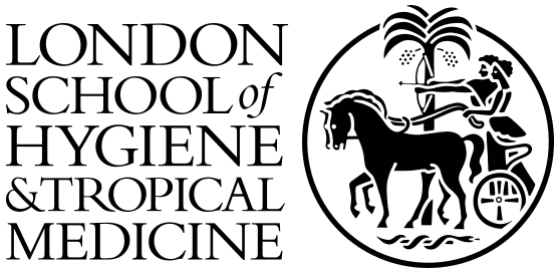

BMJ Open

Effect of continuum-of-care intervention package on improving contacts and quality of maternal and newborn healthcare in Ghana: a cluster randomised controlled trial

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To cite: Okawa S, Gyapong M, Leslie H, *et al*. Effect of continuum-of-care intervention package on improving contacts and quality of maternal and newborn healthcare in Ghana: a cluster randomised controlled trial. *BMJ Open* 2019;**9**:e025347. doi:10.1136/bmjopen-2018-025347

► Prepublication history for this paper is available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2018-025347).

Received 11 July 2018
Revised 11 April 2019
Accepted 06 August 2019

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ABSTRACT

Objective To evaluate the effect of a continuum-of-care intervention package on adequate contacts of women and newborn with healthcare providers and their reception of high-quality care.

Design Cluster randomised controlled trial.

Setting 32 subdistricts in 3 rural sites in Ghana.

Participants The baseline survey involved 1480 women who delivered before the trial, and the follow-up survey involved 1490 women who received maternal and newborn care during the trial.

Interventions The intervention package included training healthcare providers, using an educational and recording tool named 'continuum-of-care card', providing the first postnatal care (PNC) by retaining women and newborns at healthcare facility or home visit by healthcare providers.

Outcome measures Adequate contacts were defined as at least four contacts during pregnancy, delivery with assistance of skilled healthcare providers at a healthcare facility and three timely contacts within 6 weeks postpartum. High-quality care was defined as receiving 6 care items for antenatal care (ANC), 3 for peripartum care (PPC) and 14 for PNC.

Results The difference-in-difference method was used to assess the effects of the intervention on the study outcome. The percentage of adequate contacts with high-quality care in the intervention group in the follow-up survey and the adjusted difference-in-difference estimators were 12.6% and 2.2 (p=0.61) at ANC, 31.5% and 1.9 (p=0.73) at PPC and 33.7% and 12.3 (p=0.13) at PNC in the intention-to-treat design, whereas 13.0% and 2.8 (p=0.54) at ANC, 34.2% and 2.7 (p=0.66) at PPC and 38.1% and 18.1 (p=0.02) at PNC in the per-protocol design that assigned the study sample by possession of the continuum-of-care card.

Conclusions The interventions improved contacts with healthcare providers and quality of care during PNC. However, having adequate contact did not guarantee high-quality care. Maternal and newborn care in Ghana needs to improve its continuity and quality.

Trial registration number ISRCTN90618993.

Strengths and limitations of this study

- This was a cluster randomised controlled trial conducted in three rural sites which had diverse socioeconomic and ecological backgrounds and operated the Health and Demographic Surveillance System.
- This study assessed the effect of the intervention on having adequate contact of women and their newborns with healthcare providers and their reception of high-quality care in antenatal, peripartum and postnatal care.
- The results showed that regular contacts with healthcare providers did not guarantee quality of care, although the results could be affected by uneven cluster allocation and contamination.
- Maternal and newborn care programme needs to improve continuity and quality of care in Ghana.

INTRODUCTION

Maternal and newborn health has significantly improved during the Millennium Development Goals era. Women and newborns still encounter a life-threatening risk from the third trimester to the first month postpartum in resource-limited countries.[1 2] A key strategy to maintain maternal and neonatal health is to provide effective interventions continuously during the high-risk period,[3] namely continuum of care (CoC). However, CoC remains a critical challenge in many countries. In our previous study, for example, only 8% of women completed CoC from pregnancy

to postpartum period.[4] Moreover, regular contacts with healthcare providers alone would not improve maternal and newborn health outcomes if they did not receive quality care.[5]

Maternal and newborn health research provides no comprehensive definition and measurements of quality of care when we designed this study.[6] In 1988, Donabedian suggested a framework for quality of care assessment.[7] In the framework, quality of care is assessed with three dimensions: structure, process and outcomes.[7] Using this framework, existing literature measured quality of care by creating composite indexes of structure and/or process of care[8–11] and identified remarkable gaps between contacts with healthcare providers and actual quality of care during the contacts.[9 10 12 13] In addition, previous studies evaluated the effects of interventions on improving process of care (eg, receiving iron tablets, tetanus toxoid injections, HIV testing, intermittent preventive treatment for malaria or basic newborn care).[14–16] However, to the best of our knowledge, few intervention studies have evaluated the effects of interventions on both contacts with healthcare providers and quality of care from pregnancy to the postpartum period.

Ghana is one of the sub-Saharan African countries with an estimated maternal mortality ratio of 380/100 000 live births in 2013.[17] Neonatal mortality rate was 29/1000 live births in 2010–2014, with a minor reduction in the last decade.[18] The government of Ghana introduced health policies to mitigate the financial and geographical constraints affecting the access to healthcare services: community-based health planning and services (CHPS) initiative in 1999[19] and national health insurance scheme in 2004.[20] In this scheme, pregnant women are able to obtain their health insurance which includes a free package of antenatal care (ANC), delivery, caesarean section and postnatal care (PNC) services without paying the annual premium and processing fees.[21 22] Our previous studies showed that women with national health insurance were more likely to have four ANC visits and deliver at a healthcare facility.[23 24] Despite improvements in coverage for maternal and child health, further effort is needed to strengthen the CoC and improve the quality of care under the implementation of these policies.

Ghana's Ensure Mothers and Babies Regular Access to Care (EMBRACE) implementation research aimed to strengthen CoC.[25] The major activities included the development and implementation of an intervention package and evaluation of its effect on CoC. Based on the findings of formative research,[4] we developed an intervention package to ensure CoC with healthcare providers during ANC, peripartum care (PPC) and PNC. Although CoC is the primary outcome for the impact evaluation,[26] quality of care during the regular contacts is another important outcome for the process evaluation, which provides multifaceted implications for maternal and newborn health programme. Therefore, the objectives of this study were to examine the effects of the CoC intervention package on having adequate contacts with healthcare providers and high-quality care by the mothers and their newborns compared with the standard maternal and newborn care under the national guidelines and to determine the factors associated with having adequate contacts with high-quality care among those in the intervention group in the follow-up survey.

METHODS

Study design and setting

This was a cluster randomised controlled trial using the effectiveness-implementation hybrid design registered in ISRCTN (90618993).[26] In order to enhance the generalisability of study findings in rural setting of Ghana, we selected three rural sites: Navrongo (northern), Kintampo (central) and Dodowa (southern) which had diverse socioeconomic and ecological background and health systems challenges. Additionally, these study sites had Health Research Centers (HRCs) under the Ghana Health Service, and these HRCs operated the Health and Demographic Surveillance System. Such research infrastructure could be beneficial for the quality control of the intervention and surveys.

Each study site covered two districts and consisted of 36 subdistricts. We included 32 subdistricts in this study (Navrongo, 12; Kintampo, 12 and Dodowa, 8) and excluded four subdistricts because of other projects implemented or planned during our intervention period. We used subdistrict as a cluster unit as it was the primary unit of the health system. In the preintervention facility assessment, the percentage of healthcare facilities with at least one midwife was 47% in Navrongo, 36% in Dodowa and 21% in Kintampo.

We made 16 pairs of the clusters (Navrongo, 6; Kintampo 6 and Dodowa, 4), taking into account the population, the volume of delivery and the number of midwives in each cluster. Then, we randomly assigned the clusters within a pair to the intervention or the control groups. A data analyst who was not a member of the study team randomly allocated the paired clusters using computer-generated random sequences. However, we assigned three clusters with a district hospital to the intervention group as majority of the childbirths took place in these hospitals. We informed about the implementation of the intervention to the community people and healthcare providers in the intervention group only. However, complete blinding was not feasible; we implemented the intervention in the intention-to-treat design, which did not control for women's choice and access to healthcare facilities across a cluster boundary.

Participants and intervention

Women who were aged between 15 and 49 years old and delivered between 1 October 2014 and 30 September 2015 in the intervention group were eligible for study enrolment.[26]

We implemented the intervention for 12 months (1 October 2014 to 30 September 2015) as initially planned

in the protocol. The details of the intervention were described previously.[26] Women were enrolled to the intervention when they had contacts with healthcare providers anytime from pregnancy to the postpartum period.

The intervention package was composed of four interventions. First, healthcare providers underwent reorientation about CoC. Second, healthcare providers distributed the CoC card to women, which contains the schedule and actual dates of contacts with healthcare providers, information on essential care and birth preparedness and the presence of danger signs. Healthcare providers and women used the CoC card in every contact. Third, healthcare providers retained women and their newborns in the healthcare facility for the first 24 hours postpartum to provide the first PNC. Fourth, healthcare providers made home visits to provide PNC to women and their newborns within the first 48 hours if they missed the first postnatal contact by 24 hours postpartum.

We emphasised to implement the intervention using the existing health systems and resource; all intervention facilities in the three sites had reorientation of healthcare providers and implemented all or a part of the intervention package depending on availability of resource and infrastructure. In addition, district health management teams conducted monthly supervision in healthcare facilities, monitored the performance of the interventions and had a monthly meeting to report the progress and discuss the challenges in collaboration with research teams. In the control group, women and their newborns received the standard care recommended by the Ghana National Safe Motherhood Service Protocol.[27] During the trial period, we did not observe any harms or unintended events in the intervention or the control groups.

Survey

We conducted the baseline survey from July to September 2014, with a sample of 1500 women who delivered between 1 September 2012 and 30 June 2014, and the follow-up survey was performed from October to December 2015, with a sample of 1500 women who received care during the intervention period. We calculated the required sample size based on an expected increase in four antenatal contacts from 86.6% to 95.0% according to the finding of our formative study.[4] We considered a 95% CI, 80% power, an intraclass correlation coefficient of 0.02675 and 10% attrition in the sample size calculation.[26] We performed two-stage random sampling to select 500 eligible women from each study site for the baseline and follow-up surveys.

For the first stage, we defined subdistricts as a cluster unit. A subdistrict is composed of several administrative community units. We used the administrative community units as a primary sampling unit and randomly selected primary sampling units from each subdistrict that corresponded to the probability proportionate to the population. For the second stage, we randomly selected 10 women per primary sampling unit.

Trained research assistants performed the survey by visiting the households of the eligible women who had no knowledge about the cluster allocation and conducting face-to-face interviews with them. The structured questionnaire included women's sociodemographic characteristics; frequency and timing of contacts with healthcare providers; contents of care that women and their newborn received during ANC, PPC and PNC and whether they received the CoC card. The frequency and timing of contacts and contents of care corresponded to the recommendation of the Ghana National Safe Motherhood Service Protocol.[27]

Main outcome measures

We defined adequate contacts based on the frequency and timing of contacts with healthcare providers as follows: at least four contacts with healthcare providers during pregnancy, delivery with assistance of skilled healthcare providers at a healthcare facility and three contacts with healthcare providers within 48 hours, at 1 week (3–10 days) and at 6 weeks (36–48 days) postpartum (table 1).

We measured the quality of care based on the contents of care received by the women and their newborns during ANC, PPC and PNC (table 1). The process-of-care dimension in Donabedian's framework was employed.[7] We created quality of care indexes that consisted of 6 care items for ANC, 3 for PPC and 14 for PNC. High-quality care was defined as receiving all care items during ANC, PPC and PNC.

Having adequate contacts with healthcare providers and high-quality care was considered as the primary study outcome. The variable was composed of three categories: inadequate contacts regardless of care quality, adequate contacts with low-quality care and adequate contacts with high-quality care (ie, quality-adjusted adequate contacts).

Confounders

We considered the following variables as potential confounders: study site, living in a subdistrict with a district hospital, age, education, marital status, parity, religion, wealth quintile index and the status of national health insurance membership. Of these variables, age and parity were initially continuous variables and converted to categorical variables: age (≤19, 20–34 and 35–49), parity (primipara and multipara). The variable of wealth quintile index was generated by performing principal component analysis of 13 household assets.

Statistical analysis

We calculated the distributions of the basic characteristics of the women, the percentage of each care item received by women and their newborns and the percentage of having adequate contacts with healthcare providers and high-quality care. We evaluated the effect of the intervention on adequate contacts with high-quality care during ANC, PPC and PNC. However, the effect of the intervention could be biased because of imbalanced cluster allocation; the effect could appear greater as three clusters

Table 1 Definitions of the study outcome

Stage	Contacts with healthcare providers	Contents of care	Primary outcome
ANC	At least four contacts	6 care items: 1. HIV test 2. Haemoglobin test ≥2 3. Tetanus toxoid vaccination ≥2 4. Intermittent preventive treatment for malaria ≥3 5. Blood group and Rhesus factor test 6. Blood pressure assessment ≥4	i. Inadequate contacts: ≤3 contacts ii. Adequate contacts with low-quality care: ≥4 contacts with ≤5 care items iii. Adequate contacts with high-quality care (ie, quality-adjusted adequate contacts): ≥4 contacts with six care items
PPC	Skilled facility-based delivery (SFD)	3 care items: 1. Dried newborn's body 2. Skin-to-skin contact 3. Initiation of breastfeeding ≤30 min	i. Inadequate contact: non-SFD ii. Adequate contact with low-quality care: SFD with ≤2 care items iii. Adequate contact with high-quality care (ie, quality-adjusted adequate contact): SFD with three care items
PNC	3 contacts with timeliness: First:≤48 hours Second: 3–10 days Third: 36–48 days	14 care items: Mother: 1. Temperature measurement 2. Blood pressure assessment 3. Bleeding check 4. Breastfeeding problem check 5. Haemoglobin assessment 6. Fundal height assessment 7. Perineum/Lochia check 8. Vitamin A supplement Newborn: 1. General physical examination 2. BCG immunisation 3. Oral polio vaccine 4. Umbilical cord bleeding check 5. Temperature measurement 6. Breastfeeding difficulties check	i. Inadequate contact: ≤2 contacts or non-timely contacts ii. Adequate contacts with low-quality care: 3 timely contacts with ≤13 care items iii. Adequate contacts with high-quality care (ie, quality-adjusted adequate contacts): 3 timely contacts with 14 care items

ANC, antenatal care; PNC, postnatal care; PPC, peripartum care.

with district hospitals were assigned to the intervention group. Moreover, women in the control group could access district hospitals in the intervention area, which in turn lead to a potential contamination that could make the effect of the intervention smaller. Thus, to control for these potential biases, we used the difference-in-difference (DiD) method with four groups including the intervention (n=863) and control (n=617) groups in the baseline survey and the intervention (n=870) and control (n=602) groups in the follow-up survey. Before performing the DiD analysis, we assessed two assumptions. First, no time-varying difference existed between the intervention and the control groups.[28] We did not observe any specific changes that might have affected the study outcome in both groups during the trial period. Second, the outcome trend should be equal in the intervention and the control groups in the absence of the trial.[28] However, it was not feasible to measure the change that could have occurred in the intervention group in the absence of the intervention because we did not conduct any surveys before the baseline survey. Therefore, we performed the DiD analysis with cluster robust estimators of variance, controlling for individual characteristics. Robust estimators of variance is a technique used to estimate cluster robust SEs and adjust the CIs of the DiD estimators when the regression model is potentially affected by cluster correlations.[29]

We also considered the potential effect of contaminations. Therefore, we calculated DiD estimators in the intention-to-treat and per-protocol designs separately. The intention-to-treat design focuses whether the intervention works in the real-world setting, which shows effectiveness of the intervention.[30] In the intention-to-treat analysis, we compared the percentages of the study outcomes between the intervention and the control groups corresponded to the initial cluster allocation. The results could be affected by coverage and contamination of the intervention. The per-protocol design focuses whether the intervention works in the ideal setting, which shows the efficacy of the intervention.[30] In the per-protocol analysis, we treated the possession of the CoC card as actual participation in the intervention. Thus, women in the intervention group who did not receive the CoC card and women in the control group who received the CoC card were excluded from the per-protocol analysis.

Finally, we performed subgroup analyses to identify factors associated with having adequate contacts with high-quality care among women in the intervention group in the follow-up survey (n=870). This analysis focused on identifying the characteristics of women who had greater chances of having adequate contacts with high-quality care in the intervention area. We used multivariable logistic regression with cluster robust SEs. The independent variables were study site, living in a subdistrict with a district hospital, age, education, marital status, parity, religion, wealth quintiles and the status of national health insurance membership. We used Stata 13 (Stata Corp, College Station, Texas, USA) for the analyses.

Participants and public involvement

Participants and public were not involved in the design of, the recruitment to and conduct of the study because this was a randomised controlled trial. However, community people in the intervention group were announced about the EMBRACE project at the commencement of the trial.

Ethical approval

We obtained ethical approvals from Ghana Health Service, Navrongo HRC, Kintampo HRC, Dodowa HRC and The University of Tokyo. Consent was obtained from the local health authorities and community leaders prior to conducting the intervention study. We obtained oral informed consent from participants of the intervention, whereas we obtained written informed consent from participants of the surveys. For those who were aged under 18, we requested permission from their guardians and obtained their signature on the consent form.

RESULTS

We analysed the baseline survey data of 1480 women and the follow-up survey data of 1490 women. The baseline survey dataset included 617 women (41.7%) in the control group and 863 women (58.3%) in the intervention group. The follow-up survey dataset included 620 (41.6%) in the control group and 870 (58.4%) in the intervention group. We excluded the data of 10 women from the baseline survey because they did not meet the inclusion criteria. Additionally, we excluded 10 women from a primary sampling unit at baseline and another 10 women from a primary sampling unit of the follow-up survey.

Table 2 shows the distributions of the basic characteristics of the women. The intervention group had more Muslim and wealthy women than the control group.

Table 3 shows the contents of care received by the women and their newborns during ANC, PPC and PNC. After the intervention, 12.6% of women in the intervention group received all 6 items during ANC, 33.6% received all 3 items during PPC and 41.5% of women and their newborns received all 14 items during PNC. The adjusted DiD estimators showed no significant changes across the three phases: 2.2 (p=0.61) at ANC, 2.3 (p=0.69) at PPC and 8.1 (p=0.35) at PNC. Among the four ANC care items in which receptions were recorded in the CoC card, blood group testing increased from 49.9% to 79.5% in the intervention group. The reception of other care items in the intervention group remained low even after the intervention: haemoglobin tests (40.9%), intermittent preventive treatment for malaria (43.7%) and tetanus toxoid vaccination (46.4%). During the peripartum period, only 47.0% in the intervention group of the follow-up survey initiated breastfeeding within the first 30 min. During PNC, over 60% of women and their newborns in the intervention group of the follow-up survey received each care item.

Table 4 shows the effect of the intervention on adequate contacts with high-quality care. For the per-protocol analysis, we excluded 238 women in the intervention group who did not receive a CoC card and 134 women in the control group who received a CoC card. During ANC, 12.6% of women in the intervention group in the follow-up survey had adequate contacts with high-quality care. The adjusted DiD estimators for adequate contacts with high-quality care during ANC were 2.2 (p=0.61) in the intention-to-treat design and 2.8 (p=0.54) in the per-protocol design. During PPC, 31.5% of women in the intervention group in the follow-up survey had adequate contacts with high-quality care. The adjusted DiD estimators for adequate contact with high-quality care during PPC were 1.9 (p=0.73) in the intention-to-treat design and 2.7 (p=0.66) in the per-protocol design. During PNC, 33.7% of women in the intervention group in the follow-up survey had adequate contacts with high-quality care. The adjusted DiD estimators for adequate contact with high-quality care during PNC were 12.3 (p=0.13) in the intention-to-treat design and 18.1 (p=0.02) in the per-protocol design. Additionally, table 4 shows the gap between adequate contacts (ie, adequate contacts with high-quality and low-quality care) and quality-adjusted adequate contacts (ie, adequate contacts with high-quality care). In the intention-to-treat design, 76.9% of women in the intervention group in the follow-up survey had adequate contacts during ANC; however, only 12.6% had quality-adjusted adequate contacts. Moreover, 82.0% delivered with the assistance of a skilled birth attendant at a healthcare facility, while only 31.5% had a skilled delivery with high-quality care. During PNC, 62.2% of women and their newborns had adequate contacts. However, only 33.7% had quality-adjusted adequate contacts.

Table 5 shows factors associated with having adequate contacts with high-quality care according to the characteristics of women in the intervention group in the follow-up survey (n=870). Women living in Navrongo were more likely to have adequate contacts with high-quality care during PPC and PNC than women living in Kintampo (adjusted odds ratio (AOR)=0.27; 95% CI 0.12 to 0.63 at PPC, AOR=0.08; 95% CI 0.03 to 0.19 at PNC) and in Dodowa (AOR=0.20; 95% CI 0.10 to 0.41 at PPC; AOR=0.39; 95% CI 0.23 to 0.65 at PNC).

Table 2 Basic characteristics of women (n=2970)

	Baseline (n=1480)			Follow-up (n=1490)		
	Control (n=617)	Intervention (n=863)		Control (n=620)	Intervention (n=870)	
	n (%)	n (%)	P value	n (%)	n (%)	P value
Study site			0.43			0.40
Navrongo	220 (35.7)	280 (32.4)		220 (35.5)	280 (32.2)	
Kintampo	198 (32.1)	288 (33.4)		200 (32.3)	290 (33.3)	
Dodowa	199 (32.3)	295 (34.2)		200 (32.3)	300 (34.5)	
Living in a subdistrict with a district hospital			<0.01			<0.01
Yes	70 (11.4)	328 (38.0)		70 (11.3)	340 (39.1)	
No	547 (88.7)	535 (62.0)		550 (88.7)	530 (60.9)	
Age			0.83			0.93
≤19	35 (5.7)	53 (6.1)		92 (14.8)	130 (14.9)	
20–34	452 (73.3)	638 (73.9)		439 (70.8)	621 (71.4)	
35–49	130 (21.1)	172 (19.9)		89 (14.4)	119 (13.7)	
Education			0.77			0.12
Did not complete primary school	178 (28.9)	257 (29.8)		145 (23.4)	182 (20.9)	
Completed primary school	170 (27.6)	222 (25.7)		196 (31.6)	242 (27.8)	
Completed secondary school	209 (33.9)	289 (33.5)		207 (33.4)	326 (37.5)	
Complete tertiary school	60 (9.7)	95 (11.0)		72 (11.6)	120 (13.8)	
Marital status			0.12			0.32
Married	415 (67.3)	542 (62.8)		351 (56.6)	470 (54.0)	
Cohabitating	150 (24.3)	224 (26.0)		163 (26.3)	260 (29.9)	
Other	52 (8.4)	97 (11.2)		106 (17.1)	140 (16.1)	
Parity			0.37			0.09
Primipara	128 (20.8)	196 (22.7)		187 (30.2)	299 (34.4)	
Multipara	489 (79.3)	667 (77.3)		433 (69.8)	571 (65.6)	
Religion			<0.01			<0.01
Christian	524 (84.9)	656 (76.0)		533 (86.0)	682 (78.4)	
Muslim	51 (8.3)	150 (17.4)		65 (10.5)	145 (16.7)	
Others	42 (6.8)	57 (6.6)		22 (3.6)	43 (4.9)	
Wealth quintiles			<0.01			<0.01
Lowest	144 (23.3)	156 (18.1)		171 (27.6)	188 (21.6)	
Lower	141 (22.9)	155 (18.0)		132 (21.3)	112 (12.9)	
Middle	104 (16.9)	196 (22.7)		118 (19.0)	174 (20.0)	
Higher	120 (19.5)	169 (19.6)		106 (17.1)	192 (22.1)	
Highest	108 (17.5)	187 (21.7)		93 (15.0)	204 (23.5)	
National health insurance			0.21			0.06
Covered	344 (55.8)	510 (59.1)		407 (65.7)	611 (70.2)	
Not covered	272 (44.2)	353 (40.9)		213 (34.4)	259 (29.8)	

P, P value for χ^2 test.

During ANC, however, women living in Dodowa were more likely to have adequate contacts with high-quality care (AOR=3.26; 95% CI 1.67 to 6.33) than those living in Navrongo. Women with national health insurance membership were more likely to have adequate contacts with high-quality care during ANC (AOR=1.78; 95% CI

Table 3 Content of ANC, PPC and PNC (n=2970)

	Baseline		Follow-up					
	Control (n=617)	Intervention (n=863)	Control (n=620)	Intervention (n=870)				
	%	%	%	%	cDiD	P value	aDiD	P value
ANC								
All six care items received	5.7	4.9	10.7	12.6	2.8	0.52	2.2	0.61
Blood group and Rhesus factor test	52.8	49.9	67.9	79.5	–	–	–	–
HIV test	59.0	55.6	79.7	77.6	–	–	–	–
Blood pressure assessment four times	55.3	51.5	71.5	72.4	–	–	–	–
Tetanus toxoid vaccination two doses	40.8	39.3	55.3	46.4	–	–	–	–
Intermittent preventive treatment for malaria three doses	40.4	36.3	44.2	43.7	–	–	–	–
Haemoglobin test two times	28.9	26.4	35.8	40.9	–	–	–	–
PPC								
All three care items received	24.3	23.8	31.8	33.6	2.3	0.70	2.3	0.69
Dried newborn's body	87.8	90.0	94.2	93.3	–	–	–	–
Skin-to-skin contact	47.8	45.9	58.9	60.7	–	–	–	–
Initiation of breastfeeding ≤30 min	44.9	38.9	46.3	47.0	–	–	–	–
PNC								
All 14 care items received	10.2	11.5	31.8	41.5	8.5	0.34	8.1	0.35
Mother								
All eight maternal care items received	21.2	22.5	35.2	47.7	11.3	0.12	10.9	0.14
Temperature measurement	65.5	65.2	69.4	78.1	–	–	–	–
Blood pressure assessment	50.2	47.3	69.5	76.8	–	–	–	–
Bleeding check	52.7	58.3	69.2	73.3	–	–	–	–
Breastfeeding problem check	46.4	52.4	66.8	72.0	–	–	–	–
Vitamin A supplement	59.0	57.7	58.9	68.4	–	–	–	–
Fundal height measurement	49.6	51.3	55.0	64.3	–	–	–	–
Perineum/lochia check	47.5	53.4	57.6	63.2	–	–	–	–
Haemoglobin assessment	48.5	48.9	51.1	61.7	–	–	–	–
Newborns								
All six newborn care items received	13.1	20.3	52.6	58.2	–1.6	0.87	–2.1	0.82
General physical examination	71.8	69.0	74.8	77.9	–	–	–	–
Temperature measurement	16.1	24.8	71.3	76.0	–	–	–	–
Breastfeeding difficulties check	47.5	57.0	71.0	73.8	–	–	–	–
Umbilical cord bleeding check	49.0	57.5	71.5	73.3	–	–	–	–
OPV	66.8	60.1	66.5	68.4	–	–	–	–
BCG immunisation	63.4	60.5	60.0	64.3	–	–	–	–

The DiD estimates were adjusted for study site, living in a subdistrict with district hospital, age, education, marital status, parity, religion, wealth quintiles and the status of the national health insurance membership.
aDiD, adjusted difference-in-difference estimators; cDiD, crude difference-in-difference estimators; OPV, oral polio vaccine; P, P value for DiD estimators.

1.14 to 2.77) and PNC (AOR=1.46; 95% CI 1.07 to 2.00) than those without membership. During ANC, unmarried women or women without cohabiting partners (ie, single, divorced, separated or widowed) were less likely to have adequate contact with high-quality care (AOR=0.40; 95% CI 0.17 to 0.94), whereas multiparous women were more likely to have adequate contacts with high-quality care than primiparous women (AOR=1.76, 95% CI 1.07 to 2.87). During PPC, women in the lower group in the wealth quintiles were more likely to have adequate

Table 4 Effect of intervention on having adequate contacts with high-quality care (n=2970)

	Baseline		Follow-up: Intention-to-treat						Follow-up: Per-protocol					
	Control (n=617)	Intervention (n=863)	Control (n=620)	Intervention (n=870)	cDiD	P value	aDiD	P value	Control (n=486)	Intervention (n=632)	cDiD	P value	aDiD	P value
	%	%	%	%					%	%				
ANC														
Inadequate contacts	32.7	31.6	22.7	23.1	–	–	–	–	23.7	22.0	–	–	–	–
Adequate contacts with low-quality care	61.6	63.5	66.6	64.3	–	–	–	–	66.5	65.0	–	–	–	–
Adequate contacts with high-quality care	5.7	4.9	10.7	12.6	2.8	0.52	2.2	0.61	9.9	13.0	3.9	0.43	2.8	0.54
PPC														
Inadequate contact	25.0	26.8	20.0	18.1	–	–	–	–	22.6	15.2	–	–	–	–
Adequate contact with low-quality care	54.1	53.1	49.8	50.5	–	–	–	–	50.0	50.6	–	–	–	–
Adequate contact with high-quality care	20.9	20.2	30.2	31.5	2.1	0.72	1.9	0.73	27.4	34.2	7.6	0.25	2.7	0.66
PNC														
Inadequate contacts	87.2	86.8	45.3	37.8	–	–	–	–	48.2	32.1	–	–	–	–
Adequate contacts with low-quality care	9.9	11.9	32.1	28.5	–	–	–	–	32.9	29.8	–	–	–	–
Adequate contacts with high-quality care	2.9	1.3	22.6	33.7	12.7	0.14	12.3	0.13	18.9	38.1	20.8	0.01	18.1	0.02

The DiD estimates were adjusted for study site, living in a subdistrict with a district hospital, age, education, marital status, parity, religion, wealth quintiles and the status of the national health insurance membership.
aDiD, adjusted difference-in-difference estimators; cDiD, crude difference-in-difference estimators; P, P value for DiD estimators.

Table 5 Factors associated with adequate contacts with high-quality care in the intervention group of the follow-up survey (n=870)

	ANC	PPC	PNC
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Study site			
Navrongo	1.00	1.00	1.00
Kintampo	0.80 (0.41 to 1.57)	0.27 (0.12 to 0.63)	0.08 (0.03 to 0.19)
Dodowa	3.26 (1.67 to 6.33)	0.20 (0.10 to 0.41)	0.39 (0.23 to 0.65)
Living in a subdistrict with a district hospital			
Yes	1.44 (0.83 to 2.50)	1.57 (0.84 to 2.91)	1.11 (0.69 to 1.79)
No	1.00	1.00	
Age			
≤19	0.81 (0.28 to 2.35)	0.75 (0.39 to 1.42)	0.48 (0.24 to 0.95)
20–34	1.00	1.00	1.00
35–49	0.69 (0.46 to 1.03)	1.00 (0.65 to 1.54)	0.79 (0.46 to 1.37)
Education			
Did not complete primary school	1.00	1.00	1.00
Completed primary school	1.09 (0.55 to 2.18)	1.26 (0.76 to 2.08)	0.73 (0.50 to 1.06)
Completed secondary school	1.65 (0.76 to 3.56)	1.18 (0.71 to 1.98)	0.64 (0.44 to 0.93)
Complete tertiary school	2.32 (0.81 to 6.67)	0.96 (0.47 to 1.99)	0.77 (0.37 to 1.59)
Marital status			
Married	1.00	1.00	1.00
Cohabitating	0.85 (0.55 to 1.29)	0.78 (0.51 to 1.20)	1.03 (0.58 to 1.82)
Other	0.40 (0.17 to 0.94)	1.26 (0.84 to 1.89)	1.14 (0.61 to 2.12)
Parity			
Primipara	1.00	1.00	1.00
Multipara	1.76 (1.07 to 2.87)	1.21 (0.79 to 1.86)	0.75 (0.41 to 1.39)
Religion			
Christian	1.00	1.00	1.00
Muslim	1.11 (0.59 to 2.08)	0.68 (0.39 to 1.19)	0.86 (0.47 to 1.58)
Other	0.50 (0.06 to 3.91)	1.63 (0.92 to 2.90)	1.87 (0.83 to 4.25)
Wealth quintiles			
Lowest	1.00	1.00	1.00
Lower	0.62 (0.23 to 1.69)	1.80 (1.14 to 2.83)	1.19 (0.80 to 1.76)
Middle	0.70 (0.27 to 1.80)	1.41 (0.83 to 2.42)	0.89 (0.53 to 1.48)
Higher	1.59 (0.68 to 3.75)	1.48 (0.85 to 2.60)	1.21 (0.68 to 2.15)
Highest	1.40 (0.61 to 3.21)	1.28 (0.70 to 2.33)	1.98 (1.00 to 3.92)
National Health Insurance			
Covered	1.78 (1.14 to 2.77)	1.20 (0.79 to 1.81)	1.46 (1.07 to 2.00)
Not covered	1.00	1.00	1.00

AOR by multivariable logistic regression analyses with cluster robust SEs.
AOR, adjusted odds ratios.

contacts with high-quality care, compared with women in the lowest group in the wealth quintiles (AOR=1.80; 95% CI 1.14 to 2.83). During PNC, teenage women were less likely to have adequate contacts with high-quality care than women aged 20 to 34 years (AOR=0.48, 95% CI 0.24 to 0.95). Women who had completed secondary school were less likely to have adequate contact with high-quality care compared with women who had never completed primary school (AOR=0.64; 95% CI 0.44 to 0.93).

DISCUSSION

A 12-month implementation of the intervention showed significant effects on regular contacts of women and

their newborns with healthcare providers and their reception high-quality care during at PNC in the per-protocol design. In the intention-to-treat design, however, the intervention showed no significant effects during ANC, PPC and PNC. In addition, a large gap remained between the crude adequate contacts and quality-adjusted adequate contacts. Hence, despite strengthening regular contacts with healthcare providers through the intervention, women and their newborns did not necessarily receive high-quality care. Furthermore, a chance to have adequate contacts and receive high-quality care varied among women with different sociodemographic backgrounds (ie, study site and membership of national health insurance) in the intervention group.

The results showed the intervention was efficacious in increasing postnatal contacts and receiving high-quality care among those who actually received the intervention, but did not provide evidence of the effectiveness. Before implementing the intervention, we found that the women were not aware of the importance of PNC, and they believed in a local custom that women and their newborns should stay at home for 6 weeks postpartum. As other intervention studies focused,[31 32] this intervention was designed to improve women's care seeking behaviour and healthcare' provider's knowledge. Using the CoC card, women learnt the importance and timings of PNC during ANC and were given specific appointments for PNC visits. Healthcare providers received a 3-day training course and a monthly supervision from the district health management team. The result indicates that the intervention package was efficacious, but did not reach all women equally.

The intervention showed no significant effect on ANC. Only 12.6% of women in the intervention group had adequate contacts and received high-quality care. Low coverage of haemoglobin assessment, tetanus toxoid vaccination and intermittent preventive treatment for malaria could result in low-quality care during ANC. During the intervention, we addressed these challenges by tracking the reception of these care items and blood group test using the CoC card. After the intervention, blood group testing significantly increased, whereas other care items did not change significantly. One possible explanation was that pregnant women could not receive those care items multiple times as recommended by the national guidelines. The percentage of women who had adequate contacts with high-quality care during ANC was higher in Dodowa than in Navrongo and Kintampo. A potential explanation is that Dodowa might be more advantageous in procuring the essential drugs and equipment for ANC as Dodowa is a part of the Greater Accra region.

During PPC, the intervention did not show significant effect of the intervention on adequate contact with high-quality care. Although over 80% of women had adequate contact (ie, facility-based skilled delivery) in the intervention group during the follow-up survey, only 60% of the women had skin-to-skin contact and 47% initiated breastfeeding within 30 min after delivery. Poor practice of these basic newborn care might result in a large gap between adequate contact and quality-adjusted contact in PPC. These newborn care do not require any equipment or technical skills and can be practiced at any PPC settings.

Women living in Navrongo were more likely to have adequate contacts with healthcare providers and receive high-quality care during PPC and PNC than those living in Kintampo and Dodowa. This implies that the intervention package works effectively through the advanced primary health systems in Navrongo. In Ghana, CHPS initiatives developed a community-based primary health system.[19] The initiatives was first introduced in Navrongo in 1994 and scaled-up across the country.[19] However, the community-based health systems remain underdeveloped in most parts of the country, including Dodowa and Kintampo. Unequal assignment of midwives among the three study sites was a typical example, which could affect the availability and quality of maternal and newborn care. The intervention package could work more effectively in improved health systems.

Women covered by the national health insurance were more likely to have adequate contacts and receive high-quality care during ANC and PNC, whereas unmarried women, women without cohabiting partners or teenage women were less likely to have adequate contacts with high-quality care during ANC or PNC. This highlights the importance of the national health insurance for women with low socioeconomic status to receive essential care. However, only 63% of the women in this study had insurance membership. The evidence presented in this study would be useful in advocating for the enrolment of more pregnant women in the national health insurance scheme.

Limitations

This study has several limitations. First, the clusters in the study were not homogeneous and cluster allocation was uneven. This might have impacted the effects of the intervention. The implementation in the intention-to-treat design allowed women to choose and use any healthcare facilities across the clusters, which could also influence the effect of the intervention. Second, the study sites had been exposed to various research projects.[33–36] The effects of our intervention could be built on the effects of previous projects. Third, no standardised measurements for the quality of ANC, PPC and PNC were available. Each quality of care index consisted of different numbers of items. Moreover, although the value of each item was not equal, we treated all items with an equal weight. Thus, comparing the quality of care among ANC, PPC and PNC would not be appropriate.

CONCLUSION

The intervention package for strengthening the CoC showed a significant effect on contacts with healthcare providers and the quality of care in PNC, but not in ANC

and PPC. Women and their newborns did not receive high-quality care during the regular contacts with healthcare providers. The intervention package could work more effectively under a well-developed community-based health system and with broader national health insurance coverage. Ensuring regular contacts with healthcare providers and improving quality of care are both vital in promoting maternal and newborn health in Ghana.

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Acknowledgements The authors thank the Ministry of Foreign Affairs in Japan and the Ministry of Health in Ghana. We also express our gratitude to the Ghana Health Service and the District Health Management Teams of the Shai-Osudoku, Ningo-Prampram, Kintampo North, Kintampo South, Kassena Nankana East and Kassena Nankana West for their support and cooperation to this study. We would also like to thank Professor Ana Langer, Associate Professor Margaret E Kruk, Professor Michael Reich and Lecturer Jesse B Bump, the Department of Global Health and Population, Harvard T. H. Chan School of Public Health, for their technical advice. We also thank the Takemi Programme in International Health, Harvard T. H. Chan School of Public Health and Japan Medical Association for their support.

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Contributors SO, MG, AS, KK, FY, CT, SA, KN, ARO, SOA, EA, GQA, JY, AH and MJ conceived and designed the study. SO, MG, FY, CT, SA, ARO and SOA conducted interventions and collected data. SO analysed, interpreted the data and drafted manuscript. SO, HL, AS, KK, EA, AH and MJ interpreted data. SO, MG, HL, AS and MJ contributed to the revision of manuscript. AH and MJ are the study guarantor. All authors approved the final version of the manuscript.

Funding This paper was funded by the Japan International Cooperation Agency (JICA) Human Development Department and JICA Research Institute (http://www.jica.go.jp/english/index.html).

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The study was approved by the Ethics Review Committee of Ghana Health Service, the Institutional Review Boards of Dodowa HRC and Navrongo HRC, the Institutional Ethics Committee of Kintampo HRC in Ghana and the Research Ethics Committee of Graduate School of Medicine, the University of Tokyo in Japan.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request.

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