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Randomized Trial of Group Postpartum Care Model Improves Knowledge and Clinical Outcomes

Yenupini Joyce Adams, John Stephen Agbenyo, Elizabeth Lau, Jessica Young, and David Haas

Background: In sub-Saharan Africa, the risk of obstetric complications remains high throughout the postpartum period.

Objective: We developed and tested a novel, integrated model of group postpartum care titled Focused-Postpartum Care (Focused-PPC) to improve outcomes. In this paper, we report clinical outcomes of participants in the intervention arm and differences in knowledge of postbirth warning signs among those in the intervention and control arms.

Methods: Focused-PPC encompassed recommended clinical assessments, targeted education, and peer support up to 1 year after birth. Focused-PPC was implemented as a parallel randomized controlled trial involving 192 postpartum women across four health centers in Tamale, Ghana, from February 2022 to August 2023. Eligible participants 18 years or older with a live birth were randomly assigned to either the Focused-PPC intervention arm or the control arm at a 1:1 allocation and were not blinded to their allocation. At each health center, 48 participants were allocated to either an intervention or control arm. Focused-PPC groups in the intervention arm consisted of eight participants per group. Participants in the intervention arm received the Focused-PPC integrated group model of care. Participants in the control arm received the standard of postnatal care already administered at each health center.

Results: Baseline analysis included 96 participants from the control arm and 91 participants from the intervention arm. We found that vital signs and clinical outcomes were relatively stable; however, incidences of hypertension substantially decreased among participants in the intervention arm. By 3 months postbirth, most participants in the intervention arm were able to identify all postbirth warning signs and retain this knowledge compared to the control arm. Those in the intervention arm were also knowledgeable of more warning signs at each time point compared to the control arm.

Discussion: An integrated, evidence-based approach to postpartum care, such as Focused-PPC, has potential to increase knowledge and improve clinical outcomes among mothers in Ghana.

Key Words: Ghana, maternal mortality, obstetric complications, postpartum period, randomized controlled trial

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Although reducing global maternal mortality ratio by 2030 has been made a priority by the United Nations' Sustainable Development Goal 3.1, maternal deaths in low–middle income countries remain high—with 70% of global maternal deaths occurring in sub-Saharan Africa (SSA) alone (World Health Organization [WHO], 2024). In Ghana, WHO estimates the maternal mortality ratio to be 308 maternal deaths per 100,000 live births, higher than the global average of 211 deaths per 100,00 births (WHO, 2019). Most maternal deaths occur in the time following childbirth, known as the postpartum period. In Northern Ghana, where this study was conducted, 32.2% of women give birth at home (Budu, 2020), and nearly 40% of women who deliver in a hospital with an uncomplicated vaginal delivery stay less than 24 hours in the facility after birth (Campbell et al., 2016). The risk of unpredictable obstetric complications remains high throughout the postpartum period, yet mothers or health care providers do not always prioritize postpartum care. Fortunately, the majority of mortality and morbidity from pregnancy-related causes are preventable if complications are treated early (Pan American Health Organization, n.d.). Therefore, it is imperative that women are provided with sufficient education on postpartum complications and associated warning signs, enhancing their ability to recognize warning signs of complications and make informed decisions.

In SSA, the most common postpartum complications include postpartum hemorrhage, infection, postpartum preeclampsia, thromboembolism, pulmonary embolism, uterine rupture, sepsis, and postpartum depression (Benova et al., 2019; Bowles et al.,

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This study was approved by the institutional review board at the University of Notre Dame (Protocol No. 21-06-6662). The study also received in-country approval via the Navrongo Health Research Center and Ghana Health Service.

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2020). Warning signs can vary in intensity and duration depending on the complication, where certain symptoms indicate the need for urgent care. Despite the risks posed by obstetric complications, literature suggests that women in SSA are largely uninformed on perinatal warning signs—which, if ignored, could have negative implications on their health. In Eastern Ethiopia, researchers found that only 24.1% of mothers interviewed could recall three or more of the 16 danger signs of pregnancy (Abdurashid et al., 2018). Similarly, less than half of a sample of postpartum women in Accra, Ghana, could identify any warning sign associated with preeclampsia (Joshi et al., 2020).

In Ghana, midwives are the primary maternity care practitioners, making their knowledge of postbirth warning signs (PBWS) essential for educating patients on the importance of early identification and management of complications (Adams & Ray, 2020). In prior research, midwives were found to have poor knowledge of both the recommended components of postpartum clinical examinations and the most common warning signs of life-threatening complications (Adams & Ray, 2020). Patient education is regarded as a low-cost intervention (Marcus, 2014; The Joint Commission, 2010), and it can be leveraged as an effective tool for cultivating safe motherhood. To optimize the health of women in Ghana, standardized education on PBWS should become integrated into the standard of postpartum care.

It is recommended that postpartum care include assessments of vaginal bleeding, uterine tonus, fundal height, temperature, and heart rate, as well as general well-being, micturition and urinary incontinence, bowel function, healing of any perineal wound, headache, fatigue, back pain, perineal pain and perineal hygiene, breast pain, and lochia (Lopez-Gonzalez & Kopparapu, 2022; WHO, 2022). Not all women in SSA receive the comprehensive care necessary to monitor and maintain their health after birth (Adams & Smith, 2018). In a systematic review including 25 studies across SSA, Bradley et al. (2016) reported that women often felt their intrapartum care was not comprehensive or centered on each individual's status, but rather that their health care providers focused on the more technical aspects of care and maintaining power and knowledge over their patients. Additionally, in a study in Kenya, Han et al. (2023) found that hospital providers conducted very little monitoring for hemorrhage among postpartum women, despite this being the most common cause of maternal mortality in the region. In SSA, postpartum assessments before discharge have been found to be suboptimal and far from universal (Benova et al., 2019). In a study in rural Malawi, women reported partial clinical assessments before discharge from a health facility, with only 16% of women receiving all WHO-recommended postpartum clinical assessments, while 11% received none (Adams et al., 2017). Some of the leading causes of postpartum mortality—such as venous thromboembolism, sepsis, and postpartum hemorrhage—are associated with abnormal vital signs including blood pressure and heart rate (Green et al., 2021). Therefore, consistent assessment of vital signs among postpartum women is a valuable measure for identifying health concerns early and preventing negative outcomes.

Given that all women need comprehensive postpartum physical assessments and education, we developed Focused-Postpartum Care (Focused-PPC), an integrated group model of postpartum care encompassing clinical assessments recommended by WHO and Ghana Health Service (GHS), standardized postpartum education, and peer support. The intervention was developed to address gaps in postpartum care identified through prior experiences working in the setting, and postpartum care needs assessment was completed with women in the health facilities where the intervention was to be implemented (Adams et al., 2023). We conducted a randomized controlled trial (RCT) in which we tested the Focused-PPC intervention. This manuscript presents results from the Focused-PPC RCT on women's knowledge of PBWS and clinical outcomes. We hypothesized that participants in the intervention arm would demonstrate greater knowledge of PBWS than those in the control arm over the course of the study and that the intervention arm would also experience a more significant increase in their knowledge of PBWS overall.

METHODS

Focused-PPC

Focused-PPC includes (a) more frequent contact with health care team/providers; (b) extended period of care beyond 6 weeks, up to 12 months postpartum; (c) standardized postpartum education; and (d) group setting and peer support. Focused-PPC sessions are held within 2 weeks, 6 weeks, and every month until 12 months (13 sessions). Women receive recommended clinical assessments and education for the first 6 weeks and continue to receive measures of vital signs and education until 12 months. Focused-PPC education is comprehensive and standardized, focusing on the unique needs of postpartum women based on time frame after birth, and delivered with audio/visual engagement aids. Group sessions enable women to provide peer support to each other.

Study Design and Setting

Focused-PPC was implemented as an unblinded parallel RCT from July 2021 to August 2023 across four health centers in Tamale, Ghana, with a total of 48 participants from each health center. In the published protocol (Adams & Agbenyo, 2023), we provide details on the study's design, recruitment and enrollment procedures, and randomization process of the study.

Allocations for participants within each location were given out weekly using a stratified random number generator in R (https://www.r-project.org/) by the study statistician, where Focused-PPC allocations were expected to be filled for eight within a 2-week window. The study analyst would reassign allocations for participants who had not yet returned for their first check-in (when intervention would begin) when there were less than six women assigned to a new Focused-PPC group within a 2-week window. Participants were not aware of allocations until they came in for the first check-in. Study personnel were aware of allocations once they were initially assigned due to needing to prepare materials for Focused-PPC group sessions.

Participants and Data Collection

Eligible participants were recruited during their third trimester of pregnancy. After birth, participants were enrolled in the study and randomized to either the control or intervention arm at a 1:1 allocation. Data were collected via interviewer-administered surveys at baseline, 1 to 2 weeks postbirth, 6 weeks postbirth, and monthly thereafter up to 1 year postbirth. Further details regarding eligibility criteria, sample size calculation, enrollment, and data collection can be found in the published study protocol (Adams & Agbenyo, 2023).

Study Intervention

Focused-PPC Intervention

Participants assigned to the intervention arm were placed in a group of eight postpartum women who met at 1 to 2 weeks after birth, 6 weeks after birth, and every month thereafter up to 1 year after birth. Those in the intervention arm received Focused-PPC, an integrated group model of postpartum care led by midwives encompassing clinical assessments recommended by the WHO and GHS, targeted education regarding women's needs during the postpartum period, and peer support. Further details regarding the procedures, curriculum, and fidelity associated with this intervention can be found in the published protocol (Adams & Agbenyo, 2023). The midwives participating in the Focused-PPC intervention

were licensed/registered, professionally trained in their field, and practicing at the participating health facilities. Both midwives and project assistants participated in a 2-day intensive training to understand the Focused-PPC model and its curriculum. Additionally, they participated in the Association of Women's Health, Obstetric, and Neonatal Nurses' (AWHONN) evidence-based postpartum education training program (AWHONN, 2023), providing the necessary knowledge to educate women about warning signs and complications that may occur after birth.

Control Arm

Participants assigned to the control arm received usual postnatal care administered at each health center. This included individual health center visits for the mother within 14 days after birth and again at 6 weeks after birth, followed by child welfare visits monthly for up to 12 months after birth. Most women are not usually physically assessed during these visits (Adams et al., 2023).

Variables and Outcome Measures

Variables

Descriptive variables encompassed both demographic and obstetric variables, including age, marital status, education, income, mode of delivery, personnel present at birth, number of pregnancies, number of living children, provision of prenatal care, and postnatal care recommendations received. Independent variables were allocation (to either control or intervention arm), time, and location. Dependent variables included knowledge of PBWS and confidence in recognizing postpartum complications.

Outcome Measures

Vital signs included blood pressure, temperature, respirations, heart rate, and weight. Vital signs were all quantitative, continuous variables that midwives assessed. Physical assessments included: breast assessment, uterine assessment, urinary assessment, bowel assessment, lochia (bleeding) assessment, laceration/incision assessment, extremity assessment, emotional assessment, and pain assessment. Physical assessments were all nominal variables assessed by midwives. We collected data on serious health issues or complications experienced. Nominal variables regarding complications experienced included: complication experienced, severity of complication experienced, where the complication developed, assistance sought for the problem, where assistance was sought, and when assistance was sought.

We assessed education on PBWS and postpartum complications via survey questions that asked participants whether midwives/trained personnel taught them about warning signs, whether they were informed of where to go when experiencing warning signs, whether they were provided with booklets about warning signs/complications to reference, which topics they were educated on regarding the most common postpartum complications, and whether they understood the education provided to them. All variables except for education topics were nominal, while education topics were treated as dichotomous. A list of education topics encompassing the most common PBWS and their respective complications was presented to each participant, and they reported whether they were taught about each topic.

We measured knowledge of PBWS by presenting participants with a list of the most common warning signs that can threaten a woman's health following birth. AWHONN established this list and includes the following warning signs: pain in the chest; obstructed breathing or shortness of breath; seizures; thoughts of hurting oneself; severe bleeding; an incision that is not healing; a red, swollen or painful leg; a temperature of 100.4°F or higher; and severe headache or vision changes (AWHONN, 2023). Participants were asked whether each of the nine symptoms listed was a warning of a problem that can occur after birth. Each individual warning sign was treated as a dichotomous variable.

Our last outcome was confidence in recognizing postpartum complications. Regarding eight of the most common postpartum complications, participants reported their confidence in being able to recognize each should they occur. These complications included hemorrhage, infection, preeclampsia/eclampsia, hypertension, postpartum depression, blood clots in the veins, blood clots in the lungs, and disease in the heart. For each complication, the participants reported whether they were not confident, somewhat confident, or very confident in their ability to recognize the problem. This produced eight ordinal variables.

Data Analysis

Descriptive statistics of frequencies and averages were calculated for all variables and outcome measures. Frequencies of categories for demographic and obstetric characteristics of participants were compiled to confirm that control and Focused-PPC participants were similar and that randomization worked. Identification of the outcomes of PBWS, blood pressure, complication of topics taught, and confidence in recognizing complications were summarized as frequencies and averages per allocation arm over time.

A multilevel model was created with interactions for location, allocation, and time—which were all fixed effects to model the sum score of PBWS (Table 1, Supplemental Digital Content, http://links.lww.com/NRES/A553). Random intercepts were included for participants. Other fixed effects in the model included level of education, whether it was the participants' first pregnancy, and whether participants had a monthly income. The time variable was handled as categorical since time points were not equally spaced, and there was no hypothesized form of how time would affect the outcome. Multiple imputation was used via the mice package in R (van Buuren & Groothuis-Oudshoorn, 2011) to create complete cases for modeling the 91 Focused-PPC participants and 96 control participants that participated in at least one follow-up.

Ethical Compliance

This study was approved by the institutional review board at the University of Notre Dame (Protocol No. 21-06-6662) and is registered as a clinical trial by the U.S. National Library of Medicine at ClinicalTrials.gov (ID: NCT05280951). The study also received in-country approval via the Navrongo Health Research Center and GHS. All participants were provided with detailed information regarding the study's procedures and its voluntary nature, and each participant provided informed consent. Each participant was assigned a unique ID number, which was attached to all their data throughout the study. Those enrolled in the Focused-PPC intervention were given a 5-kg bag of rice and a liter of oil for their participation at the end of the study.

RESULTS

Participant Characteristics

Participants' demographic characteristics and obstetric history were very similar in control and Focused-PPC arms, showing that the randomization was successful. Overall, nearly all women were married, half did not attend school, and half had a source of income. Only one fifth of women attended either tertiary or vocational school. Additionally, nearly all women delivered vaginally with help from a midwife or nurse. For most women, this was not their first pregnancy. Nearly all women reported having gone for weighing/antenatal care during their pregnancy, planned to breastfeed, and were told to return to a health facility after giving

TABLE 1. Participant Demographic Characteristics and Obstetric History

Question	Value	Control	Focused-PPC
Location	Bagabaga	24	24
	Choggu	24	24
	Kalpohin	24	24
	Kanvilli	24	24
What is your marital status?	Never married/single	0	0
	Currently married	95	95
	Divorced/separated	0	0
	Widowed	0	0
	NA	1	1
What is the highest level of education you have completed?	Did not attend school	45	39
	Primary school	28	21
	Secondary school	16	23
	Tertiary/vocational school	6	12
	NA	1	1
Do you have a source of income?	Yes	45	57
	No	49	38
	NA	2	1
Was this baby delivered normally or through operation?	Normal delivery	92	92
	Operation (cesarean)	3	1
	NA	1	3
At the time of your delivery, who helped you?	Doctor	5	3
	Midwife or nurse	93	94
	Other (please specify)	1	0
	Patient attendant	1	1
	Your family member	2	1
Was this your first pregnancy?	Yes	36	31
	No	57	63
	NA	3	2
How many times have you been pregnant?	1	37	33
	2	20	23
	3	16	14
	4	14	9
	5	4	8
	6	1	5
	7	0	2
	8	1	0
	NA	3	2
How many children do you have living, including this child?	1	1	3
	2	21	24
	3	18	15
	4	13	9
	5	1	8
	6	2	4
	7	0	1
	8	1	0
	NA	39	32
Were you going for weighing when you were pregnant?	Yes	95	93
	No	0	1
	NA	1	2
What do you plan to feed your newborn in the first 6 months?	Breastfeeding	92	90
	Feeds prepared for children (formula)	1	2
	Both	1	1
	NA	2	3
Did they inform you to return to a health facility for check-up after delivery?	Yes	92	89
	No	3	5
	NA	1	2
What time were you asked to return for a check-up after delivery?	3 days after delivery	30	29
	Between 7 and 14 days after delivery	44	57
	6 weeks after delivery	14	20
	When the mother or baby is not well OR when the mother or baby has a problem	28	29
	Other (specify)	1	0
	They never asked me to come	1	1

birth. Participants' demographic characteristics and obstetric history are summarized in Table 1. Out of the 192 total randomized participants for the study, 96 were allocated to the control, and 96 were allocated to the intervention (Figure 1, Supplemental Digital Content, http://links.lww.com/NRES/A553).

Physical Assessments and Vital Signs

Participants in the control arm received usual care, and most women were usually not physically assessed. In the Focused-PPC arm, participants received the full range of recommended clinical assessments from midwives at 2 weeks and 6 weeks postpartum. These assessments included evaluation of participants' breasts, uterus, bladder, bowel, lochia, episiotomy, extremities, emotional state, cultural needs, and pain. Throughout the study, midwives addressed and treated any concerning aspects of physical assessments as they arose. For example, two participants who had cases of breast engorgement were educated about management, and antibiotics were prescribed for those who needed them. A total of 15 participants had concerning assessments in which the uterus was not firm by palpation. In these cases, midwives performed fundal massages to prevent bleeding and uterine atony. Midwives reported that two participants had abnormal lochia. One of these women had lochia with an abnormal odor and was tested to identify any infection. Another woman experienced an abnormally large amount of lochia and received blood count testing as well as education regarding the usual types and amounts of bleeding that are expected after birth. In regard to cultural needs, four participants reported that they needed their husbands' consent to seek or receive treatments; all of these women received education about warning signs that indicate they should promptly seek care. Bladder, bowel, episiotomy, extremities, emotional state, and pain assessments were reported in normal range with no unexpected findings throughout the study.

Further, vital signs, including blood pressure, temperature, respirations, heart rate, and weight, were measured among Focused-PPC participants up to 12 months postbirth. Temperature, respirations, and heart rate were stable and normal for all participants over time. Participants were recorded as having steadily lost weight until their 3-month check-ins; at this point, their weights tended to stay the same. If any vital sign values were concerning or abnormal, midwives followed medical protocols to address the needs of participants. For

TABLE 2. PBWS Identified by Participants Over Time (by Allocation)

	Baseline		1–2 weeks		3 months		6 months	
Sign	**Control *n* = 96**	**Focused-PPC *n* = 96**	**Control *n* = 88**	**Focused-PPC *n* = 84**	**Control *n* = 90**	**Focused-PPC *n* = 79**	**Control *n* = 88**	**Focused-PPC *n* = 76**
Pain in chest (%)	51	46.9	51.1	82.1	40	100	42	98.7
Obstructed breathing/shortness of breath (%)	38.5	34.4	47.7	71.4	32.2	100	26.1	94.7
Seizures/convulsions/twitching (%)	35.4	33.3	35.2	58.3	21.1	98.7	17	97.4
Thoughts of hurting yourself (%)	29.2	31.2	35.2	67.9	13.3	97.5	20.5	97.4
Severe bleeding (%)	79.2	79.2	80.7	96.4	75.6	100	62.5	98.7
Incision taking long to heal (%)	41.7	45.8	45.5	70.2	33.3	98.7	22.7	93.4
Swollen leg/pain in leg (%)	32.3	28.1	31.8	46.4	12.2	98.7	13.6	96.1
Fever/high temperature (%)	49	51	52.3	78.6	40	98.7	47.7	96.1
Severe headache (%)	55.2	55.2	52.3	84.5	46.7	98.7	47.7	97.4
None of the above (%)	7.3	8.3	5.7	1.2	3.3	0	10.2	0

instance, if necessary, a blood pressure protocol that included medical counseling and intervention with medication was implemented in the event of abnormal blood pressure readings.

Nearly half of all Focused-PPC participants had high blood pressure at baseline, classified as greater than 130 systolic or greater than 90 diastolic (Table 2, Supplemental Digital Content, http://links.lww.com/NRES/A553). By 6 months, only a quarter ($n = 21$) of participants still had high blood pressure, and by 12 months, the number of cases decreased to only 13 participants (Figure 2, Supplemental Digital Content, http://links.lww.com/NRES/A553).

Complications Experienced

Out of all participants in the study, only five gave birth to a newborn who needed to be admitted to the neonatal intensive care unit at birth, and only four women gave birth through a cesarean. No participants were delivered via vacuum extraction. Most participants gave birth around 38 weeks, although the earliest birth recorded was at 31 weeks, and the latest birth recorded was at 43 weeks. Five participants experienced serious health problems related to the delivery, and two of these went on to elaborate that the health problems were severe bleeding and low hemoglobin.

Most participants did not report having experienced serious health problems over the year-long study. Of those who did, eight reported experiencing severe headaches or vision changes, and one reported experiencing pain in the chest. Complications experienced by participants were rare, but when they occurred, participants normally reported that they sought assistance for their problems. This occurrence was true regardless of allocation to control or Focused-PPC. All participants with serious health problems went to either a pharmacy or hospital/clinic for assistance within a week of noticing the problems.

Education on Complications

At baseline, there were a similar number of participants from both the control ($n = 17$) and Focused-PPC ($n = 11$) arms who reported that midwives/nurses/trained staff did not advise or teach them about warning signs of serious complications after birth. Additionally, a similar number of participants in the control arm ($n = 12$) and the Focused-PPC arm ($n = 8$) reported they were not told where to go if they experienced any complications. However, by the 1- to 2-week check-in postbirth, only one participant in the Focused-PPC arm reported they did not receive any education on complications, while 13 participants in the control arm reported the same. From baseline onward, more Focused-PPC participants than control participants recalled being educated on every complication topic (Figure 3, Supplemental Digital Content, http://links.lww.com/NRES/A553).

Knowledge of PBWS

Both Focused-PPC and control participants initially did not identify most PBWS, with the sole exception of severe bleeding, which 79% of participants identified at baseline. By the 1- to 2-week check-in postbirth, knowledge in the control arm stayed the same while knowledge increased in the Focused-PPC arm, with participants identifying many more PBWS. By 3 months postbirth, most Focused-PPC participants were overwhelmingly able to identify all warning signs and retain this knowledge up until 6 months postbirth. On the contrary, participants in the control arm identified warning signs less frequently at each subsequent time point, and by 6 months postbirth, nearly 10% of the control arm could not identify any PBWS. Table 2 shows the individual signs identified by control and Focused-PPC participants at each time point postbirth.

A multilevel model—where the outcome was knowledge of PBWS—showed that the three-way interaction of allocation,

TABLE 3. Estimated Treatment Effect Sizes From the Multilevel Model for the Outcome of Knowledge of PBWS

Time	Effect size	SE	*df*	CI
Baseline	−0.02	0.18	698	(−0.37, 0.32)
1–2 Weeks Check-in	1.58	0.21	698	(1.18, 1.99)
3 Months	4.10	0.29	698	(3.53, 4.67)
6 Months	4.28	0.32	698	(3.66, 4.90)

Note. CI = confidence interval.

location, and time was significant, in addition to each two-way interaction and main effects. The model fit well with an R^{2fv} of .84 (Rights & Sterba, 2019). Treatment effect sizes (Cohen's *d*) at each time point and their confidence intervals are shown in Table 3; they are calculated as the treatment mean difference divided by the square root of the sum of the within-participant and between-participant variance. As expected, baseline showed no difference and an effect size of near 0. At the 1- to 2-week check-in, the effect size is considered very large at 1.58 and only gets larger for the further time points. Since the three-way interaction was significant, the effects of location, allocation, and time were inextricably linked and must be interpreted all together. Within health centers, Focused-PPC participants' ability to identify PBWS increased and remained high over time whereas control participants' ability decreased; at most time points after baseline, Focused-PPC participants could identify significantly more PBWS than control participants (Figure 4, Supplemental Digital Content, http://links.lww.com/NRES/A553).

Confidence to Recognize Complications

At baseline, Focused-PPC and control participants were equally confident in their ability to recognize each complication. With the exception of infection and hemorrhage—which participants felt somewhat confident in recognizing at baseline—all participants were less than somewhat confident in recognizing each complication. As the study progressed, control participants became less confident in their ability to recognize every complication. The Focused-PPC participants became more confident in recognizing each complication beginning at 1 to 2 weeks postbirth. By the 3-month check-in, Focused-PPC participants seemed to nearly reach their peak confidence in their ability to recognize each complication. Figure 1 shows the average confidence in recognizing each complication throughout the duration of the study for both control and Focused-PPC participants.

DISCUSSION

The Focused-PPC intervention was the first of its kind to integrate recommended clinical care, a standardized education curriculum, and peer support into postpartum care model delivered over an entire year after birth. This intervention was developed to promote the quality of mothers' lives postbirth and, ultimately, reduce maternal morbidity and deaths.

Focused-PPC participants received the full range of GHS-recommended clinical assessments in Ghana. Our intervention differed in that physical and mental health assessments were provided to every woman and were conducted up to 1 year after birth. Women received head-to-toe assessments for the first 6 weeks postpartum and continued to receive assessments of vital signs and mental health screening every month until 1 year. In this way, we were able to quickly identify any health issues. The most common abnormal vital signs among participants in our study were elevated blood pressure or hypertension. In a recent population-based cohort study, it was found that hypertension contributes to approximately 10% of maternal morbidities and is the second highest cause of maternal mortalities in SSA (Aftab et al., 2021). Elevated blood pressure readings were noted at several time points across the study but were able to be promptly managed by midwives in the Focused-PPC arm. SSA faces a disproportionately high burden of maternal hypertension, and delays in seeking care contribute to the majority of hypertension-related maternal deaths (Berhan & Endeshaw, 2015; Geleto et al., 2018). Therefore, immediate identification and treatment of the condition by health care professionals is especially crucial in Ghana and similar settings.

In terms of education, all Focused-PPC sessions followed a standardized education curriculum. Standardized education is crucial to improve outcomes in SSA, where maternal knowledge surrounding critical topics such as potential complications and care-

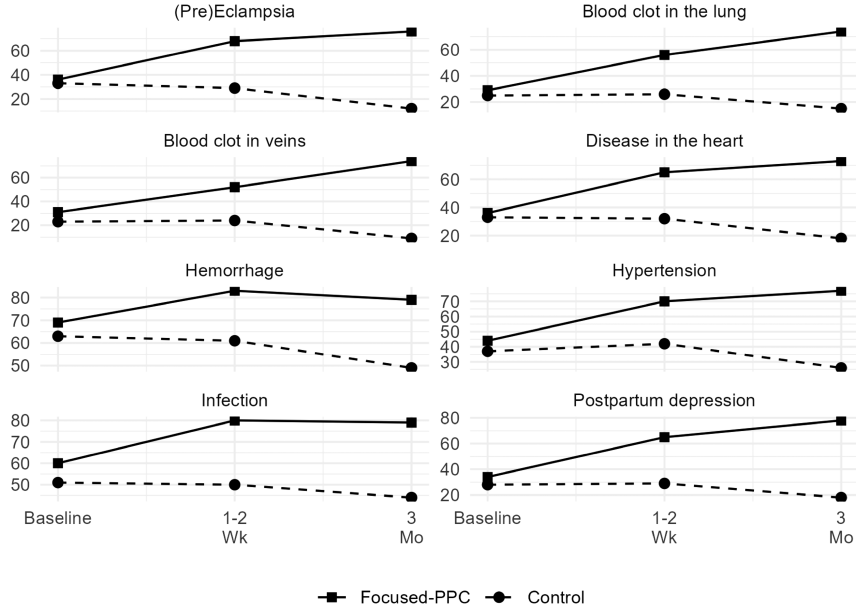

FIGURE 1. Participants' average confidence to recognize complications over time.

seeking plans, is often lacking (Adams & Sladek, 2022; Geleto et al., 2019; Joshi et al., 2020; Lau et al., 2023). This curriculum was designed to address the specific needs of the community, identified via a needs assessment (Adams et al., 2023), and cover the most important topics related to postbirth safety and recovery, as determined by a panel of medical and research experts. Often, most postpartum education in Ghana is delivered very quickly after birth, addressing all topics at once or omitting important topics (Adams & Sladek, 2022; Lau et al., 2023). Our model differed in that education was spaced apart, and topics were addressed at relevant time points. Evidence of the effect of our targeted education curriculum was seen in increased knowledge among Focused-PPC participants as compared to the control arm. For instance, some of the main education topics presented to women were warning signs of life-threatening complications postbirth. Nearly all maternal deaths caused by these complications can be prevented, and previous research has indicated that education on warning signs is directly linked to increased knowledge of complications and their symptoms (Jewaro et al., 2020; Lau et al., 2023; Salem et al., 2018). In this study, we found that, over time, knowledge of PBWS continued to increase in the Focused-PPC arm while knowledge generally decreased or stalled in the control arm. By 3 months postpartum, nearly all Focused-PPC participants could identify every warning sign of potential complications, and this knowledge was maintained thereafter. These results yield assuring implications that standardized education delivered in this setting can contribute to enhanced knowledge of PBWS.

Furthermore, the benefits of standardized postpartum education provided as part of Focused-PPC were evident in participants' increased confidence in their ability to recognize complications. While participants in the control arm lost confidence to recognize complications over the course of the study, those in the Focused-PPC gained confidence to recognize every complication over time. Data from this study provided valuable insight regarding the ability of mothers to recognize or respond to major postpartum complications. It is worth noting that the two complications participants felt the least confident recognizing throughout the entirety of the study were a blood clot in the lungs and postpartum depression. This denotes room for improvement in the education surrounding these complications. It is imperative that knowledge and confidence surrounding these complications increase, as both conditions remain prevalent in the region (Danwang et al., 2017; Sefogah et al., 2020).

Limitations

The multilevel model used for analysis can be generalized to the region studied but may not reflect other regions in Ghana. Additionally, since the research was conducted over time, it is possible that there were outside unmeasured variables that affected the change over time. Due to the nature of the intervention and the multilevel model used, interpretations were made at the arm level (intervention and control) and not at the participant level. Another limitation is that although control participants were not required to go back to the clinics and could answer the check-in surveys over the phone, the treatment participants were required to attend the clinic monthly to participate in treatment and take the check-in surveys. This resulted in more treatment participants dropping out of the study over time than control participants due to the inability to continue their participation after moving.

CONCLUSION

Results indicate that an integrated, evidence-based approach to postpartum care, such as Focused-PPC, could potentially improve the outcomes of mothers in SSA. Our intervention provided frequent contact with midwives after birth, which allowed them to assess for and treat postpartum complications in a timely manner. Additionally, women gained vital knowledge surrounding postpartum complications and their warning signs.

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