## RESEARCH

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## Abstract

**Background** Postpartum hemorrhage is a leading cause of maternal deaths in Tanzania, highlighting the critical need for effective training for student nurse-midwives in ordinary diploma programs. The study aimed to determine the changes in knowledge, skills, self-confidence, and satisfaction in preventing and managing postpartum hemorrhage among student nurse-midwives after the simulation-based education method is being used.

**Methods** A pre-post quasi-experimental study design without a control group was conducted to assess the impact of simulation-based education on student nurse-midwives' knowledge, skills, self-confidence, and satisfaction regarding the prevention and management of postpartum hemorrhage at one college of health and allied sciences in the northern Tanzania. A total of 55 student nurse-midwives were included. Data were collected using structured self-administered questionnaires related to knowledge, skill check, self-confidence, and satisfaction. Descriptive statistics, bivariate analysis using T-tests and Chi-square tests, as well as multiple regression models, were employed to analyze the data. A *p*-value of less than 0.05 was used to assess statistically significant differences in the adjusted mean (Beta Coefficient) between the post-intervention and pre-intervention periods.

**Results** The results indicated that student nurse-midwives experienced a significant improvement in knowledge and skills after simulation-based education method (p < 0.001). Additionally, the multiple regression analysis revealed that knowledge scores were notably higher at endline of the study compared to the baseline, with an effect size of (A $\beta$ C = 11.7; 95% CI: 11.0–12.5) and 13.9(12.7–15.1) respectively. Furthermore, students reported high level of self-confidence and satisfaction regarding their abilities in preventing and managing postpartum hemorrhage after simulation, as assessed using the unadjusted Bloom technique.

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**Conclusion** The results revealed that simulation-based education was an effective pedagogical method for improving student nurse-midwives knowledge, skills, self-confidence, and satisfaction in the prevention and management of postpartum hemorrhage.

Keywords Simulation-based education, Postpartum hemorrhage, Knowledge, Skills, Self-confidence, And satisfaction

## Background

Educating student nurse-midwives in obstetric emergencies, including postpartum hemorrhage is of great importance since the major cause of maternal death in Tanzania, is postpartum hemorrhage, which is a curable and preventable condition accounting 25% of maternal deaths [1]. Currently, Tanzania's maternal mortality rate is 104/100,000 live births [2]. The global target is to reduce maternal mortality to less than 70/100,000 live births by 2030 [1].

Diploma nurses and midwives form the bulk of the nursing workforce in the country. Since this cadre doesn't pursue internship practice after graduation, their education is crucial for developing the necessary competencies needed [2]. The diploma program in nursing and midwifery is governed by the National Technical Award (NTA) [3]. The program covers essential knowledge and skills necessary for preventing and managing postpartum hemorrhage, including active management of the third stage of labour. These competencies are central to the curriculum and align with the core competencies emphasized by the International Confederation of Midwives [3, 4].

In low and middle-income countries, studies report that the current traditional teaching method such as lectures used for training nurse and midwifery students are insufficient to equip the students with the hands on skills necessary to manage postpartum hemorrhage [5, 6]. However, previous studies have demonstrated that simulation-based education as a pedagogical method significantly enhances students' knowledge and psychomotor skills in managing postpartum hemorrhage [7, 8].

The term "simulation" refers to activities that mimic the real clinical environment and are designed to demonstrate procedures, decision-making, and critical thinking. The simulation use methods such as role-playing and tools such as interactive videos or mannequins" [9]. This approach enables nursing students to practice clinicaland decision-making skills in a safe environment without putting actual patients at risk. It also increases self-confidence and satisfaction in learning and bridges the gap between theoretical knowledge and practical application through various scenarios [10-14]. However, simulationbased method poorly designed can promote negative learning [12].

In nurse education, typical scenarios involve a simulated patient imitating real-life clinical nursing care situations [15]. Simulation- based education is usually structured in three sessions including briefing, simulation, and debriefing. A briefing is an activity that takes place before onset of the scenario in which preparatory information related to learning objectives and available equipment is given to the participants to promote active learning [16].

The scenario phase starts after the briefing and should not last more than 15 min. This phase must be designed to ensure that student achieve the learning objectives [17]. The debriefing phase is the cornerstone of the simulation process. It involves tutors or faculty guiding a discussion based on the simulation, fostering reflective thinking among the participants, and offering feedback on their performance to enhance learning for future situations [16, 18].

The competency-based national curriculum for nursing and midwifery in Tanzania requires nurse educators to use diverse teaching methods including simulation to ensure that student nurse-midwives gain the essential skills and knowledge upon graduation [3, 19].

Vumilia et al. [19] investigated the experiences of 240 Tanzanian nurse educators in the implementation of a competency- based curriculum. Their findings revealed that simulation, as pedagogical approach, was underutilized, with only 53% of educators incorporating it into their teaching. Furthermore, there is lack of experience and documentation on simulation-based education in low and middle-income countries, including Tanzania [20].

Therefore, this study aims to determine the changes in knowledge, skills, self-confidence, and satisfaction in preventing and managing postpartum hemorrhage among student nurse-midwives when simulation-based education method is being used. To specify the aim the following research question will be explored: Does the use of simulation-based education enhance student nursemidwives' knowledge, skills, confidence, and satisfaction regarding the prevention and management of postpartum hemorrhage?

## Methods

### Study design

A pre-post quasi-experimental study design without a control group was conducted to assess student nursemidwives knowledge, skills, self-confidence, and satisfaction with simulation-based education method at one college of health and allied sciences in the northern zone, Tanzania.

#### Study setting

The study was carried out in a simulation laboratory at the faculty of nursing in northern region. This laboratory is equipped with various low-fidelity simulation mannequins, including delivery models, fetal monitoring models, pelvic models, Mama Natalia, birthing simulator and skills trainer (Mama Birthie) and Neonatalie baby. In this study, a low-fidelity mannequin Mama Natalia was used which has been strapped on standardized patient who has been trained to act as a postpartum hemorrhage patient.

The Mama Natalia mannequin can be used for conducting normal delivery, performing active management of the third stage of labor, assisted delivery (forceps and vacuum) and postpartum hemorrhage where a trained standardized patient can manipulate Mama Natalia uterus to contract or to become atonic uterus (flabby) [21].

# The nursing and midwifery course in the ordinary diploma program

The content of the ordinary diploma in nursing and midwifery course during the third year for the first semester includes care of a woman with abnormal pregnancy, labor, and puerperium; care of a woman with obstetric emergency conditions, including postpartum hemorrhage; care of newborns with abnormal conditions; supervision in nursing and midwifery practice; the basics of epidemiology and biostatistics; and the fundamentals of research. Additionally, the curriculum allocates hours for theory and supervised skills practice for the topic "care of women with obstetric emergency conditions" [3].

#### Sample size estimation

Sample size was estimated using the formula for calculating sample size for intervention or experimental studies including quasi-experimental study design by [22].

$$n = \frac{\left\{z_{1-\alpha}\sqrt{2\ \bar{P}\left(1-\bar{P}\right)} + z_{1-\beta}\sqrt{P_{1}\left(1-P_{1}\right) + P_{2}\left(1-P_{2}\right)}\right\}^{2}}{\left(P_{1}-P_{2}\right)^{2}}$$

Where: P1 = the estimated proportion at the time of the first survey = 21.5% as per study by [23], P2 = the target proportion at some future date, so that  $(P_2 - P_1)$  is the magnitude of change we postulate to detect at the end of intervention program = 43.5% as per study by Mohamed et al. (2018), P =  $(P_1 + P_2)/2$ ;  $Z_{1-\alpha}$  = the z-score corresponding to desired level of significance = 5%, Z1- $\beta$  = the z-score corresponding to the desired level of power standard values of  $Z_{1-\alpha}$  =80. With the above statistical parameters, the minimum sample size was 55. We selected 55 student nurse-midwives to optimize participation while maintaining data quality. Similar studies typically

use sample size between 50 and 100 participants which proved sufficient for drawing reliable conclusions [24, 25]. Furthermore, a sample size of 55 strikes a balance between precision and feasibility, ensuring that key estimates remain within an acceptable margin of error for reliable and generalizable results (Cohens, 1992). The sample size was also constrained by the availability of eligible participants at the institution. Additionally, all student nurse-midwives from the college who received simulation-based education voluntarily consented to participate in the study. However, individuals under 18 years old and those who were seriously ill during data collection were excluded. No participants fell into these categories during the data collection period.

#### Data collection method and tools

#### The postpartum hemorrhage simulation sessions

The postpartum hemorrhage simulation sessions were carried out during eight days in February 2023 with 55 third-year student nurse-midwives. The principal investigator randomly divided the students into groups of seven people. Every day, one group was given a chance to learn through a simulated case scenario using the mannequin, Mama Natalia strapped on a nurse student who simulated the patient. The student nurse-midwives received the scenario and objectives on prevention and management of postpartum hemorrhage one day before the simulation. In each simulation session 7 student's nursemidwives performed the simulation scenario twice and 48 students were observing the session. It was the first time for student nurse-midwives to participate in simulation. The simulation session was delivered through the following sequential phases:

**Briefing phase** In this phase the scenario was presented to the student nurse-midwives (additional file1). Furthermore, the learning objectives were presented including (1) to perform active management of the third stage of labor as preventive measures for postpartum hemorrhage and (2) to manage a woman with postpartum hemorrhage due to atonic uterus immediately after normal spontaneous vaginal delivery.

A brief orientation to the room and equipment's was done. The students were given different roles in the scenario to play including one simulated patient ("Mama Natalia"), three nurses, one doctor, and two relatives. The student nurse-midwives were told to treat the standardized patient as a real patient and act as if they were in actual clinical practice.

Furthermore, students were also told to use protective gear as needed, to request assistance as well as ask for medication if needed. To reduce anxiety and create a relaxed conducive environment student were assured that the simulation was not an exam, instead it was meant for learning purposes, and that mistakes can occur and everything that happens during the simulation session was treated confidential. This phase took about 5-10 min.

**The scenario phase** In this phase the students acting performed various immediate actions according to the scenario. The scenario phase took approximately 15 min.

**Debriefing phase** The debriefing phase took place immediately after the simulation session and lasted between 35 and 40 min. During the debriefing the principal investigator facilitated the discussion among the student nursemidwives based on the simulated scenario using Gibbs' reflective learning cycle [26]. The reflective cycle includes six stages focusing on how to learn from experience by [1] describing [2], involving feelings [3], evaluating [4], analysing [5], concluding and [6] planning for new personal acting/role-play. The purpose was to assist the development of student nurse-midwives understanding, improve future performance, and promote the transfer and integration of learning into practice.

## Data collection tools

The three instruments used to collect the data were in English. The first instrument was a self-administered questionnaire assessing student nurse-midwives' knowledge in the prevention and managing postpartum hemorrhage. The first part included socio-demographic characteristics comprising four questions, the second part assessed student nurse-midwives knowledge in the prevention and management of postpartum hemorrhage comprising 22 questions with yes and no answers including definition, causes, risk factors, types, active management of third stage of labour, and management postpartum hemorrhage due to atonic uterus (additional file 2). The instrument was adopted and modified to Yes and No answers [8].

The second instrument assessed the student nursemidwives skills in preventing and managing postpartum hemorrhage using a check list comprising of 22 questions (additional file 3) which was adopted and modified from the [27]. The third instrument assessed the student nurse-midwives self-confidence and satisfaction with simulation-based education (additional file 4), where five items covered students' satisfaction in simulation learning and eight items self-confidence in simulation [28].

**Baseline data** The baseline data collection on knowledge and skills related to the prevention and management of postpartum hemorrhage was done two weeks after the theoretical and skill practice in the skill laboratory. Student nurse-midwives attended a two-hour lecture session on the prevention and management of postpartum hemorrhage, followed up by three-hour demonstration in the skills laboratory. During the demonstration, the nurse tutor showed how to manage postpartum hemorrhage using the MamaNatalie manikin. Thereafter, the students were left on their own to practice.

**Post test data collection** Data collection on knowledge and skills in the prevention and management of postpartum hemorrhage was done two weeks after the simulation session in the simulation laboratory. While self-confidence and satisfaction with simulation was done immediately after the simulation session.

### Study variables & measurements

The study had four dependent variables that were measured categorically as low, moderate, and high scores. These variables include knowledge, skills, self-confidence and satisfaction scores in the prevention and management of postpartum hemorrhage. Individual students' level of knowledge, skills, self-confidence and satisfaction in prevention and managing postpartum hemorrhage was measured using non-adjusted Bloom technique [29].

The non-adjusted Bloom technique classifies individual percentage scores as < 60%, 60-79.9%, and 80-100% for low, moderate, and high, respectively [29]. In this study student nurse-midwives who scored below 60% were regarded as having a low score of knowledge, skills, self-confidence and satisfaction in the prevention and management of postpartum hemorrhage.

In this study, there were four independent variables which were assessed. These include sex, age, marital status, and educational level.

#### Reliability

Pre-testing of questionnaires was done with 11 student's nurse-midwives, but no modification was made to the questionnaires. The results from the pretesting were not added to the current study results. Reliability for knowl-edge and skills in the prevention and management of postpartum hemorrhage was done using 'Cronbach's alpha and the results were 0.80 for knowledge and 0.75 for skills. Regarding satisfaction and self-confidence, the tool was valid and reliable according to [30] with Cronbach's alpha of 0.94 for satisfaction and 0.87 for self-confidence.

### Data analysis

Data cleaning was done to detect any outliers, inconsistent responses, and missing values. Data analysis was performed using Stata software version 17 (Stata Corp Inc., TX, USA 2021). Descriptive statistics were summarized using frequencies and proportions for categorical variables and measures of central tendencies such as mean with their respective measure of dispersion such as

**Table 1** Baseline profile of students midwives (N = 55)

Intervention arm n (%)]
17(30.9)
38(69.1)
55(100)
0(0.0)
12(21.8)
43(78.2)
21.8 (2.0)

standard deviation were used to summarize the continuous variables.

The relationship between a set of explanatory variables and outcome variables was assessed using a T-test, as the outcome variables were continuous, and the explanatory variables were binary categorical. Furthermore, a student's T-test is appropriate for small sample sizes. Additionally, a chi-square test was employed in the bivariate analysis to investigate the association between binary outcome variables and explanatory variables. Crude and adjusted odds ratios, along with their 95% confidence intervals, were estimated using multiple linear regression models to assess the association between independent variables and outcomes. A *p*-value of <0.05 was considered statistically significant for differences in adjusted mean (Beta Coefficient) between the post-intervention and pre-intervention [31, 32].

## **Ethical consideration**

The study was approved by the institutional review board on 30/6/2022 and the Tanzanian National Health Research Ethics Committee under certificate NIMR/ HQ/R.8a/Vol.IX/4275. A written informed consent was obtained from all study participants. To ensure confidentiality, the written questionnaires were designed without personal identifiers.

## Results

#### Socio-demographic characteristics of student midwives

A total of 55 student nurses' midwives from one college of health and allied sciences who were undertaking midwifery course were involved in this study (Table 1). The majority 38(69.1%) of participants were female, and a significant proportion, 43 (78.2%) had completed advanced level of education. The mean age of the participants was 21.8 (2.0) years.

**Table 2** Knowledge and skills in preventing and managing postpartum haemorrhage between baseline and endline using unadjusted bloom technique (N=55)

Variable	Baseline [n=55 (%)]	End line [ <i>n</i> = 55(%)]	<i>p-</i> value
Knowledge			
Unadjusted Bloom (cut off points)			
Low:<60%	53(96.4)	0(0.0)	< 0.001
Moderate: 60-79.9%	2(3.6)	1(1.8)	
High: 80–100%	0(0.0)	54(98.2)	
Skills			
Unadjusted Bloom (cut off points)			
Low:<60%	52(94.6)	2(3.6)	< 0.001
Moderate: 60-79.9%	2(3.6)	1(1.8)	
High: 80–100%	1(1.8)	52(94.6)	

**Table 3** Mean and standard deviation postpartum hemorrhage knowledge, and skills scores using T-test at baseline and endline (N = 55)

Arm & Domain	Exposure Variable	Change in outcome (knowledge and skills)			
		Mean (SD)	T-test	Df	<i>P</i> - value
Intervention arm					
Knowledge	Phase				
	Baseline	9.5 (2.2)	33.2	108	< 0.001
	Endline	21.3 (1.4)	-	-	-
Skills	Phase				
	Baseline	6.5 (3.7)	21.53	108	< 0.001
	Endline	20.6 (3.1)	-	-	-

Max score: knowledge 22, skills 22

## Knowledge and skills on postpartum haemorrhage using unadjusted bloom technique

The comparison of student nurse-midwives between baseline and endline are illustrated in Table 2. At baseline, 53 students (96.4%) demonstrated low knowledge and 52 students (94.6%) exhibited low skills. After undergoing, simulation-based education method there was statistically significant improvement in all domains (P < 0.001).

## Postpartum hemorrhage knowledge and skills absolute scores between baseline and endline

At the endline, the mean scores for knowledge and skills among student midwives were significantly higher than at baseline, with scores of 21.3 compared to 9.5 (t = 33.2, p = 0.001) and 20.6 compared to 6.5 (t = 21.53, p = 0.001), respectively (Table 3).

## Effect of simulation-based education on knowledge, and skills using linear regression models

An overall mean score at baseline and end line were 9.5 vs. 21.3 out of 22 scores for knowledge and 6.5 vs. 20.6

### Table 4 Effect of simulation base-education on knowledge and skills using linear regression models (N=55)

Domain	Variable	Mean (SD)	uβC, 95%Cl	P-value	aβC,95%Cl	P-
						value
Intervention arm						
Knowledge	Phase					
	Baseline (ref)	9.5(2.2)				
	Endline	21.3(1.4)	11.7(11.1-12.4)	< 0.001	11.7(11.0-12.5)	< 0.001
Skills	Phase					
	Baseline (ref)	6.5(3.7)				
	Endline	20.6(3.1)	14.0(12.7-15.3)	< 0.001	13.9(12.7-15.1)	< 0.001

Unadjusted Beta Coefficient (uβC), Adjusted Beta Coefficient (aβC), Confidence Interval (CI), adjusted variables: Knowledge outcome was adjusted for age. Max scores = 22 for each knowledge and skills

**Table 5** Level of satisfaction and self-confidence in prevention and management of postpartum haemorrhage post intervention (N=55)

Domain	Category	n(%)
Satisfaction	Unadjusted Bloom (score)	
	Low:<60%	0(0.0)
	Moderate: 60-79.9%	0(0.0)
	High: 80–100%	55(100)
Self-confidence	Unadjusted Bloom (score)	
	Low:<60%	0(0.0)
	Moderate: 60-79.9%	0(0.0)
	High: 80–100%	55(100)

out of 22 scores for skills, respectively. After adjusting for age, multiple regression analysis showed that knowledge and skills scores were significantly higher at endline compared to the baseline, with an adjusted mean difference (A $\beta$ C) of 11.7(95% CI: 11.0–12.5) and (A $\beta$ C) of 13.9(95% CI: 12.7–15.1) respectively as shown in Table 4.

## Satisfaction and self-confidence in the prevention and management of postpartum haemorrhage

After the simulation sessions the study evaluated the level of satisfaction and self-confidence in the prevention and management of postpartum haemorrhage. Results indicated that all students' nurse-midwives who participated in simulation-based education method exhibited high level of satisfaction and self-confidence in the prevention and management of postpartum haemorrhage. This was determined using unadjusted Bloom technique for scoring their level of satisfaction and self-confidence (Table 5).

### Discussion

This study aimed at determining the changes in knowledge, skills, self-confidence and satisfaction in the prevention and management of postpartum hemorrhage after using the simulation-based education method. The results indicate a significant improvement in students' knowledge, skills, self-confidence, and satisfaction scores after participating in the simulation session. This reveals that simulation-based education method was effective in enhancing student nurse-midwives knowledge, skills, self-confidence, and satisfaction in the prevention and management of postpartum hemorrhage. Although, the improvement was only measured once, and two weeks after the use of simulation- based education.

Generally, the results from this study are not new findings. Several studies have demonstrated that training student nurse-midwives using simulation in the prevention and management of postpartum hemorrhage have improved students' skills, knowledge, self-confidence, and satisfaction in learning [30, 33–35]. However, the students' knowledge, skills and self- confidence in postpartum hemorrhage in a Tanzania context is important since improved competencies may increase the quality of care as well as reducing the maternal deaths in Tanzania [1].

There is limited experience and documentation related to simulation-based education within health education programs in low-income countries inclusive Tanzania [20]. Therefore, this study has made an important contribution to the field of knowledge on how simulationbased education can contribute to improved nursing knowledge, skills and confidence in prevention and management of postpartum hemorrhage. However, further research is necessary to explore if students who participated in this study will transfer their gained knowledge and skills into clinical practice. Though, it is reported that student nurse-midwives taught with simulation have been shown to transfer the learned skills and knowledge in the clinical area, resulting in provision of safe and effective quality care to postpartum patients [36].

The improved knowledge score after the simulation training can also be due to the fact, that the student nurse-midwives received the scenario one day before the simulation training and had a chance to read about the topic and to be active learners during the simulation sessions. These results are consistent with previous studies [16, 37–39], which revealed that sharing the simulation scenario with the learners in advance helps students to engage during the simulation session, but also providing them with the requisite knowledge and skills to participate actively during the simulation activities ultimately

achieving the learning outcomes. Similar, the International Nursing Association for Clinical Simulation and Learning guideline for best standards in simulation (INASCL) encourage that the students should get the simulation scenario prior to the day of the simulation to provide the students with the necessary resources with the aim of achieving the learning outcomes [16].

The post intervention results in the current study revealed high scores related to psychomotor skills in the prevention and management of postpartum hemorrhage. This can be attributed to the fact that the students could practice their skills on "simulated patient" acting or mimic as a real patient in clinical setting and the availability of adequate equipment's. This is in line with previous studies reporting that availability of realistic and authentic equipment's and the use of a simulated patient enhances students skills acquisition during simulation [40, 41].

Additionally, all the student nurse-midwives in the current study participated in the simulation sessions in the simulation laboratory for two hours every day for a period of eight days either simulating or observing many simulation sessions. The scenario was also repeated twice during each simulation session. This may explain the nurse-midwives' students improved skills. Studies report that repeating the scenario gives the students the opportunity to be active participants and improve their skills [42, 43].

Students' active participation and observation roles during the simulation are pivotal. Active participation allowed the students to directly apply their knowledge and skills in a controlled yet realistic environment. The extended duration in the skills lab, spanning eight days, might have fostered a psychologically safe environment. This prolonged period may have gradually developed trust and camaraderie among the student midwives. The sociocultural approach to learning acknowledges that learning is most effective when students feel comfortable and confident in their interactions with peers and facilitators [44].

The student nurse midwives also reported improved self-confidence and satisfaction in the prevention and management of postpartum hemorrhage after the simulation session. Previous studies also report that repetition of scenario enhances student nurses' self-confidence and satisfaction in learning [35, 36, 45, 46].

After each simulation session there were a debriefing session led by the first author, which is essential to encourage students reflective thinking and where feedback is provided about the students' performance, with the purpose of learning [16, 18]. The first author who were leading the debriefing sessions used Gibb's reflective cycle [26], which may have supported the students learning as the students could get feedback on what was done well and what needed to be improved related to the postpartum hemorrhage simulation case.

In the current study, the simulation-based education method was used to teach the subject prevention and management of postpartum hemorrhage two hours every day for a period of eight days among 55 student nurse-midwives in an ordinary diploma in nursing and midwifery program in Tanzania. The simulation sessions were new in the nursing school and was an extra teaching activity in the teaching plan in addition to theory and skill practice about the subject. The results from the study show clearly that the students gained important knowledge, skills, and self-confidence after the simulation training. Thus, this study shows that implementing simulation- based education to enhance the education of ordinary diploma in nursing and midwifery is vital to prepare them as future skilled nurse midwives and further to improve quality of care. Though, how the simulation-based education can be implemented in an already tight curriculum needs to be further explored together with the Tanzanian nursing and midwifery council.

### Study strengths and limitations.

The study's strength lies in its use of a pre-tested data collection tool and the confirmation of reliability through Cronbach's alpha. However, the current study was done at one institution and lacked a control group, so the generalizability of the study results might be limited. As previously noted, retention of knowledge and skills was assessed two weeks after the simulation session; longer and repeated follow-ups might have resulted in different findings. Future research might consider these approaches to gain a more comprehensive understanding.

### Conclusion

The results revealed that simulation-based education was an effective pedagogical method for improving student nurse-midwives knowledge, skills, self-confidence, and satisfaction in the prevention and management of postpartum hemorrhage. However, further research is needed to explore how these students apply their competence in clinical settings and to further investigate their experiences with simulation-based methods. Longitudinal studies are also required to evaluate the retention of knowledge and skills over time. These results suggest that the Ministry of Health and Nurse and Midwifery Council in Tanzania should support nurse training institutions by integrating standardized postpartum hemorrhage scenarios into the ordinary diploma curriculum and by training nurse educators in simulation-based teaching methods.

#### Abbreviations

I.U	International Unit
INASCL	International Nursing Association for Clinical Simulation and
	Learning guideline for best standards in simulation
NTA	National Technical Award

SD Standard Deviation	
Vs Versus	
aβC Adjusted Beta Coefficient	
uβC Unadjusted Beta Coefficient	
CI Confidence Interval	
NatHREC National Health Research Ethics	Committee

#### **Supplementary Information**

The online version contains supplementary material available at https://doi.or g/10.1186/s12884-025-07590-4.

Supplementary Material 1

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#### Author contributions

The conception and design of the study: R.F, J.R, MJM, I.T, and E.C.FAcquisition of the data: R.F.Data analysis: R.F Interpretation of the results R.F, J.R, and MJM, Drafted and wrote the manuscript: R.F.Critical revision and constructive feedback regarding the manuscript: I.T, MJM, E.C.F, and J.R.

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#### Data availability

The data and material used in the current study are available from the corresponding authors upon a reasonable request.

#### Declarations

#### Ethics approval and consent to participate

The study was approved by the Kilimanjaro Christian Medical University College on 30/6/2022 number 2582 and the Tanzanian National Health Research Ethics Committee NatHREC/HQ/R.8a/Vol.IX/4275. The study adhered to the declaration of Helsinki [47] by obtaining a written informed consent from the participants prior to the commencement of the study, and the participant's data were anonymized.

#### **Consent for publication**

Not applicable.

#### **Competing interests**

The authors declare no competing interests.

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