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Effect of a Culturally Adapted Birth Preparedness and Complication Readiness Training Intervention on Attitudes and Practices among Hehe Pregnant Women in Rural Iringa, Tanzania: A Controlled Pretest–Posttest Quasi-Experimental Study

Rosalia B. Mwenda[1]

rosemwenda98@yahoo.com

The University of Dodoma

Saada Seif

The University of Dodoma

Rehema Stephano

The University of Dodoma

Fabiola Moshi

The University of Dodoma

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Abstract

Background

Birth preparedness and complication readiness (BPCR) are important components of maternal health, yet educational interventions may be less effective when health messages are not culturally and linguistically relevant. This study evaluated the effect of a culturally adapted BPCR training intervention on attitudes and practices among Hehe pregnant women in rural Iringa, Tanzania.

Methods

A controlled pretest–posttest quasi-experimental study was conducted among 176 pregnant women attending antenatal care. Participants were allocated to a Culturally Adapted BPCR Training group (n = 88) or a Standard Translated BPCR Training group (n = 88). BPCR attitudes and practices were assessed before and four weeks after the intervention. Within-group changes were assessed using paired-samples *t*-tests, between-group differences using independent-samples *t*-tests, and intervention effects using Difference-in-Differences regression. Adjusted linear regression was also used to examine factors associated with post-test outcomes.

Results

The 176 participants had a mean age of 26.47 ± 6.13 years. At baseline, practice scores did not differ significantly between groups (7.41 ± 2.25 vs. 7.85 ± 1.78, $p = 0.150$), whereas attitude scores were lower in the intervention group (21.58 ± 3.47 vs. 24.69 ± 5.11, $p < 0.001$). At post-test, practice scores were higher in the intervention group (9.60 ± 1.40 vs. 9.03 ± 1.58, $p = 0.012$), while attitude scores were similar between groups (24.41 ± 4.31 vs. 24.86 ± 4.31, $p = 0.482$). The DiD analysis showed significantly greater improvements in attitudes (β = 2.55, 95% CI: 0.74–4.35, $p = 0.006$) and practices (β = 0.99, 95% CI: 0.24–1.74, $p = 0.010$) in the culturally adapted group. In adjusted regression, intervention assignment was associated with higher post-test practice scores (β = 0.658, 95% CI: 0.203–1.112, $p = 0.005$), but not with post-test attitude scores (β = −0.137, 95% CI: −1.509–1.235, $p = 0.844$).

Conclusions

Culturally Adapted BPCR education was associated with greater improvements in attitudes and practices than Standard Translated education among Hehe pregnant women in rural Tanzania. These findings support consideration of cultural and linguistic adaptation when developing BPCR education for culturally distinct populations. However, the findings should be interpreted in light of the quasi-experimental design, district-level allocation, baseline imbalance in attitudes, short follow-up, and the inability to directly assess mechanisms underlying the observed changes.

Trial Registration

Pan African Clinical Trials Registry PACTR202607626025411, registered retrospectively on 09 July 2026 https://pactr.samrc.ac.za

Background

Maternal and neonatal mortality remain major public health challenges, particularly in low- and middle-income countries. Globally, an estimated 260,000 women die from maternal causes, equivalent to more than 700 deaths every day, corresponding to a maternal mortality ratio of 197 deaths per 100,000 live births (1, 2). The burden remains disproportionately concentrated in sub-Saharan Africa, which accounted for approximately 70% of global maternal deaths, with an estimated maternal mortality ratio of 454 deaths per 100,000 live births (1, 2). Tanzania also continues to experience a substantial maternal health burden despite improvements in access to antenatal and maternity services. The national maternal mortality ratio was estimated at 104 deaths per 100,000 live births (3). Also, 90% of births were attended by skilled birth attendants (3), and 78% of pregnant women went to at least one antenatal care visit (4). Maternal deaths are commonly associated with delays in recognizing complications, deciding to seek appropriate care, reaching health facilities, and receiving adequate treatment after arrival (5, 6).

Birth preparedness and complication readiness (BPCR) is an established approach for promoting readiness for childbirth and potential obstetric emergencies. It encourages pregnant women and their families to plan for skilled birth attendance, transportation, financial resources, blood donors, and other requirements for emergency care (7–10). By addressing some of the factors underlying delays in seeking and reaching appropriate care, BPCR may contribute to timely care-seeking and preparedness for childbirth and complications. However, providing BPCR information alone may not translate into positive attitudes or consistent preparedness and care-seeking practices. Studies in Tanzania and other sub-Saharan African countries have reported gaps in birth preparedness and complication-readiness practices (11–14).

The effectiveness of maternal health education may depend on how well information reflects women's cultural and linguistic contexts. Culturally responsive communication incorporates locally meaningful terminology, examples, and explanations that may improve engagement, acceptance, confidence, and implementation of recommended practices (15–18). When health messages are culturally and linguistically meaningful, they may be more readily accepted and incorporated into decisions and practices related to childbirth preparedness and care-seeking. This approach may be particularly relevant among Hehe communities in rural Iringa, where Kihehe remains an important linguistic and cultural reference alongside Swahili (19).

The Health Belief Model provides a useful framework for understanding attitudes and practices related to BPCR through constructs such as perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy (20, 21). The framework is therefore relevant for interpreting how culturally responsive BPCR education may influence attitudes and practices.

Despite widespread BPCR education through antenatal care, evidence remains limited on whether culturally adapted materials are associated with greater improvements in BPCR attitudes and practices than standard translated materials in rural Tanzania. Few studies have directly compared a Culturally Adapted Swahili BPCR Training Manual with a Standard Translated Swahili BPCR Training Manual under comparable educational conditions.

Therefore, this study aimed to evaluate the effect of a previously prepared Culturally Adapted Swahili BPCR Training Manual, compared with a Standard Translated Swahili BPCR Training Manual, on BPCR attitudes and practices among Hehe pregnant women attending antenatal care in the rural Iringa Region, Tanzania.

Methods

Study Design and Setting

A controlled pretest–posttest quasi-experimental study was conducted to evaluate two previously prepared BPCR educational packages. The intervention group received the Culturally Adapted Swahili BPCR Training Manual, whereas the control group received the Standard Translated Swahili BPCR Training Manual.

The study was guided by the Health Belief Model. The educational intervention emphasized understanding pregnancy and childbirth complications, recognizing danger signs, the importance of advance preparation, the benefits of timely care-seeking, and actions to overcome barriers to obtaining appropriate maternal healthcare (20).

The study was conducted in Kilolo and Mufindi districts of Iringa Region, southern Tanzania. The area is predominantly rural and largely inhabited by the Hehe population. Maternal healthcare services are provided through dispensaries, health centers, and hospitals, with antenatal care serving as an important entry point to the health system (22). Baseline data were collected from 18 to 21 November 2025, and post-intervention data were collected from 16 to 19 December 2025. One district was designated as the intervention district and the other as the control district. The geographical separation of the study arms was intended to reduce information exchange and contamination between participants receiving the different educational packages.

Participants

Eligible participants were pregnant women attending antenatal care at selected public health facilities who were in the first or second trimester, belonged to the Hehe population, had resided in the Iringa Region for at least six months, were willing to participate, and provided informed consent.

Women in the third trimester were excluded because the study required sufficient time to participate in the educational intervention and complete the subsequent follow-up assessment. Women employed in the health sector were excluded because of their potential prior exposure to maternal health education. Women enrolled in other research or health programs that could interfere with the intervention were also excluded. Participants who developed serious medical or obstetric conditions that prevented continued participation during the study period were excluded from further participation.

Sample Size and Sampling

The sample size was estimated using WinPEPI version 11.65, developed by Abramson in 2011, based on a comparison of mean BPCR knowledge scores between two independent groups, using a two-sided significance level of 0.05 and 80% statistical power (23). The expected difference in BPCR knowledge scores and estimates of outcome variability were informed by a previous quasi-experimental BPCR intervention study conducted in Indonesia by Astika et al. (24).

The previous study reported a mean BPCR knowledge score of 38.5 (SD 5.2) in the intervention group and 32.7 (SD 3.4) in the control group, corresponding to an expected mean difference of 5.8 points. These estimates

were used as the expected outcome means and variability parameters in the WinPEPI calculation. The calculation produced a minimum required sample size of 164 participants. A total of 176 pregnant women were recruited, comprising 88 participants in the intervention group and 88 in the control group.

Sampling Technique and Procedure

A multistage sampling procedure was used to select study sites and participants. The sampling process involved five stages: selection of districts, divisions, wards, villages, and participants. Three rural districts in the Iringa Region were eligible for inclusion, from which two districts were randomly selected using simple random sampling. The two selected districts were Mufindi and Kilolo. Mufindi was assigned to the intervention group, while Kilolo was assigned to the control group. The intervention district received the Culturally Adapted Swahili BPCR Training Manual, whereas the control district received the Standard Translated Swahili BPCR Training Manual. Within each selected district, divisions, wards, and villages were selected using simple random sampling. Eligible pregnant women were then identified from antenatal care registers and selected using systematic random sampling.

Stage 1: Selection of districts

Three rural districts in the Iringa Region were eligible for inclusion. Two districts, Mufindi and Kilolo, were randomly selected using simple random sampling. Mufindi was assigned to the intervention group, while Kilolo was assigned to the comparison group. The intervention district received the Culturally Adapted Swahili BPCR Training Manual, whereas the comparison district received the Standard Translated Swahili BPCR Training Manual. Thus, each study condition was represented by one district.

Stage 2: Selection of divisions

Each selected district had four divisions. Two divisions were selected from each district using simple random sampling through a lottery method, resulting in four selected divisions. An independent person conducted the random selection. The selected divisions formed the sampling units for subsequent ward selection.

Stage 3: Selection of wards

Two wards were selected from each of the four selected divisions using simple random sampling through a lottery method, resulting in eight selected wards. An independent person conducted the random selection of wards from each selected division.

Stage 4: Selection of villages

Two villages were selected from each of the eight selected wards using simple random sampling through a lottery method, resulting in 16 selected villages. An independent person conducted the random selection. Eight villages were therefore selected from the intervention district and eight from the comparison district. The 16 selected villages constituted the geographical sampling units for participant recruitment.

Stage 5: Selection of participants

Public dispensaries providing antenatal care services to women from the selected villages were identified as participant recruitment sites, and all eligible dispensaries serving the selected villages were included. Pregnant women attending antenatal care at the selected dispensaries were assessed for eligibility using the predefined inclusion and exclusion criteria. Eligibility, including self-identification as Hehe, was confirmed with each woman before recruitment.

A total of 176 participants were recruited, with 11 participants selected from each of the 16 selected villages. Thus, eight intervention villages contributed 88 participants, and eight comparison villages contributed 88 participants. Eligible women were selected using systematic random sampling. For each village, the sampling interval (k) was calculated as k = N/n, where N represented the total number of eligible pregnant women in the sampling frame and n represented the target sample of 11 participants. A random starting participant was selected, followed by every kth eligible woman until 11 participants were recruited from each village. The same procedure was applied in both intervention and comparison villages.

Data Collection Procedures

Baseline data were collected from 18 to 21 November 2025 before delivery of the educational intervention. Trained research assistants who were experienced midwives conducted face-to-face interviews in private and quiet areas of the participating antenatal care clinics. Each interview lasted approximately 15–20 minutes. Research assistants received standardized training on questionnaire administration, ethical procedures, interview techniques, confidentiality, and neutrality. Personnel responsible for intervention delivery were separate from those responsible for outcome assessment. Participants were assigned unique identification numbers, and names were not recorded on the study questionnaires.

Post-intervention data were collected from 16 to 19 December 2025, four weeks after baseline assessment, using the same questionnaire and data collection procedures.

Data Collection Instrument

A structured questionnaire adapted from standardized BPCR monitoring tools developed by the Johns Hopkins Program for International Education in Gynecology and Obstetrics (JHPIEGO) was used (10). The questionnaire collected sociodemographic and obstetric characteristics and assessed BPCR knowledge across key domains, including birth preparedness, danger signs during pregnancy, labor and childbirth, the postnatal period, and newborn danger signs.

BPCR Attitudes

Attitudes toward BPCR were assessed using 15 statements measured on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). The total attitude score therefore ranged from 15 to 75, with higher scores indicating more favorable attitudes toward BPCR.

BPCR Practices

BPCR practices were assessed using 12 dichotomous items covering recommended birth-preparedness and complication-readiness behaviors. Each recommended practice was scored 1 when reported as undertaken and

0 when not undertaken. The total practice score ranged from 0 to 12, with higher scores indicating greater engagement in recommended BPCR practices. The three outcome measures were treated as continuous scores in the analyses.

Validity and Reliability

The questionnaire was adapted from standardized BPCR assessment tools previously used in maternal health research and monitoring surveys among women in low- and lower-middle-income countries, including Tanzania (10). Similar BPCR assessment tools have also been used in Malaysia, where the attitude scale demonstrated a Cronbach's alpha of 0.72 (25), and in Ethiopia, where a Cronbach's alpha of 0.85 was reported (26).

The questionnaire underwent translation, expert review, and pretesting before use in the study. The English questionnaire was translated into Swahili by bilingual experts. Independent back-translation was subsequently undertaken, and discrepancies between the original and translated versions were reviewed and resolved by the research team and language experts.

Pretesting was conducted among pregnant women outside the study area to assess clarity, comprehensibility, and appropriateness of the questionnaire. Internal consistency was assessed using the data collected in the present study. Because practice items were dichotomously scored, the Kuder–Richardson Formula 20 (KR-20) was used for these scales, while Cronbach's alpha was used for the attitude scale. The practice scale demonstrated a KR-20 coefficient of 0.64. The latter was considered acceptable for a relatively short scale measuring specific behavioral practices and intended primarily for group-level comparisons.

Study Variables

The primary independent variable was study group assignment, categorized as the intervention group receiving the Culturally Adapted Swahili BPCR Training Manual and the control group receiving the Standard Translated Swahili BPCR Training Manual. Additional participant characteristics considered as covariates included maternal age, gestational age, gravidity, marital status, living arrangement, educational level, reading ability, and occupation.

The three dependent variables were BPCR knowledge, BPCR attitudes, and BPCR practices. Knowledge was operationalized as the total score from 0 to 64. Attitudes were operationalized as the total score from 15 to 75. Practices were operationalized as the total score from 0 to 12. Higher scores represented better knowledge, more favorable attitudes, and greater engagement in recommended BPCR practices.

Implementation of the Educational Packages

The two educational packages evaluated in this study had been prepared before the present evaluation. The present study focused on their implementation, evaluation, and comparative effects on BPCR outcomes.

Culturally Adapted Swahili BPCR Training Manual

After completion of the baseline assessment, participants in the intervention group received the Culturally Adapted Swahili BPCR Training Manual. Each session was facilitated by one trained intervention trainer using the training manual, timetable, and corresponding Swahili lesson plan. Each session lasted approximately two hours, comprising approximately one hour of structured facilitation and one hour of interactive discussion, questions, and answers, as specified in the implementation timetable. The sessions were delivered face-to-face

in Swahili using an interactive participatory approach. The trainer directly delivered the culturally adapted BPCR content, incorporating culturally adapted terminology, contextual explanations, and visual representations developed for the local Hehe context. Participants were encouraged to ask questions, discuss the meanings of BPCR concepts, and relate the information to their own experiences and local context. For concepts without direct culturally equivalent terminology, such as "blue baby" and "cord prolapse," the trainer used visual aids together with clear explanatory descriptions and interactive discussion to facilitate participants' understanding and learning.

Participants were encouraged to ask questions and discuss issues related to the session content. The trainer provided clarification in Swahili to support comprehension and active participation. At the end of the education session, the trainer informed participants of the scheduled four-week follow-up assessment, which coincided with their next scheduled monthly antenatal care visit, and the date was recorded in their clinic cards as a reminder. After completing the education session, participants received their routine antenatal care services from a midwife at the health facility.

Standard Translated Swahili BPCR Training Manual

Participants in the control group received the previously prepared Standard Translated Swahili BPCR Training Manual. The control group received one approximately two-hour, face-to-face group education session. The session covered the same core BPCR subject areas as the intervention group, including birth preparedness, danger signs, skilled birth attendance, emergency preparedness, antenatal care, and timely healthcare-seeking. The session was delivered in Swahili using a participatory approach.

The teaching format and approximate duration were similar between the two study arms. The principal distinction between the two conditions was the educational package used: the intervention group received the Culturally Adapted Swahili BPCR Training Manual, whereas the control group received the Standard Translated Swahili BPCR Training Manual. At the end of the education session, the trainer informed participants of the scheduled four-week follow-up assessment, which coincided with their next scheduled monthly antenatal care visit, and the date was recorded in their clinic cards as a reminder. After completing the education session, participants received their routine antenatal care services from a midwife at the health facility.

Evaluation Phase

Four weeks after implementation of the assigned educational package, a post-intervention assessment was conducted among participants in both groups from 16 to 19 December 2025. The same structured questionnaire and face-to-face interview method used at baseline were applied at the post-intervention assessment. However, different research assistants conducted the post-intervention assessment from those who conducted the baseline assessment. The assessment was conducted at the participating antenatal care facilities in private and quiet areas. The same procedures for questionnaire administration, confidentiality, and participant identification used at baseline were maintained during the post-intervention assessment.

Intervention Fidelity and Contamination Control

The intervention and control sessions were delivered separately at different locations on the same dates. Trainers assigned to the intervention group did not participate in delivery of the control educational sessions. Data collectors were separate from the trainers and were not involved in delivery of either educational package.

Different data collectors were used for the post-test assessment from those who conducted the baseline assessment. The researcher provided overall supervision and administrative oversight of the study, including distribution of questionnaires and provision of financial, stationery, and technical support, but did not administer the questionnaires, deliver either educational package, or participate in baseline or post-test data collection.

To minimize contamination, the intervention and control groups were implemented in geographically separate districts. Outcome assessment was conducted by research assistants who were not involved in the delivery of either educational package and not involved in the baseline. The same questionnaire, assessment schedule, and researcher-administered questionnaire procedures were used in both groups.

Data Analysis

Data were analyzed using IBM Statistical Package for the Social Sciences (SPSS) version 27. Descriptive statistics were used to summarize participant characteristics and study outcomes. Continuous variables were summarized using means and standard deviations, while categorical variables were summarized using frequencies and percentages. The distribution of continuous outcome variables was assessed before inferential analysis, and parametric methods were used when the relevant assumptions were considered acceptable.

Baseline characteristics of the intervention and control groups were compared using independent-samples t-tests for continuous variables and chi-square tests for categorical variables. These comparisons were used to describe baseline characteristics and assess differences between the study groups before the intervention.

Difference-in-Differences Analysis

The primary analysis used a Difference-in-Differences regression approach to estimate whether changes in BPCR outcomes from baseline to four-week follow-up differed between the intervention and control groups. The study group was coded as 0 for the control group and 1 for the intervention group, while time was coded as 0 for baseline and 1 for post-intervention. For each outcome, the model included the study group, time, and the Group × Time interaction:

$$\textbf{Outcome} = \beta_0 + \beta_1\,(\textbf{Group}) + \beta_2\,(\textbf{Time}) + \beta_3\,(\textbf{Group} \times \textbf{Time}) + \varepsilon$$

The Group × Time interaction coefficient (β_3) represented the DID estimate and therefore the difference in change in the outcome between the intervention and control groups. Separate models were fitted for BPCR knowledge, attitudes, and practices. Standard errors and 95% confidence intervals were adjusted using the regression estimation procedure applied in the analysis.

Adjusted Analysis

Because BPCR knowledge, attitude, and practice were analyzed as continuous outcomes, multiple linear regression models were fitted to examine whether intervention-group assignment was associated with post-intervention outcomes after adjustment for baseline outcome scores and selected covariates. Separate models were fitted for BPCR knowledge, attitudes, and practices. Each model included a study group, the corresponding baseline outcome score, maternal age, educational level, gravidity, marital status, occupation, living

arrangement, and reading ability. Adjusted regression coefficients were reported with 95% confidence intervals and p-values.

Statistical significance was set at $p < 0.05$. No missing outcome data were identified; therefore, no imputation procedures were required. No post-hoc subgroup or sensitivity analyses were conducted.

Ethical Considerations

As the study involved human participants, ethical clearance was obtained from the Research Review Committee of the Research and Publication Office at the University of Dodoma prior to data collection (reference number MA.84/261/86/11). All procedures involving human participants were conducted in accordance with institutional ethical standards and the principles of the Declaration of Helsinki.

Permission to conduct the study in the Iringa Region was obtained from the Permanent Secretary, President's Office, Regional Administration and Local Government (reference number AB.307/323/01"R"/70). Permission to collect data in the Iringa Region was also obtained from the Iringa Regional Secretary (reference number Na.FA.225/265/01/J/281). Permission to conduct the study in Mufindi and Kilolo districts was obtained from the respective district directors. The permission reference number for Mufindi District was Na. HW/MUF/S.40/43/VOL.IV/39, and that for Kilolo District was Na. KDC/S.10/4/VOLL.VIII/193. Permission to use the antenatal care guidelines for the study was obtained from the Ministry of Health (reference number PA.104/282/02).

Written informed consent was obtained from all participants before inclusion in the study. Participants were informed about the purpose and procedures of the study, potential benefits, and the voluntary nature of participation. They were informed that they could withdraw from the study at any time without affecting their access to healthcare services. Confidentiality and privacy were maintained throughout the study by assigning unique identification numbers instead of recording participants' personal names.

Cultural respect and sensitivity were observed throughout all stages of the study to ensure that the training content, delivery, and implementation were culturally appropriate and did not conflict with participants' beliefs, values, or customary practices.

Results

A total of 176 pregnant women were enrolled, with 88 participants allocated to the Culturally Adapted BPCR Training Manual intervention group and 88 allocated to the Standard Translated BPCR Training Manual control group. All enrolled participants received the assigned educational program and completed both baseline and post-intervention assessments. There were no losses to follow-up or exclusions after allocation, and all 176 participants were included in the final analysis. No adverse events or unintended consequences related to the educational interventions were reported in either group.

Sociodemographic characteristics of study participants

Table 1 presents the baseline sociodemographic and obstetric characteristics of the 176 study participants by study group. Most participants were aged 20–34 years, were between 13 and 24 weeks of gestation, were

multigravida, were married, and were living with a partner. The majority had primary education, reported reading easily, and were engaged in farming as their main occupation (Table 1).

Table 1
Baseline sociodemographic characteristics of pregnant women by study group (N = 176).

Variables	Category	Intervention (n = 88) n %)	Control (n = 88) n (%)
Age (years) Mean ± SD (Min-Max)		26.50 ± 6.35 (18–44)	26.38 ± 5.89 (18–42)
	< 20	15 (17.0)	13 (14.8)
	20–34	60 (68.2)	65 (73.9)
	≥ 35	13 (14.8)	10 (11.4)
Gestational age (months) Mean ± SD (Min-Max)		4.80 ± 1.13 (2–6)	4.53 ± 1.29 (2–6)
	≤12 weeks	11 (12.5)	20 (22.7)
	13–24 weeks	77 (87.5)	68 (77.3)
Gravidity			
	Primigravida	21 (23.9)	10 (11.4)
	Multigravida	67 (76.1)	78 (88.6)
Marital status			
	Single	15 (17.0)	8 (9.1)
	Married	73 (83.0)	80 (90.9)
Living with a partner			
	No	18 (20.5)	10 (11.4)
	Yes	70 (79.5)	78 (88.6)
Educational level			
	Primary education	57 (64.8)	64 (72.7)
	Secondary education and above	31 (35.2)	24 (27.3)
Reading ability	Easily	82 (93.2)	86 (97.7)
	With difficulty	6 (6.8)	2 (2.3)
Occupation	Peasant	78 (88.6)	80 (90.9)
	Business woman/employed	10 (11.4)	8 (9.1)

Baseline comparison of attitudes and practices between intervention and control groups

The mean practice score was 7.41 ± 2.25 in the intervention group compared with 7.85 ± 1.78 in the control group, and the difference was not statistically significant (mean difference = − 0.44, p = 0.150). However, the intervention group had a significantly lower mean attitude score than the control group (21.58 ± 3.47 vs. 24.69 ± 5.11; mean difference = − 3.11, p < 0.001). Thus, the groups were comparable at baseline with respect to practice, but a statistically significant baseline difference was observed in attitude scores (Table 2).

Table 2
Baseline comparison of attitudes and practice between intervention and control groups of pregnant women (N = 176)

	Intervention (n = 88)	**Control (n = 88)**		
	Mean ± SD	**Mean ± SD**	**Mean difference**	**P-value**
Attitudes	21.58 ± 3.47	24.69 ± 5.11	-3.11	< 0.001
Practice	7.41 ± 2.25	7.85 ± 1.78	-0.44	0.150

Note: Mean difference represents the difference between the intervention and control groups (intervention − control). Independent-samples t-tests were used to compare baseline mean scores between groups.

Post-intervention comparison of BPCR attitudes and practices between intervention and control groups

The intervention group also had significantly higher mean practice scores than the control group (9.60 ± 1.40 vs. 9.03 ± 1.58; mean difference = 0.57, p = 0.012). In contrast, mean attitude scores did not differ significantly between the intervention and control groups (24.41 ± 4.31 vs. 24.86 ± 4.31; mean difference = − 0.45, p = 0.482) (Table 3).

Table 3
Post-intervention comparison of BPCR attitudes and practices between intervention and control groups of pregnant women (N = 176).

	Intervention (n = 88)	**Control (n = 88)**		
	Mean ± SD	**Mean ± SD**	**Mean difference**	**P-Value**
Attitudes	24.41 ± 4.31	24.86 ± 4.31	− 0.45	0.482
Practices	9.60 ± 1.40	9.03 ± 1.58	0.57	0.012

The mean difference represents the difference between the intervention and control groups (intervention − control). Independent-samples t-tests were used to compare post-intervention scores between groups.

Within-group comparison of birth BPCR attitudes and practices before and after the intervention

Within-group comparisons showed significant improvements in attitudes and practices in the intervention group following the intervention. Attitude scores increased from 21.58 ± 3.47 at pretest to 24.41 ± 4.31 at posttest, representing a mean increase of 2.83 points (t = 4.825, p < 0.001). Practice scores also increased from 7.41 ± 2.25 to 9.60 ± 1.40, representing a mean increase of 2.19 points (t = 8.483, p < 0.001).

In the control group, practice scores increased from 7.85 ± 1.78 at pretest to 9.06 ± 1.58 at posttest, representing a mean increase of 1.20 points (t = 5.448, p < 0.001). However, the change in attitude scores from 24.69 ± 5.11 to 24.98 ± 4.19 was not statistically significant (mean increase = 0.28, t = 0.441, p = 0.660) (Table 4).

Table 4
Within-group comparison of birth BPCR attitudes and practices before and after the intervention of pregnant women (N = 176).

Attitudes	Group	Posttest Mean ± SD	Pretest Mean ± SD	Mean difference (posttest − pretest)	t	P-Value
	Intervention	24.41 ± 4.31	21.58 ± 3.47	2.83	4.825	< 0.001
	Control	24.98 ± 4.19	24.69 ± 5.11	0.28	0.441	0.660
Practices						
	Intervention	9.60 ± 1.40	7.41 ± 2.25	2.19	8.483	< 0.001
	Control	9.06 ± 1.58	7.85 ± 1.78	1.20	5.448	< 0.001

Note: Mean difference represents the change in score from pretest to posttest (posttest − pretest). Paired-samples t-tests were used to assess within-group changes. A positive mean difference indicates an increase in scores from pretest to posttest. p < 0.001 indicates a statistically significant change.

Factors Associated with Post-test BPCR Attitude Scores

In the adjusted multiple linear regression analysis, assignment to the intervention group was not significantly associated with post-test attitude scores (β = −0.137, 95% CI: −1.509–1.235, *p* = 0.844). None of the other variables included in the model was significantly associated with post-test attitude scores (Table 5).

Table 5
Adjusted multiple linear regression analysis of factors associated with post-test attitude scores among pregnant women (N = 176)

Variable	Category	Coefficient (β)	Std. Error	t-value	P-value	95% CI	
						Lower	Upper
Group	Intervention	-0.137	0.695	-0.20	0.844	-1.509	1.235
Education	Secondary and above	-0.440	0.710	-0.62	0.536	-1.841	0.962
Attitudes (Pre-test)	Continuous	0.108	0.075	1.44	0.152	-0.040	0.255
Gravidity	Multigravida	-0.468	1.065	-0.44	0.661	-2.571	1.636
Marital Status	Married	3.805	2.096	1.82	0.071	-0.333	7.943
Living with Partner	Yes	-3.610	2.003	-1.80	0.073	-7.565	0.345
Reading Ability	Easily	2.751	1.562	1.76	0.080	-0.333	5.835
Occupation	Business/employed woman	-1.667	1.090	-1.53	0.128	-3.819	0.485
Age	20–34 years	-0.180	1.018	-0.18	0.860	-2.190	1.830
	≥ 35 years	0.228	1.337	0.17	0.865	-2.411	2.868
Constant	—	20.164	2.679	7.53	< 0.001	14.875	25.453

Note: β = regression coefficient; CI = confidence interval. *P* < 0.05 was considered statistically significant.

Factors associated with post-test BPCR practice scores

In the adjusted multiple linear regression analysis, assignment to the intervention group was significantly associated with higher post-test BPCR practice scores (β = 0.658, 95% CI: 0.203 to 1.112, P = 0.005). Higher pre-test practice scores were also significantly associated with higher post-test practice scores (β = 0.119, 95% CI: 0.003 to 0.234, P = 0.044). None of the other variables included in the model was significantly associated with post-test BPCR practice scores (Table 6).

Table 6
Adjusted multiple linear regression analysis of factors associated with post-test practice scores among pregnant women (N = 176)

Variable	Category	Coefficient (β)	Std. Error	t-value	P-value	95% CI	
						Lower	Upper
Group	Intervention	0.658	0.230	2.86	0.005	0.203	1.112
Education	Secondary and above	-0.179	0.247	-0.73	0.469	-0.668	0.309
Practice (Pre-test)	Continuous	0.119	0.058	2.03	0.044	0.003	0.234
Gravidity	Multigravida	-0.086	0.370	-0.23	0.816	-0.817	0.645
Marital Status	Married	0.460	0.732	0.63	0.531	-0.986	1.905
Living with Partner	Yes	-0.134	0.699	-0.19	0.848	-1.514	1.246
Reading Ability	Easily	0.059	0.545	0.11	0.914	-1.017	1.136
Occupation	Business/employed woman	-0.223	0.378	-0.59	0.557	-0.969	0.524
Age	20–34 years	0.537	0.363	1.48	0.141	-0.180	1.255
	≥ 35 years	0.184	0.478	0.38	0.701	-0.759	1.127
Constant	—	7.497	0.746	10.05	< 0.001	6.024	8.971

Note: β = regression coefficient; CI = confidence interval. P < 0.05 was considered statistically significant. Reference categories were used for categorical variables.

Difference-in-Differences regression analysis of the effect of culturally adapted BPCR training on attitudes and practices.

The Difference-in-Differences regression analysis showed that the culturally adapted BPCR training was associated with significantly greater improvements in BPCR attitudes and practices in the intervention group compared with the control group. Significant Group × Time effects were observed for attitudes (β = 2.55, 95% CI: 0.74–4.35, p = 0.006) and practices (β = 0.99, 95% CI: 0.24–1.74, p = 0.010), indicating greater improvements in these outcomes among participants receiving the culturally adapted training. Overall, the findings suggest that the culturally adapted BPCR training was associated with improvements across all two BPCR outcomes: attitudes and practices (Table 7).

Table 7
Difference-in-Differences regression analysis of the effect of culturally adapted BPCR training on attitudes and Practices among pregnant women (N = 176)

Variable	Coefficient	Std. Error	t	P-value	95% CI	
					Lower	Upper
Attitudes						
Variable	**Coefficient**	**Std. Error**	**t**	**P-value**	**95% CI**	
Group: Intervention	-3.113636	.6501038	-4.79	< 0.001	− 4.392263	-1.835009
Time: Post	.2840909	.6501038	0.44	0.662	-0.994536	1.562718
Group × Time	2.545455	.9193856	2.77	0.006	.737203	4.353706
Constant	24.69318	.4596928	53.72	< 0.001	23.78906	25.59731
Practice						
Variable	**Coefficient**	**Std. Error**	**t**	**P-value**	**95% CI**	
Group: Intervention	− .443	.268533	-1.65	0.100	− .9713336	.08497
Time: Post	1.204545	.268533	4.49	**< 0.001**	.6763937	1.732697
Group × Time	.9886364	.379763	2.60	0.010	.2417169	1.735556
Constant	7.852273	.1898815	41.35	< 0.001	7.478813	8.225732

Note: The group was coded as 0 = control and 1 = intervention. The Group × Time coefficient represents the difference-in-differences estimate of the intervention effect. Positive coefficients indicate greater improvement in the intervention group than in the control group.

Estimated marginal means of attitudes and practices by group and time

The estimated marginal means showed improvements in all two BPCR outcomes from pre- to post-intervention in both groups. Attitude scores increased from 21.58 to 24.41 in the intervention group, whereas only a slight increase was observed in the control group, from 24.69 to 24.98. Similarly, practice scores increased from 7.41 to 9.60 in the intervention group and from 7.85 to 9.06 in the control group. Overall, the intervention group demonstrated greater improvements in attitudes and practices than the control group, as shown by the estimated marginal means in (Table 8).

Table 8
Estimated marginal means of BPCR attitudes, and practices by group and time among pregnant women (N = 176).

Attitudes:						**95% CI**	
Group	**Time**	**Margin**	**Std. Error**	**t-value**	**P-value**	**Lower**	**Upper**
Control	Pre	24.69318	0.4596928	53.72	< 0.001	23.78906	25.59731
Control	Post	24.97727	0.4596928	54.33	< 0.001	24.07315	25.8814
Intervention	Pre	21.57955	0.4596928	46.94	< 0.001	20.67542	22.48367
Intervention	Post	24.40909	0.4596928	53.10	< 0.001	23.50497	25.31322
Practice:							
Control	Pre	7.852273	.1898815	41.35	< 0.001	7.478813	8.225732
Control	Post	9.056818	.1898815	47.70	< 0.001	8.683358	9.430278
Intervention	Pre	7.409091	.1898815	39.02	< 0.001	7.035631	7.782551
Intervention	Post	9.602273	.1898815	50.57	< 0.001	9.228813	9.975732

Note: Estimated marginal means are presented with standard errors and 95% confidence intervals. The Group × Time interaction represents the difference-in-differences estimate of change between the intervention and control groups.

Discussion

The Difference-in-Differences analysis showed significantly greater improvements in both BPCR attitudes and practices among women receiving culturally adapted BPCR education compared with standard translated education. These findings suggest that culturally adapted BPCR education may be associated with greater improvement than standard translated education in this setting, although the quasi-experimental design does not establish that cultural adaptation alone caused the observed differences.

The difference in attitude trajectories between the two groups is important to interpret in light of their baseline scores. Women receiving the culturally adapted intervention had lower baseline attitude scores than those receiving the standard translated training, but their scores increased by 2.83 points compared with 0.28 points in the comparison group. Thus, despite starting from a lower level, the intervention group reached a similar mean attitude score at post-test. The significant Difference-in-Differences estimate indicates that attitude scores increased more over time in the intervention group than in the comparison group, rather than simply indicating a higher post-intervention level. This finding is broadly consistent with evidence that structured and culturally responsive antenatal education can improve BPCR-related outcomes (27, 28) A recent systematic review of culturally appropriate antenatal education interventions in low- and middle-income countries reported generally favorable effects on BPCR-related outcomes, although heterogeneity in intervention approaches, outcome measures, and study designs limits direct comparison across studies (29, 30)

One possible explanation for the greater improvement observed in the intervention group is the cultural and conceptual relevance of the adapted educational material. Cultural adaptation can extend beyond linguistic

translation by modifying terminology, explanations, examples, and communication approaches to preserve the intended meaning of health messages within a population's sociocultural context (31, 32). This may be particularly relevant when maternal health concepts are unfamiliar, lack direct local linguistic equivalents, or may be understood differently across cultural settings. Presenting BPCR concepts using locally meaningful terminology and contextual explanations could potentially enhance comprehension, perceived relevance, and engagement with recommended behaviors (31, 32). These mechanisms, however, were not directly assessed in the present study and should therefore be considered plausible explanations rather than demonstrated pathways.

A similar pattern was observed for BPCR practices. Practice scores increased in both groups, but the increase was greater among women receiving the culturally adapted training, resulting in a significant differential change of 0.99 points. Improvement in the comparison group suggests that standard BPCR education and routine ANC exposure may also contribute to changes in preparedness practices. The greater change observed in the culturally adapted group is consistent with previous intervention evidence showing that structured maternal health education can improve BPCR practices, including financial preparation, identification of transportation, selection of a delivery facility, and identification of skilled providers or blood donors (33, 34). The present study adds to this evidence by comparing culturally adapted education with standard translated education, thereby addressing whether differences may exist between two forms of BPCR education rather than between education and no education.

The comparison between these two educational approaches is important. Since both groups received BPCR education, the observed differences cannot be attributed simply to exposure to maternal health information. Rather, they suggest that incorporating cultural and linguistic adaptation into BPCR education may be associated with greater improvement in BPCR outcomes. Translation can increase linguistic accessibility, whereas cultural adaptation may additionally address conceptual meaning, locally familiar expressions, and contextual relevance (35, 36). These features may be particularly relevant in settings where cultural norms, terminology, household decision-making, and resource constraints influence how maternal health recommendations are understood and implemented. Nevertheless, the present study did not directly test whether these features mediated the observed differences.

The findings can also be considered within a Health Belief Model-informed perspective (20). Culturally responsive communication could potentially influence perceptions relevant to BPCR, including perceived benefits and barriers, perceived susceptibility to complications, cues to action, and confidence in undertaking recommended behaviors (37, 38). However, these specific constructs were not measured in the present study. The observed change in the overall attitude score, therefore, should not be interpreted as evidence of changes in individual Health Belief Model constructs. Rather, the findings are consistent with the possibility that culturally responsive communication may facilitate engagement with recommended maternal health behaviors.

The improvement in practice in both groups further indicates that BPCR practices are influenced by factors beyond the educational approach. Preparedness actions may depend on financial resources, transportation, geographical accessibility, household decision-making, availability of health services, and broader health-system conditions (33, 39). Cultural adaptation may enhance the relevance of BPCR messages, but it cannot independently address these structural constraints. Culturally responsive education should therefore be considered alongside strategies that enable women and families to act on BPCR information, including

preparation for transportation and costs, referral planning, and access to appropriate maternal and newborn services.

These findings have implications for BPCR education within ANC, particularly in culturally and linguistically diverse settings. Programs could consider complementing translation with community-informed adaptation of terminology, examples, explanations, and communication strategies when developing materials for populations with distinct cultural contexts (40). Provider training could also incorporate culturally responsive communication skills to support the delivery of maternal and newborn health information in ways that are understandable and contextually meaningful. At the same time, educational interventions should be accompanied by measures addressing practical barriers to preparedness and access to care (41, 42)

Several limitations should be considered. First, the quasi-experimental design and district-level allocation leave the possibility that unmeasured differences between the intervention and comparison settings contributed to the observed outcomes. Second, the groups differed in baseline attitude scores, although the primary Difference-in-Differences analysis examined differential change over time rather than relying on post-test differences alone. Third, only one pre-intervention measurement was available, so the parallel-trends assumption underlying Difference-in-Differences could not be directly assessed. Fourth, the four-week follow-up limits conclusions about whether the observed changes are sustained. Fifth, practice outcomes were based on participant reports and may be subject to recall or social-desirability bias. Finally, the study was conducted among pregnant women in rural Iringa, limiting the extent to which the findings can be generalized to populations with different cultural, linguistic, or geographical contexts.

A strength of the study was the use of a comparison group receiving standard translated BPCR education, which allowed culturally adapted and translated approaches to be compared within the same broader educational domain. The controlled pretest–posttest design and complete follow-up also enabled changes over time to be examined rather than relying solely on post-test differences. Nevertheless, stronger designs are needed to establish the reproducibility and durability of these findings. Future studies could use individual or cluster randomization, multiple pre-intervention assessments, longer follow-up, and objective measures of preparedness practices. Research examining comprehension, cultural relevance, self-efficacy, and other potential behavioral mechanisms could also clarify how cultural adaptation may contribute to changes in BPCR outcomes.

Conclusion

Culturally adapted BPCR education was associated with greater improvements in BPCR attitudes and practices than Standard Translated education among pregnant women in rural Tanzania. The findings indicate a greater differential change over time in the culturally adapted group for both outcomes. Cultural and linguistic adaptation may therefore be relevant when designing BPCR education for culturally distinct populations, although the findings should be interpreted in light of the quasi-experimental design, district-level allocation, baseline imbalance in attitudes, short follow-up, and inability to directly assess the mechanisms underlying the observed changes. Culturally responsive education should complement, rather than substitute for, interventions addressing the financial, transportation, geographical, household, and health-system factors that influence women's ability to prepare for and respond to obstetric and neonatal complications.

How harms were defined and assessed

No adverse events or harms related to the educational interventions were anticipated or observed during the study. Because the intervention involved a one-time maternal health education session and did not involve medical procedures, medications, or clinical treatment, systematic monitoring of adverse events was not performed. Participants were informed that participation was voluntary and that they could withdraw from the study at any time without affecting their access to antenatal care services

Interim analyses and stopping guidelines

No interim analyses were planned or conducted. Data were analyzed after completion of participant recruitment, intervention delivery, and follow-up assessment. Therefore, no stopping guidelines were established.

Interpretation consistent with results, balancing benefits and harms, considering other evidence

The discussion interprets the findings in relation to the observed changes in BPCR knowledge, attitudes, and practices, considers the potential contribution of cultural adaptation alongside contextual factors influencing maternal health behaviors, and relates the findings to relevant previous evidence.

Declarations

Trial Registration

Pan African Clinical Trials Registry PACTR202607626025411, registered retrospectively on 09 July 2026 https://pactr.samrc.ac.za

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analyzed during the current study are not publicly available because they contain potential identifiable participant information. However, de-identified data are available from the corresponding author upon reasonable request for academic or research purposes, subject to approval by the relevant ethics committee and in accordance with institutional policies and participants consent.

Competing interests

The authors declared that they have no competing interest.

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Authors' contributions

RBM contributed to conceiving the study and conceptualization, writing the background information, study design, and study methodology, project supervisor, software data analysis, curation of data, drafting and proofreading. FVM, SAS, and RS contributed to the background, study design, approaches, and methodology, data analysis, supervision and the manuscript was refined with input from all authors.

Conceiving of the study and conceptualization: Rosalia Batista Mwenda

Background: Rosalia Batista Mwenda, Saada Ali Seif, Rehema Stephano, and Fabiola Vincent Moshi.

Methodology: Rosalia Batista Mwenda, Saada Ali Seif, Rehema Stephano, and Fabiola Vincent Moshi.

Supervision: Fabiola Vincent Moshi

Writing original draft: Rosalia Batista Mwenda, Saada Ali Seif, Rehema Stephano and Fabiola Vincent Moshi.

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