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RESEARCH ARTICLE OPEN ACCESS

Effect of educational intervention on midwives' skills in utilising uterine balloon tamponade for managing postpartum haemorrhage in Ogun State, Nigeria

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Abstract
Objective: Studies demonstrated the cost-effectiveness of Uterine Balloon Tamponade (UBT) in reducing PPH. However, in Ogun State, Nigeria studies revealed midwives' inadequate skills to utilise UBT. Therefore, this study assessed the effect of the intervention on midwives' skills in utilising UBT for managing PPH at Primary Healthcare Centres (PHC), Ogun State, Nigeria.
Methodology: The study utilised a quasi-experimental design involving the Experimental group (EG) and Control group (CG). A sample size of 146 professional midwives working at PHC in Ogun State was utilized for the study. Six Local Government Areas were purposefully selected based on PPH prevalence. A checklist was used to assess midwives' skills in utilising UBT. The Intervention was teaching, video simulations, and practical demonstrations of UBT. Data was collected in three phases with a 93.8% response rate. Data were analysed using descriptive and inferential statistics at a 5% level of significance.
Results: The pre-intervention skills mean score for EG was 3.57 ± 0.66 and CG was 3.58 ± 0.60, while the immediate and 8th-week post-intervention mean scores for EG were 7.84 ± 0.75; 8.0 ± 0.70, and for CG were 3.71 ± 0.67 and 3.71 ± 0.65, respectively. The Cohen's d effect size for midwives' skills in utilising UBT for managing PPH is large at 1.18.
Conclusion: The intervention improved midwives' skills in utilising UBT to manage PPH. The study recommends the implementation of similar interventions in relevant healthcare settings to ensure the utilisation of UBT in managing PPH.

Keywords: Intervention, Maternal mortality, Midwives' skills, Postpartum haemorrhage, Uterine balloon tamponade

Plain English Summary

This study looked at how well midwives in Ogun State, Nigeria, could use a method called Uterine Balloon Tamponade (UBT) to treat heavy bleeding after childbirth. UBT is recommended by the World Health Organization for this purpose. Studies found that many midwives didn't have enough training to use UBT properly. So, the study assessed the effect of teaching the midwives through videos and hands-on practice on their use of UBT.

The midwives were divided into two groups: one group received the training (Experimental Group) and the other didn't (Control Group). The two groups were tested to see how well they could use UBT before and after the training.

The results showed that the midwives who received the training had significantly improved skills in using UBT compared to those who didn't. The study suggests that similar training programs should be implemented in other healthcare settings to ensure better treatment for heavy bleeding after childbirth

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Background

Maternal mortality remains a major global health concern; according to a recent report by the World Health Organization (WHO), maternal death occurs approximately every two minutes, resulting in approximately 800 women losing their lives each day due to preventable causes related to pregnancy and childbirth (1). The report also emphasised that a significant majority, almost 95%, of these unfortunate incidents take place in countries classified as lower-middle-income. Notably, Sub-Saharan Africa alone accounts for approximately 70% of maternal mortality, amounting to 202,000 cases (1). Although there has been a 34.2% decrease in the global maternal mortality ratio (MMR) between 2000 and 2020, the African region continues to confront a severe predicament, representing 69% of all maternal mortality worldwide in 2020 (1). Nigeria ranks third among the three countries with significantly elevated maternal mortality rates on a global scale, evidenced by an MMR of 1047 per 100,000 live births[1]. Furthermore, WHO revealed that the lifetime probability of a Nigerian woman experiencing mortality during pregnancy, childbirth, or postpartum is 1 in 22, in contrast to 1 in 4,900 in most affluent nations (2).

Following childbirth, PPH continues to be a prominent contributor to maternal mortality, accounting for 28.8% of all maternal mortality (2). According to Bienstock (3), PPH is characterised by a cumulative blood loss of 1000 ml or greater, or blood loss accompanied by indications or manifestations of hypovolemia, irrespective of the method of delivery. Insufficient resources, untrained birth attendants, delivery in poorly equipped facilities, and a shortage of key obstetric care supplies are all factors that are linked to haemorrhage (4). The International Federation of Gynaecology and Obstetrics (FIGO) asserts that the majority of deaths resulting from PPH can be averted by implementing proactive measures during the third stage of labour, as well as promptly and efficiently implementing the first response bundle of intervention of PPH management recommended by the WHO (5). Nevertheless, it is worth noting that a significant proportion of women, ranging from 10% to 20%, exhibit a lack of response to the first response bundle of intervention, commonly known as refractory PPH, which notably heightened morbidity and mortality from postpartum haemorrhage (2). This matter holds significant importance in settings with limited resources, such as basic healthcare centres, where the accessibility to surgical facilities may be limited (5). Therefore, WHO suggests various nonsurgical interventions for managing refractory PPH (2). These interventions encompass bimanual uterine compression, external aortic compression, *Uterine Balloon Tamponade (UBT)*, utilisation of a non-pneumatic anti-shock garment, and the administration of a second dose of tranexamic acid (2, 4, 5, 6).

The uterine balloon tamponade is a cost-effective and uncomplicated device specifically developed to treat postpartum haemorrhage resulting from uterine atony (5, 6). Several UBT devices differ in terms of cost, reusability, and effectiveness; however, irrespective of the device employed, all of them possess identical essential components and applications (6). Systematic review and meta-analysis revealed that UBT systems demonstrate a high level of safety and a success rate exceeding 85% in the treatment of postpartum haemorrhage (4, 6). This intervention serves as a crucial instrument in the endeavour to tackle refractory PPH and mitigate the resulting morbidity and death (2).

Nevertheless, despite the demonstrated efficacy and utility of uterine balloon tamponade in the management of PPH, scholarly investigations have revealed that professional healthcare practitioners in resource-constrained environments lack adequate knowledge and skills regarding this intervention, resulting in restricted utilisation (6, 7, 8). A study (9) emphasised that the integration of UBT into the health systems of South Africa and Ghana for the management of postpartum haemorrhage has been impeded by a lack of awareness and insufficient understanding. Insufficient knowledge, skills and training were recognised by scholars (7, 8, 9, 10) as variables that contribute to the inadequate utilisation of UBT among skilled healthcare workers in the management of postpartum haemorrhage. In another study (10), it was observed that healthcare staff in Niger State, Nigeria, exhibited an inadequate understanding of the role of UBT in the management of severe PPH. Studies recommend thorough training and ongoing training on the knowledge and skills of utilising UBT in the management of PPH in all healthcare establishments (5, 6, 7, 8, 9, 10). Both WHO and FIGO emphasised the significance of consistent training in UBT insertion techniques for healthcare workers to proficiently handle PPH (2, 5).

However, the Nursing and Midwifery Council of Nigeria (NMCN) has not included UBT in its curriculum, impeding midwives' ability to acquire the necessary knowledge and skills. Also, studies on educational interventions aimed at improving UBT knowledge and skills among midwives in Nigeria are limited, particularly in Ogun State further impeding midwives' ability to acquire the necessary knowledge and skills (10). Therefore, this intervention study targeted an educational

package on UBT skills to improve the effective utilisation of UBT among midwives in the management of PPH. This study adapted the diffusion theory of innovation and precede-proceed health intervention model to implement a program enhancing professional midwives' knowledge and skills in utilising uterine balloon tamponade for postpartum haemorrhage management.

The specific objective of the study was to assess the effect of educational intervention on the midwives' skills in utilising UBT for managing PPH in experimental and control groups. The hypothesis stated no significant difference in midwives' pre- and post-intervention skill scores of utilising UBT in managing PPH in the experimental and control groups.

Materials and Methods

This study adopted a quantitative research method utilising a non-equivalent control group quasi-experimental research design involving two groups (experimental & control groups). The experimental group was subjected to two diverse teaching strategies as part of the educational intervention package—namely, practical-based demonstrations and video simulations of Uterine Balloon Tamponade (UBT) while the control group was subjected to no intervention package. A further description of the design is summarised in Table 1 below:

Table 1: Summary of the quasi-experimental study design

Groups	Baseline Data	Interventions For 2 Weeks	Evaluation immediately after the intervention	Evaluation 8 weeks after intervention
Experimental Group	O_1	X	O_2	Q_3
Control group	Q_1	O	Q_2	Q_3

Key: X = Intervention; O=No intervention; O_1 = Observation before intervention in experimental and control groups; O_2= observation immediately after intervention in the two groups; Q_3= Observation at 8th week after intervention in two groups

The study was conducted in Ogun State, Nigeria. Ogun State consists of three senatorial districts and is further divided into twenty (20) local government areas (LGAs) comprising the Primary Health Care system. The study focused on professional midwives actively engaged in delivering maternal healthcare services at the public primary healthcare centres in Ogun State, Nigeria. The entire population under consideration comprises two hundred and thirty (230) professional midwives/nurses, encompassing both males and females. The two independent groups formula was used to calculate a sample size of 146 from the total population of 230 professional midwives working at public primary healthcare centres in Ogun State.

The three senatorial districts in Ogun State (Ogun Central, East and West) were used for the study to ensure equal representation and opportunity across the entire State. Two Local Government Areas (LGAs) were purposively selected based on the PPH prevalence from each Senatorial district, making a total of Six LGAs for the study. A simple random technique through balloting was used to assign three LGAs to the Experimental Group (EG) and three LGAs to the Control Group (CG). Due to the restricted number of professional midwives across all the local government areas, a total enumeration of all midwives available in public primary healthcare centres within the selected six local governments was used for the study. The summary of the sampling technique is described in Figure 1 below.

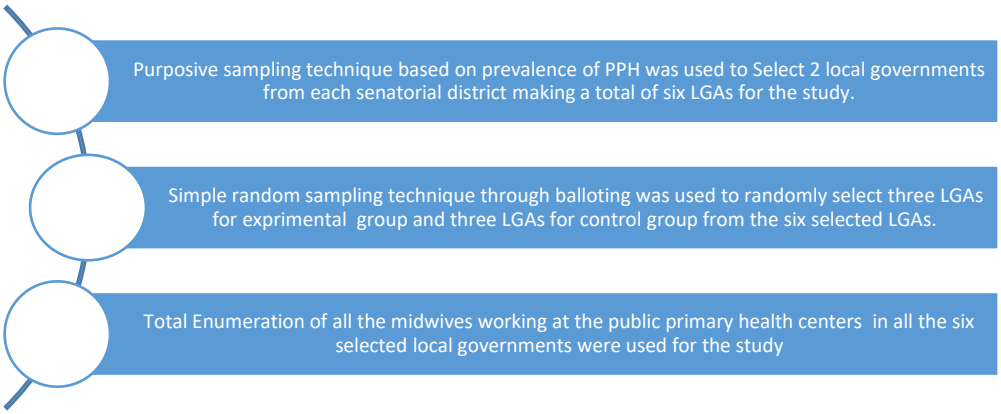

Figure 1: Summary of the Sampling Technique (Source: Researcher: Adamu-Adedipe (2024))

A self-developed checklist was used to assess the practical skills of utilising UBT among respondents for managing PPH. The checklist consists of specific activities that are expected to be performed. These activities were evaluated on a four-point continuum scale from 0 to 1, with varying fractions representing the extent of completion (0, 1/4, 1/2, 1) for each activity conducted by the respondent.

The study encompassed three distinct phases, namely the pre-intervention phase, intervention phase and post-intervention phase to comprehensively address its objectives.

In the pre-intervention phase, a pre-intervention test of midwives' skills of utilising UBT was done in both experimental and control groups and analysed to ensure respondent homogeneity. This phase lasted for two weeks. The intervention phase, phase focused on providing participants in the experimental group with teaching modules that comprised theoretical components, video simulation and practical demonstration to enhance their skills in utilising UBT for managing post-partum haemorrhage. An immediate post-intervention test was applied at the end of this phase. This phase lasted for two weeks and 3 days. At 8TH week post-intervention phase, an individual practical demonstration of UBT to assess the retention level of Midwives' practical skills in utilising UBT for the management of PPH was done. The phase lasted for two weeks.

After retrieving the instruments, the data was screened to identify and correct missing data and outliers, achieving a 93.8% response rate in the three phases. The collected data was then coded and analysed using the Statistical Package for Social Sciences (SPSS), Version 27. Both descriptive and inferential statistical techniques were employed in the analysis.

The Mann-Whitney U test was employed at a significance level of 0.05; this test analysed the effect of educational intervention on midwives' post-intervention skills in utilising UBT for managing PPH. The hypothesis was tested using the Friedman test at a significance level of 0.05 to analyse differences in midwives' pre-intervention, immediate post-intervention, and 8-week post-intervention skills scores in utilising UBT for the management of PPH in both the experimental and control groups. Post Hoc Analysis was done on the Difference in Midwives' Pre and Post-Intervention Skill Scores of Utilising UBT in managing PPH.

Results

The study assessed the effect of an educational intervention on midwives' skills in utilising uterine balloon tamponade to manage postpartum haemorrhage. A sample size of 146 respondents was calculated for the study, but 137 participated in the study, comprising 64 in the experimental group and 73 in the control group, yielding a response rate of 93.9%. The p-values for the sociodemographic characteristics between the two groups were greater than 0.05, indicating no significant differences in these characteristics between the groups.

Table 2: Description of the Socio-demographic Characteristics of the Respondents

Variables	Experimental group (n=64) n (%)	Control group (n=73) n (%)	p-value
Age			
Below 25 years	5(7.8)	8(11.0)	0.923
25 - 34 years	11(17.2)	14(19.2)	
35 - 44 years	22(34.4)	21(28.8)	
45 - 54 years	21(32.8)	23(31.5)	
55 years and above	5(7.8)	7(9.6)	
Gender			
Male	8(12.5)	10(13.7)	0.836
Female	56(87.5)	63(86.3)	
Professional Qualification			
RM	15(23.4)	15(20.5)	0.683
RN & RM	49(76.6)	58(79.5)	
Designation			
NO II	3(4.7)	5(6.8)	0.795
NO I	6(9.4)	10(13.7)	
SNO	25(39.1)	30(41.1)	
PNO	20(31.3)	20(27.4)	
ACNO	7(10.9)	7(9.6)	
CNO	3(4.7)	1(1.4)	
Experience			
Below 5 years	8(12.5)	9(12.3)	0.893

5 - 14 years	24(37.5)	32(43.8)
15 - 24 years	25(39.1)	25(34.2)
25 years and above	7(10.9)	7(9.6)
Total	**64(100.0)**	**73(100.0)**

Source: (Field Survey, 2023)

Descriptive Analysis

Research Objective: To determine the effect of the educational intervention on midwives' post-intervention skills in utilising uterine balloon tamponade for managing PPH in both experimental and control groups.

Table 3: Effect of the Educational Intervention on Midwives' Post-Intervention Skills in Utilising Uterine Balloon Tamponade for Managing PPH

Study Groups	Median	Mean Rank	Mann-Whitney U	Z-score	p-value
Experimental (n=64)	7.75	105.50	0.000	-10.101	0.000
Control (n=73)	3.75	37.00			

Table 3 presents the inferential analysis of the midwives' skills in utilising UBT post-intervention, comparing the experimental group that received the educational intervention and the control group that did not receive the intervention. The p-value is 0.000, which is less than the significance level of 0.05, revealing a significant difference between the experimental and control groups in their skill levels. The experimental group, which received the educational intervention on UBT, demonstrated a substantially higher level of skills in utilising UBT. This is evident from the median score of 7.75 in the experimental group, compared to the control group, which had a median score of 3.75.

The Mann-Whitney U value of 0.000 is the lowest possible value, indicating that all the observations in the control group had ranks lower than all observations in the experimental group. This result suggests a clear separation between the two groups in terms of their skill levels. The standardized test statistic (Z-score) is -10.101. This Z-score is far below the critical value of ±1.96 for a 95% confidence level (or even more stringent thresholds for higher confidence levels), indicating an extremely significant result and a large effect size of calculated Cohen's d effect size of 1.18. These results suggest that the intervention had a substantial impact on improving the midwives' practical skills in utilising UBT for managing PPH.

Hypothesis: There is no significant difference in midwives' pre and post-intervention skill scores of utilising UBT in managing PPH in the experimental and control groups.

Table 4: Difference in Midwives' Pre and Post-Intervention Skill Scores of Utilising UBT in managing PPH

Study Group	Median	Mean±SD	Mean Rank	Freidman test statistic	df	p-value
Experimental Group						
Pre-intervention	3.75	3.57±0.66	1.00	115.674	2	0.000
Immediate post-intervention	7.75	7.84±0.75	2.27			
8 weeks post-intervention	7.75	8.00±0.70	2.73			
Control Group						
Pre-intervention	3.50	3.58±0.60	1.64	10.800	2	0.005
Immediate post-intervention	3.75	3.70±0.67	2.34			
8 weeks post-intervention	3.75	3.71±0.65	2.02			

**P<0.05*

Table 4 shows the difference in midwives' pre and post-intervention skill scores of utilising UBT in managing PPH in the experimental and control groups at the pre-intervention, immediate post-intervention and eight weeks post-intervention phases. For the experimental group, the p-value (0.000) is less than the significance level of 0.05, indicating a statistically significant difference among the three time points. The mean skill scores, median scores, and mean ranks are different for pre-intervention (mean: 3.57±0.66, median: 3.75, mean rank: 1.00), immediate post-intervention (mean: 7.84±0.75, median: 7.75, mean rank: 2.27), and eight weeks post-intervention (mean: 8.00±0.70, median: 7.75, mean rank: 2.73). For the control group, the p-value (0.005) is less than the significance level of 0.05, indicating a statistically significant difference among the three time points. The mean skill scores, median scores, and mean

ranks are also different for pre-intervention (mean: 3.58±0.60, median: 3.50, mean rank: 1.64), immediate post-intervention (mean: 3.70±0.67, median: 3.75, mean rank: 2.34), and eight weeks post-intervention (mean: 3.71±0.65, median: 3.75, mean rank: 2.02). Therefore, the null hypothesis is rejected, there is a significant difference in midwives' pre- and post-intervention skill scores, as regards utilising UBT in managing PPH among midwives in both the experimental and control groups.

Table 5: Post Hoc Analysis on the Difference in Midwives' Pre- and Post-Intervention Skill Scores of Utilising UBT in Managing PPH

Pairwise Comparisons	Test Statistic	Std. Error	Std. Test Statistic	p-value
Experimental Group				
Pre-intervention knowledge-8-weeks post-intervention knowledge	-1.273	0.177	-7.204	0.000
Pre-intervention knowledge- immediate post-intervention knowledge	-1.727	0.177	-9.767	0.000
8-weeks post-intervention knowledge-Immediate post-intervention knowledge	-0.453	0.177	-2.563	0.031
Control Group				
Pre-intervention knowledge-8-weeks post-intervention knowledge	-0.185	0.166	-1.117	0.792
Pre-intervention knowledge- immediate post-intervention knowledge	-0.185	0.166	-1.117	0.792
8-weeks post-intervention knowledge-Immediate post-intervention knowledge	0.000	0.166	0.000	1.000

Table 5 provides the results of pairwise comparisons between the different time points for both the experimental and control groups via post-hoc analysis alongside Bonferroni correction for the experimental group: the significant difference was found between pre-intervention skill and 8-week post-intervention skill scores (p = 0.000); pre-intervention skill and immediate post-intervention skill scores (p = 0.000); 8-weeks post-intervention skill and immediate post-intervention skill scores (p = 0.031). These results indicate that the intervention had a significant impact on improving the skill scores of midwives in the experimental group, as evidenced by the significant differences between pre-intervention and post-intervention time points (both immediate and 8 weeks).

For the control group, no significant difference was found between pre-intervention skill scores and 8-week post-intervention skill scores is not statistically significant, p = 0.792); pre-intervention skill and immediate post-intervention skill scores (p = 0.792); and 8-weeks post-intervention skill and immediate post-intervention skill scores (p = 1.000). The results for the control group suggest that there was no significant change in the skill scores of midwives across the three time points.

Discussion

The practical skills of midwives in utilising UBT were measured similarly at three points: before the intervention, immediately after the intervention, and eight weeks post-intervention. Initially, both the experimental and control groups had low skill levels in using UBT, indicating a low level of skills in this critical procedure. However, after the intervention, the experimental group exhibited a remarkable enhancement in their practical skills. Immediately post-intervention, most of the midwives in the experimental group achieved a high level of practical skills. This improvement was not only substantial but also sustained, as evidenced by the further increase in skill levels observed eight weeks after the intervention. This indicates that the skills acquired through the intervention were retained and possibly even refined over time. On the other hand, the control group showed minimal improvement in their practical skills throughout the study period. The slight increase in their skill scores immediately after the intervention was not significant, and their skill levels remained low at eight weeks post-intervention. This stagnation underscores the necessity of comprehensive training programs to enhance practical skills in critical medical procedures.

The study's strength lies in its use of an appropriate study design and population, which are well-suited to the research objectives. Additionally, probability sampling techniques were employed to select a representative sample. However, a limitation of the study is its short duration; the research was conducted over a four-month period, which did not allow for assessing retention levels beyond an eight-week timeframe.

Inferential statistical measures identified significant differences between the experimental

and control groups' skill levels post-intervention, which highlights the efficacy of the educational intervention. The intervention provided the experimental group with not just theoretical knowledge but also practical competencies, which are crucial for the effective management of postpartum haemorrhage using UBT.

Keeping in view the findings of this current study, Sheshi et al. (2023) (10) reported poor practices in the use of uterine tamponade for severe PPH due to inadequate training and the non-availability of devices. This aligns with the pre-intervention phase, where both the experimental and control groups exhibited similar levels of practical skills, emphasizing the need for effective training interventions. The post-intervention results, especially the substantial improvement in the experimental group, support the recommendation for comprehensive training and retraining sessions to ensure proficiency among healthcare professionals (5). The current study supports this recommendation by demonstrating that the intervention led to a significant improvement in practical skills related to UBT. The control group, while showing some improvement, still had a majority with low practical skills, indicating the importance of focused interventions for skill enhancement.

The study by Natarajan et al. (2017) (11) in Sierra Leone provides qualitative insights into healthcare providers' experiences with UBT. The reported challenges in UBT use, such as insufficient training and practical experience, resonate with the findings of this study, where the control group's improvement was more modest. Furthermore, facilitators in the study by Natarajan et al. (2017) study, highlighted the need for comprehensive training and ready availability of UBT devices, aligning with the positive impact of the intervention seen in the experimental group in this study.

Furthermore, the survey conducted by Altawil et al. (2017) (12) in the United States reveals that a significant proportion of healthcare providers desire training on the use of UBT. This aligns with the current study's emphasis on the positive influence of the intervention, suggesting that training plays a crucial role in enhancing practical skills related to UBT. The current study's results, particularly the substantial improvement in practical skills in the experimental group post-intervention, resonate with the providers' expressed need for training. It reinforces the idea that effective training interventions can lead to improved skills in managing uncontrolled PPH with UBT.

Gauchotte's study (13) highlighted poor practices in using uterine tamponade for severe PPH due to inadequate training and limited device availability, which mirrors the findings in the pre-intervention phase of the current study, where both experimental and control groups displayed similar skill levels. However, the post-intervention results showed a significant improvement in the experimental group, reinforcing the need for comprehensive training to enhance healthcare professionals' proficiency in uterine balloon tamponade (UBT).

Conclusion

The study concluded that the educational intervention significantly improves midwives' skills in using uterine balloon tamponade to manage postpartum haemorrhage. Participants in the experimental group showed a notable and persistent increase in their understanding and application of UBT, highlighting the intervention's immediate and long-lasting impact. In contrast, the control group's minimal gains underscored the intervention's critical role in deepening the comprehension and expertise in UBT usage. Furthermore, the experimental group maintained their enhanced skills up to the 8th week post-intervention, confirming the intervention's sustained effectiveness.

Recommendations

Healthcare institutions and regulatory bodies should collaborate to establish and maintain ongoing training programs for midwives, focusing on uterine balloon tamponade techniques. Regular and comprehensive training sessions will ensure that healthcare professionals are proficient in the correct application of UBT devices, addressing the observed challenges related to insufficient training reported in the literature.

Academic institutions, in collaboration with healthcare organizations, should prioritize UBT training for midwives, as indicated by the literature's findings that a significant number of providers desire training on the use of UBT.

Healthcare institutions and regulatory bodies should establish regular competency assessments for midwives, specifically focusing on practical skills related to UBT. Regular evaluations will ensure that midwives maintain and continually improve their skills, aligning with the study's emphasis on the significant and lasting impact of the intervention on practical skills.

List of Abbreviations

FIGO: International Federation of Gynaecologists and Obstetrics
BUHREC: Babcock University Health Research Ethical Certificate
MMR: Maternal Mortality Rate
PPH: Postpartum Haemorrhage
UBT: Uterine Balloon Tamponade

WHO: World Health Organization

Declarations

Ethical approval and consent to participate

Ethical approvals for the study were obtained from the Babcock University Health Research Ethical Approval Committee (BUHREC 656/23) and the Ogun State Health Research Ethics Committee (OGHREC/467/204/APP). Approval was sought from the primary healthcare coordinators and apex nurses in each local government to proceed with the study. Two research assistants were recruited and trained. The participants' informed consent was obtained. Separate meetings were organized for the experimental and control groups.

Consent for publication

All the authors gave consent for the publication of the work under the Creative Commons Attribution- Non-Commercial 4.0 license.

Availability of data and materials

The data and materials associated with this research will be made available by the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Nil.

Author contributions

The study was conceived and designed by AFO, who also conducted the experiments and analysed the data, while OO supervised the study and revised the manuscript. Both authors reviewed and approved the final version. The final draft was read and approved by all the authors.

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Not applicable.

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