3)	11(22.0)		

Senior Nursing Officer	9(18.8)	10(20.0)		
Principal Nursing Officer	8(16.7)	0(0.0)		
Assistant Chief Nursing Officer	0(0.0)	8(16.0)		
Chief Nursing Officer	3(6.3)	8(16.0)		
Years of Experience				
1-5	12(25.5)	0(0.0)	19.036	0.000
6-10	8(17.0)	20(42.6)		
11-15	13(27.7)	18(38.3)		
More than 15	14(29.8)	9(19.1)		
Training on GCS before				
Yes	32(66.7)	28(56.0)	1.174	0.279
No	16(33.3)	22(44.0)		
Duration of training				
2 weeks	16(50.0)	6(23.1)	12.177	0.016
>2 weeks -<1month	11(34.4)	5(19.2)		
>1 month-<4months	3(9.4)	5(19.2)		
>4 months-<7months	1(3.1)	6(23.1)		
>7 months	1(3.1)	4(15.4)		

Comparison of Levels of Skill Demonstrated by Participants in Both Hospitals

The current study revealed that the level of good skills exhibited by the participants increases from 1(2.0%) during the pre-test to (100%) post-intervention in the intervention group, while in the control group, there was no record of good skill pre-and post-intervention (Table 2).

Table 2. Classification of level of skill demonstrated by participants in both hospitals

				TIME		
Hospital		**Classification**		**Pre-test F (%)**	**Post-tes1 F (%)**	**Post-test 2 F (%)**
INTERVENTION GROUP n=48	**Summary of GCS skill demonstrated**	Poor		32(65.3)	0(0.0)	0(0.0)
		Moderate		16(32.7)	0(0.0)	0(0.0)
		Good		1(2.0)	48(100.0)	48(100.0)
		Skill demonstrated in each component				
	Eye Opening	Poor		39(79.6)	0(0.0)	0(0.0)
		Moderate		9(18.4)	4(8.3)	5(10.4)
		Good		1(2.0)	44(91.7)	43(89.6)
	Verbal Response	Poor		46(93.9)	0(0.0)	0(0.0)
		Moderate		2(4.1)	5(10.4)	3(6.2)
		Good		1(2.0)	43(89.6)	45(93.8)
	Motor response	Poor		48(98.0)	0(0.0)	0(0.0)
		Moderate		0(0.0)	4(8.3)	3(6.2)
		Good		1(2.0)	44(91.7)	45(93.8)
CONTROL GROUP n=50	**Summary of GCS skill demonstrated**	Poor		28(56.0)	27(54.0)	23(46.0)
		Moderate		22(44.0)	23(46.0)	27(54.0)
		Good		0(0.0)	0(0.0)	0(0.0)

		Skill demonstrated in each components				
	Eye Opening	Poor		35(70.0)	35(70.0)	38(76.0)
		Moderate		15(30.0)	15(30.0)	11(22.0)
		Good		0(0.0.)	0(0.0)	1(2.0)
	Verbal Response	Poor		50(100.0)	50(100.0)	49(98.0)
		Moderate		0(0.0.)	0(0.0.)	1(2.0)
		Good		0(0.0.)	0(0.0.)	0(0.0.)
	Motor Response	Poor		49(98.0	50(100.0)	50(100.0)
		Moderate		1(2.0)	0(0.0)	0(0.0.)
		Good		0(0.0.)	0(0.0.)	0(0.0.)

Effect of Intervention on GCS Skill Demonstrated among the Participants Intra-group and Inter-group after Intervention

Intra-group Comparison

The study showed that in the control group, there was no significant difference over the assessment times in the level of GCS skill demonstrated (p=0.740), while in the intervention group, there were significant differences over the assessment time in the level of GCS skill demonstrated (p=0.000). Bonferroni *post hoc* test reveals that significant differences were between pre-*versus* post-1 and post-2, but none was observed between post-1 and post-2. It was shown that the effect of intervention on all domains and on the overall GCS score of nurses in the intervention and control groups was noticeable. The control group had no significant differences over the assessment time (Table 3a).

Table 3a. Effect of intervention on GCS skill demonstrated among the participants in the control and the intervention groups: Inter-group comparison and intra-group comparison group comparison)

	Pre	Post 1	Post 2	Friedmann	p
Effect of intervention on skill demonstrated in both intervention and control groups (facility A and facility B) (overall GCS skill comparison within groups)					
INTERVENTION n=48					
Summary of GCS skill demonstrated	41.00(39.00-43.00)a	79.00(76.00-81.00)b	78.00(75.00-81.00)b	72.890	0.000
CONTROL n=50					
Summary of GCS skill demonstrated	42.00(39.00-45.00)a	42.00(40.00-44.25)a	43.00(40.75-45.00)a	0.603	0.740
Effect of intervention on skill demonstrated on all components of GCS for both intervention and control groups (facility A and facility B) (within sub-scale comparison)					
	Pre-	**Post-1**	**Post-2**	**Friedmann**	**p**
INTERVENTION n=48					
Eye Opening	12.00(11.00-14.00)a	22.00(20.00-23.00)b	22.00(20.00-23.00)b	74.822	0.000
Verbal Response	14.00(13.00-15.00)a	27.00(26.00-28.00)b	27.00(25.00-28.00)b	72.800	0.000
Motor Response	15.00(14.00-16.00)a	30.00(30.00-31.00)b	30.00(29.25-31.00)b	76.978	0.000
CONTROL n=50					
Eye Opening	13.00(10.00-15.00)a	13.00(12.00-15.00)a	13.00(10.75-14.25)a	0.034	0.983
Verbal Response	14.00(13.00-15.00)a	14.00(13.00-14.00)a	14.00(13.00-15.00)a	0.229	0.892
Motor Response	15.00(14.00-16.00)a	15.00(14.00-16.00)a	16.00(15.00-16.00)a	9.034	0.892

Values are expressed as median (Interquartile range). Superscripts with different letters are statistically significant at p<0.05.

Inter-group Comparison

The study revealed the mean comparison of different domains as well as the overall score of the GCS scale between the two groups. No significant variances were noticed (p≤0.05) amid the intervention and the control groups during pre-test in all the domains as well as in the overall score. After intervention (post-1 and post-2), significant differences were found (p=0.000) between the intervention group and the control group (Table 3b).

Table 3b. Inter-group comparison

	INTERVENTION GROUP n=48	CONTROL GROUP n=50	Mann-Whitney	p
Pre-test				
Eye Opening	12.00(11.00-14.00)	13.00(10.00-15.00)	0.454	0.650
Verbal Response	14.00(13.00-15.00)	14.00(13.00-15.00)	0.000	1.000
Motor Response	15.00(14.00-16.00)	15.00(14.00-16.00)	0.176	0.860
Summary of GCS Skills	41.00(39.00-43.50)	42.00(39.00-45.00)	0.383	0.701
Post-test 1				
Eye Opening	22.00(20.00-23.00)	13.00(12.00-15.00)	-8.561	0.000
Verbal Response	27.00(26.00-28.00)	14.00(13.00-14.00)	-8.624	0.000
Motor Response	30.00(30.00-31.00)	15.00(14.00-16.00)	-8.621	0.000
Summary of GCS Skills	79.00(76.00-81.00)	42.00(40.00-44.25)	-8.541	0.000
Post-test 2				
Eye Opening	22.00(20.00-23.00)	13.00(10.75-14.25)	8.227	0.000
Verbal Response	27.00(25.00-28.00)	14.00(13.00-15.00)	8.593	0.000
Motor Response	30.00(29.25-31.00)	16.00(15.00-16.00)	8.639	0.000
Summary of GCS Skills	78.00(75.00-81.00)	43.00(40.75-45.00)	8.541	0.000

Values are expressed as median (interquartile range).

Association between Social Demographic Characteristics of the Participants and the Pre-test Skills, Post-test Skills Demonstrated in the Performance of the GCS in Both Intervention and Control Groups

Socio-demographic variables, pre- and post- tests, were evaluated against the overall skill exhibited by the participants as well as the skills exhibited in each of the components of the GCS.

No statistically significant associations exist between socio-demographic variables of the participants and the level of skill demonstrated, as all the variables had (p> 0.05). After intervention, at post-test one and post-test two, no association was found between the socio-demographic characteristics and the level of skill demonstrated on GCS by participants. Therefore, the level of skill demonstrated by the participants post-intervention was only influenced by the intervention given (See Table 4a).

Table 4a. Association between the participants' pre-test skills and post-test skills demonstrated in the use of GCS and their social demographic characteristics in the intervention group

	Pre-					**Post-1**			**Post-2**		
	Poor	**Fair**	**Good**	**x2**	**p**	**Poor**	**Fair**	**Good**	**Poor**	**Fair**	**Good**
INTERVENTION											
Sex											
Male	10(83.3)	2(16.7)	0(0.0)	2.000	0.157	0(0.0)	0(0.0)	12(100.0)	0(0.0)	0(0.0)	12(100.0)
Female	22(61.1)	14(38.9)	0(0.0)			0(0.0)	0(0.0)	36(100.0)	0(0.0)	0(0.0)	36(100.0)
Highest Academic Qualification											
Diploma (RN)	11(57.9)	8(42.1)	0(0.0)	3.945	0.139	0(0.0)	0(0.0)	19(100.0)	0(0.0)	0(0.0)	19(100.0)
First Degree	19(79.2)	5(20.8)	0(0.0)			0(0.0)	0(0.0)	24(100.0)	0(0.0)	0(0.0)	24(100.0)
Higher Degree	2(40.0)	3(60.0)	0(0.0)			0(0.0)	0(0.0)	5(100.0)	0(0.0)	0(0.0)	5(100.0)
Age Group (Years)											

21 - 30	15(75.0)	5(25.0)	0(0.0)	1.746	0.627	0(0.0)	0(0.0)	20(100.0)	0(0.0)	0(0.0)	20(100.0)
31 - 40	8(57.1)	6(42.9)	0(0.0)			0(0.0)	0(0.0)	14(100.0)	0(0.0)	0(0.0)	14(100.0)
41 - 50	7(70.0)	3(30.0)	0(0.0)			0(0.0)	0(0.0)	10(100.0)	0(0.0)	0 (0.0)	10 (100.0)
51 - 60	2(50.0)	2(50.0)	0(0.0)			0(0.0)	0(0.0)	4(100.0)	0(0.0)	0(0.0)	4(100.0)
Job Status											
NO II	9(69.2)	4(30.8)	0(0.0)	2.588	0.629	0(0.0)	0(0.0)	13(100.0)	0(0.0)	0(0.0)	13(100.0)
NO I	11(73.3)	4(26.7)	0(0.0)			0(0.0)	0(0.0)	15(100.0)	0(0.0)	0(0.0)	15(100.0)
SNO	4(44.4)	5(55.6)	0(0.0)			0(0.0)	0(0.0)	9(100.0)	0(0.0)	0(0.0)	9(100.0)
PNO	6(75.0)	2(25.0)	0(0.0)			0(0.0)	0(0.0)	8(100.0)	0(0.0)	0(0.0)	8(100.0)
ACNO	0(0.0)	0(0.0)	0(0.0)			0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
CNO	2(66.7)	1(33.3)	0(0.0)			0(0.0)	0(0.0)	3(100.0)	0(0.0)	0(0.0)	3(100.0)
Years of Experience											
1 - 2	11(91.7)	1(8.3)	0(0.0)	4.625	0.201	0(0.0)	0(0.0)	12(100.0)	0(0.0)	0(0.0)	12(100.0)
3 - 5	4(50.0)	4(50.0)	0(0.0)			0(0.0)	0(0.0)	8(100.0)	0(0.0)	0(0.0)	8(100.0)
6 - 10	8(61.5)	5(38.5)	0(0.0)			0(0.0)	0(0.0)	13(100.0)	0(0.0)	0(0.0)	13(100.0)
more than 10	9(64.3)	5(35.7)	0(0.0)			0(0.0)	0(0.0)	14(100.0)	0(0.0)	0(0.0)	14(100.0)
Have you received Training on GCS before?											
Yes	22(68.8)	10(31.3)	0(0.0)	0.188	0.665	0(0.0)	0(0.0)	32(100.0)	0(0.0)	0(0.0)	32(100.0)
No	10(62.5)	6(37.5)	0(0.0)			0(0.0)	0(0.0)	16(100.0)	0(0.0)	0(0.0)	16(100.0)
If yes, which of the following was the duration period?											
1week	11(68.8)	5(31.3)	0(0.0)	5.280	0.260	0(0.0)	0(0.0)	16(100.0)	0(0.0)	0(0.0)	16(100.0)
>1 week -<1 month	9(81.8)	2(18.2)	0(0.0)			0(0.0)	0(0.0)	11(100.0)	0(0.0)	0(0.0)	11(100.0)
>1 month-<3 months	1(33.3)	2(66.7)	0(0.0)			0(0.0)	0(0.0)	3(100.0)	0(0.0)	0(0.0)	3(100.0)
>3months-<6 months	0(0.0)	1(100.0)	0(0.0)			0(0.0)	0(0.0)	1(100.0)	0(0.0)	0(0.0)	1(100.0)
>6months	1(100.0)	0(0.0)	0(0.0)			0(0.0)	0(0.0)	1(100.0)	0(0.0)	0(0.0)	1(100.0)

Furthermore, no association exists between socio-demographic characteristics and the level of skill demonstrated on GCS by participants in the control group before and after the intervention. Therefore, we accept the null hypothesis. (See Table 4b).

Table 4b. Association between the participants' pre-test skills and post-test skills demonstrated in the use of GCS and their social demographic characteristics in the control group

CONTROL	**Pre-**					**Post-1**					**Post-2**				
Sex	**Poor**	**Fair**	**Good**	**x2**	**p**	**Poor**	**Fair**	**Good**	**x2**	**p**	**Poor**	**Fair**	**Good**	**x2**	**p**
Male	11(73.3)	4(26.7)	0(0.0)	2.613	0.106	7(46.7)	8(53.3)	0(0.0)	0.464	0.496	4(26.7)	11(73.3)	0(0.0)	3.224	0.073
Female	17(48.6)	18(51.4)	0(0.0)			20(57.1)	15(42.9)	0(0.0)			19(54.3)	16(45.7)	0(0.0)		
Highest Academic Qualification															
Diploma (RN)	16(55.2)	13(44.8)	0(0.0)	0.824	0.662	14(48.3)	15(51.7)	0(0.0)	0.943	0.624	14(48.3)	15(51.7)	0(0.0)	0.943	0.624
First Degree	11(61.1)	7(38.9)	0(0.0)			11(61.1)	7(38.9)	0(0.0)			7(38.9)	11(61.1)	0(0.0)		
Higher Degree	1(33.3)	2(66.7)	0(0.0)			2(66.7)	1(33.3)	0(0.0)			2(66.7)	1(33.3)	0(0.0)		
Others	0(0.0)	0(0.0)	0(0.0)			0(0.0)	0(0.0)	0(0.0)			0(0.0)	0(0.0)	0(0.0)		
Age Group (Years)															
21 - 30	13(48.1)	14(51.9)	0(0.0)	0.265	0.876	13(48.1)	14(51.9)	0(0.0)	3.277	0.194	11(40.7)	16(59.3)	0(0.0)	0.980	0.613

31 - 40	9(56.3)	7(43.8)	0(0.0)			11(68.8)	5(31.3)	0(0.0)			9(56.3)	7(43.8)	0(0.0)		
41 - 50	1(50.0)	1(50.0)	0(0.0)			2(100.0)	0(0.0)	0(0.0)			1(50.0)	1(50.0)	0(0.0)		
51 - 60	0(0.0)	0(0.0)	0(0.0)			0(0.0)	0(0.0)	0(0.0)			0(0.0)	0(0.0)	0(0.0)		
Job Status															
NO II	8(61.5)	5(38.5)	0(0.0)	2.499	0.645	6(46.2)	7(53.8)	0(0.0)	2.363	0.669	5(38.5)	8(61.5)	0(0.0)	1.473	0.831
NO I	6(54.5)	5(45.5)	0(0.0)			5(45.5)	6(54.5)	0(0.0)			5(45.5)	6(54.5)	0(0.0)		
SNO	4(40.0)	6(60.0)	0(0.0)			5(50.0)	5(50.0)	0(0.0)			5(50.0)	5(50.0)	0(0.0)		
PNO	0(0.0)	0(0.0)	0(0.0)			0(0.0)	0(0.0)	0(0.0)			0(0.0)	0(0.0)	0(0.0)		
ACNO	6(75.0)	2(25.0)	0(0.0)			5(62.5)	3(37.5)	0(0.0)			3(37.5)	5(62.5)	0(0.0)		
CNO	4(50.0)	4(50.0)	0(0.0)			6(75.0)	2(25.0)	0(0.0)			5(62.5)	3(37.5)	0(0.0)		
Years of Experience															
1 - 2	0(0.0)	0(0.0)	0(0.0)	0.608	0.738	0(0.0)	0(0.0)	0(0.0)	1.575	0.455	0(0.0)	0(0.0)	0(0.0)	1.838	0.399
3 - 5	12(60.0)	8(40.0)	0(0.0)			9(45.0)	11(55.0)	0(0.0)			8(40.0)	12(60.0)	0(0.0)		
6 - 10	10(55.6)	8(44.4)	0(0.0)			11(61.1)	7(38.9)	0(0.0)			8(44.4)	10(55.6)	0(0.0)		
more than 10	4(44.4)	5(55.6)	0(0.0)			6(66.7)	3(33.3)	0(0.0)			6(66.7)	3(33.3)	0(0.0)		
Have you received training on GCS before?															
Yes	14(50.0)	14(50.0)	0(0.0)	0.930	0.335	15(53.6)	13(46.4)	0(0.0)	0.005	0.945	15(53.6)	13(46.4)	0(0.0)	1.469	0.226
No	14(63.6)	8(36.4)	0(0.0)			12(54.5)	10(45.5)	0(0.0)			8(36.4)	14(63.6)	0(0.0)		
If yes, which of the following was the duration period?															
1week	2(33.3)	4(66.7)	0(0.0)	8.362	0.079	1(16.7)	5(83.3)	0(0.0)	4.667	0.323	4(66.7)	2(33.3)	0(0.0)	3.125	0.537
>1week <1month	1(20.0)	4(80.0)	0(0.0)			4(80.0)	1(20.0)	0(0.0)			3(60.0)	2(40.0)	0(0.0)		
>1month- <3months	5(100.0)	0(0.0)	0(0.0)			3(60.0)	2(40.0)	0(0.0)			4(80.0)	1(20.0)	0(0.0)		
>3months- <6months	3(50.0)	3(50.0)	0(0.0)			3(50.0)	3(50.0)	0(0.0)			3(50.0)	3(50.0)	0(0.0)		
>6months	1(25.0)	3(75.0)	0(0.0)			2(50.0)	2(50.0)	0(0.0)			1(25.0)	3(75.0)	0(0.0)		

Discussion

The study aimed to assess the effect of an educational interventional program on clinical nurses' skill in performance of the GCS in selected tertiary hospitals in Edo State, Nigeria. This study is a follow-up to a study conducted by Ehwarieme et al. (2021), which revealed that nurses were inadequate in GCS skills, and related the poor skill exhibited to the absence of constant practice of GCS in the clinical area. This necessitated the development of the educational intervention package that was tested in the present study. The study participants were primarily young adults, with an average age of approximately 35 years in both the intervention and the control groups (35.23 ± 9.56 and 30.22 ± 6.12, respectively). Consistent with other nursing research (Ann-Charlotte, 2015; Ehwarieme et al., 2021; Hein & Chae, 2011; Kumar, 2015). The majority of participants were female. Age and gender can influence GCS skill acquisition and performance. Younger individuals may learn faster, while older ones might leverage experience, though memory retention and motor skills may decline with age. Gender differences can affect communication, confidence, decision-making, and empathy during assessments, potentially influencing the accuracy and approach to GCS evaluations (Ehsani et al., 2015; Tomlin et al., 2024). Findings showed that before the intervention (pre-test), both the intervention and the control groups demonstrated predominantly poor performance of GCS skills. There were no statistically significant differences between the groups in the overall GCS skills or the individual components, which is consistency with the study of Ehwarieme et al. (2021). The findings of the present study are consistent with the submission of Ehwarieme and Anarado (2017), where reported usage and skills of the GCS among nurses were very poor, as only 23.4% of the respondents have used the GCS with significant usage differences between wards, and with Kebapçı et al. (2020), who recommended that nurses should receive appropriate education and skills through novel educational strategies, such as high-fidelity simulation or objective structured clinical examinations with simulated patients. This highlights the need for ongoing educational efforts to address potential skill gaps due to infrequent use of GCS in clinical settings. The intervention's practical implications include additional resource allocation, time commitment for training, operational changes, and impacts on stakeholders, while potential barriers involve logistical challenges, resistance to change, compliance issues, and sustainability concerns.

After the intervention (post-test 1), all participants in the intervention group showed good GCS skills, while the majority of the control group remained at a poor skill level. This difference was statistically significant ($p \leq 0.05$). The current study's findings regarding the educational intervention program's success in improving nurses' GCS skills align with previous studies, such as Elhagga and Eldesouky (2016), as well as the Egyptian Central Agency for Mobilization and Statistic (2016), where it was stated that, skills and practice level of nurses considerably improved after the education program. Those studies have shown that targeted training programs can significantly improve nurses' competence in neurological assessments using the Glasgow Coma Scale. The intervention program's success suggests the value of implementing standardized training programs for nurses on GCS assessment. This can ensure consistency and accuracy in patient evaluations across healthcare settings. By enhancing nurses' GCS skills, the intervention likely leads to better assessment of patients with neurological conditions and translates to improved patient care through timely identification of changes in a patient's neurological status and more informed treatment decisions.

The findings of a study conducted by Hussein (2015) in Egypt emphasized that if nurses have understanding of the skill, they will be able to apply it as good as possible and *vice versa*. In a similar background, Teles et al. (2013) stressed the teaching of essential skills to perform GCS during neurological assessment through the theoretical and practical courses of nursing. Also, Cook et al. (2013) and Abdelmowla et al. (2015) established that educational intervention efficiently improved nurses' self-confidence. Improved self-confidence enhances GCS skills by increasing accuracy, better decision-making, clearer communication, reduced stress, and encouraging more practice and skill development (Mattar et al., 2015). The present study demonstrated a significant improvement in nurses' GCS assessment skills on the post-intervention test compared to the pre-intervention test. This suggests that the educational intervention program effectively enhanced their skills, proficiency, and practical application of the GCS. These findings align with Elhagga and Eldesouky (2016), who found that improved nurse knowledge leads to better performance and increased self-confidence. Further, our results were supported by Tukaram and Milka (2014), Ahamed and Ebraheim (2017), and Hansen et al. (cited in Ihsan et al., 2013), who also showed significant improvements in the intervention groups compared to the control groups. The present study specifically highlighted a substantial increase in the number of participants who used correct methods for assessing verbal and motor responses in the intervention group.

Additionally, also, present study found evidence of strong skill retention among nurses in the intervention group. Scores on post-test 1 and post-test 2 were statistically similar, indicating that the skills learned during the educational program were retained over time. Importantly, the improvement in skill level was observed across all domains of the GCS, demonstrating a comprehensive understanding of the assessment tool. Furthermore, no significant association was found between the participants' socio-demographic characteristics and their skills in performance of the GCS assessment, both before and after the intervention ($p > 0.05$). This suggests that the intervention was effective for all participants, regardless of their background. While previous research supports the effectiveness of educational programs in improving GCS skills as reported by Yousef et al. (2021), Ali et al. (2022), Tukaram and Milka (2014), Ahamed and Ebraheim, (2017), and Loutfy et al. (2023), the present study observed a higher rate of skill retention compared to other studies. This finding highlights the potential effectiveness of the specific educational intervention package used in this research. The reason for this outstanding effect produced by the educational intervention package in the current study might be due to the specific design of the educational intervention program, including its structure, delivery mode, and learning environment. Additionally, the lack of a control group in some prior studies might explain the variation in findings.

The present study was also conducted in an adult neurological ward, unlike previous studies in paediatric neurology, critical care, and emergency units (Ahamed and Ebraheim, 2017; Ali et al., 2022; Loutfy et al., 2023; Tukaram and Milka, 2014; Yousef et al., 2021**).** Neurological wards typically have a higher volume of patients requiring GCS assessment. This frequent exposure to relevant patients likely provided participants with more opportunities to practice their newly acquired skills after the intervention. This suggests that frequent application in a real-world setting (neurological ward) might have boosted participants' motivation and confidence. Regular use of GCS likely led to further skill refinement and retention compared to settings with less frequent application. This discussion highlights the importance of considering the clinical setting when interpreting skill retention findings from educational interventions. Future research could explore the effectiveness of interventions tailored to specific ward environments to optimize learning and skill retention for nurses. Nonetheless, the effectiveness of GCS educational interventions varies by setting: in an adult neurological ward, training can be detailed and focused on chronic conditions. In a pediatric unit, it must address age-specific needs and involve parents, and in an emergency unit, it requires rapid, practical training for urgent assessments under high-pressure conditions. Therefore, the effectiveness of GCS educational interventions depends on tailoring the training to the specific clinical setting; detailed for adult neurological wards, age-specific for pediatric units, and rapid for emergency units. This ensures relevance and better outcomes in each environment.

Implications for Nursing

Research indicated that standardization of assessment, as well as knowledge and education, are extremely important in ensuring the accuracy of assessment. (Mattar et al., 2013; McLernon, 2014; Riechers et al., 2005). Our study found, however, that lack of skill and education regarding the standardized use of the GCS is still an issue for nurses dealing with neurological disorders. Nevertheless, the success of this educational instructional program demonstrates that good results can be achieved and that nurses can be empowered to take control of their professional development and continue to improve their skills, feel competent and confident in their skills, in addition to higher job satisfaction, which can have a positive impact on the overall work environment. Enhanced GCS skills translate into improved patient outcomes by ensuring accurate assessments and timely interventions, enhancing care processes by promoting consistency and informed decision-making, and increasing patient safety by enabling early detection of complications and effective team communication. Furthermore, the study emphasizes how well-targeted training interventions can enhance nurses' clinical competencies, especially when it comes to neurological evaluations with the Glasgow Coma Scale (GCS). It argues that in order to make future training directly applicable to clinical practice, it should be tailored to address specific skill gaps relevant to various healthcare contexts. This method works especially well in settings with restricted resources, such as those when time and resources are limited. Training programs that include regular assessments and feedback can aid in the retention and practical application of these abilities.

Additionally, the study shows that training models that are both economical and resource-efficient, like simulation-based and peer-led learning, can be successfully applied in comparable settings, the success of the intervention can be expanded to other regions through the development of flexible and scalable training programs, and the maintenance and expansion of acquired skills depend on the development of follow-up sessions and local capacity building through nurse educator training.

Conclusion

This study demonstrates the effectiveness of an educational intervention program in improving nurses' GCS assessment skills. Nurses in the intervention group showed significant improvements after participating in the program, while the control group with no intervention did not. This suggests that the educational intervention package which was built on the principle of self-directed learning effectively enhanced nurses' skills and practical application of the GCS. The program's success highlights the potential of self-directed learning for nurses. This format empowers them to take ownership of their learning and improve their skills at their own pace. By acquiring these GCS skills, nurses are likely to gain confidence in eliciting accurate patient responses, leading to more accurate GCS scores and improved clinical decision-making.

Limitations of the Study

- The study used a purposive sampling method to select 98 nurses from neurological wards in selected hospitals. While this method ensures that participants are relevant to the study, it limits the generalizability of the findings.
- The relatively small sample size (98 nurses) may limit the statistical power of the study, making it harder to detect small, but meaningful, effects. Additionally, the small sample size may not adequately represent the broader population of nurses, further limiting the generalizability of the findings.
- Although the observational checklist used in the study had a high inter-rater reliability (rho=0.942) and a high degree of agreement (kappa= 0.792), the study relies on self-developed instruments. The validity and reliability of such tools in different contexts or populations may not be established, potentially affecting the accuracy of the measurements.

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Conflict of Interests

No conflict of interests is to be declared by the authors..

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