







Integrating Calcium Supplementation into Facility-Based Antenatal Care Services in Western Kenya: A Qualitative Process Evaluation to Identify Implementation Barriers and Facilitators

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Abstract

Background: In countries with low calcium intake, the WHO recommends integrating calcium supplementation into antenatal care (ANC) to reduce the risk of preeclampsia, a leading cause of maternal mortality. Current WHO guidelines recommend women take 3–4 calcium supplements plus 1 iron-folic acid supplement at separate times daily. There is limited evidence about implementing these guidelines through routine ANC. Through the Micronutrient Initiative–Cornell University Calcium (MiCa) trial, we examined the effect of regimen on supplement consumption among ANC clients in western Kenya. A nested process evaluation examined factors that influence calcium supplementation delivery and uptake.

Objectives: This process evaluation assessed ANC providers', pregnant women's, and family members' experiences with calcium supplementation, and investigated the feasibility and acceptability of engaging family members to support adherence.

Methods: We conducted semistructured interviews with 7 ANC providers, 32 pregnant women, and 20 adherence partners (family members who provide reminders and support), and 200 observations of ANC consultations. Interviews were transcribed, translated, and analyzed thematically. Observational data were summarized.

Results: ANC providers reported positive feelings about calcium supplementation, the training received, and counseling materials, but reported increased workloads. Women reported that providers counseled them on supplement benefits and managing side effects, offered reminder strategies, and provided supplements and behavior change materials. Women explained that reminder materials and adherence partners improved adherence. Most adherence partners reported providing reminders and other instrumental support to help with pill taking, which women confirmed and appreciated. Some women reported that comorbidities, concerns about being perceived as HIV positive, pill burden, unfavorable organoleptic properties, and lack of food were adherence barriers.

Conclusions: Although integrating calcium into antenatal iron-folic acid supplementation was generally acceptable to ANC providers, pregnant women, and their families, calcium supplementation presents unique challenges that must be considered to successfully implement these guidelines. This trial was registered at clinicaltrials.gov as NCT02238704. *Curr Dev Nutr* 2018;2:nzy068.



Keywords: pregnant women, process evaluation, prenatal micronutrient supplementation, behavioral intervention, social support, preeclampsia, male involvement, qualitative methods, maternal nutrition

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Abbreviations used: ANC, antenatal care; IFA, iron-folic acid; MiCa, Micronutrient Initiative–Cornell University Calcium trial.

Introduction

Antenatal calcium supplementation can reduce the risk of preeclampsia, a leading cause of maternal mortality, and is considered a key nutrition-specific intervention to improve maternal and child health in low- and middle-income countries (1). The WHO recommends supplementation with 1.5–2.0 g Ca/d starting at 20 wk of pregnancy for women in countries with low habitual calcium intake (2). The WHO released these guidelines in 2013, but evidence about the acceptability, feasibility, and appropriateness of delivering calcium supplements through antenatal care (ANC) is limited. Antenatal iron and iron-folic acid (IFA) supplementation programs in low- and middle-income countries have historically faced many challenges with implementation and adherence (3), and it is anticipated that the addition of calcium supplementation could exacerbate these challenges (4). Despite these concerns, early evidence suggests that calcium supplementation may be acceptable to pregnant women and feasible to deliver through existing facility- or community-based services (5–7).

In Kenya, national guidelines recommend that women receive IFA as part of ANC (8). However, barriers to antenatal micronutrient supplementation are well documented, and include supply shortages and stockouts; ineffective counseling by ANC providers; and pregnant women forgetting to take supplements, perceiving adverse side effects, and disliking the supplements (9, 10). The Micronutrient Initiative-Cornell University Calcium (MiCa) Trial (NCT02238704) was a cluster-randomized noninferiority trial that examined the effect of supplementation regimen on the amount of calcium supplement ingested (5, 11), and included a nested qualitative process evaluation. The objectives of the process evaluation were to assess the delivery of calcium supplementation through routine ANC by examining ANC providers', pregnant women's, and family members' experiences, and to investigate the feasibility and acceptability of engaging family members to support supplementation adherence.

Methods

Overview of the MiCa trial

The trial was conducted from September 2014 to June 2015, and has been previously described (5, 11). Briefly, MiCa was a parallel, noninferiority, cluster-randomized trial comparing the effect of higher (three 500-mg calcium pills per day) and lower (two 500-mg calcium pills per day) dosage calcium supplement regimens on supplement consumption by pregnant women seeking ANC from government health facilities. Pregnant women ($n = 1036$; 16–30 weeks of gestation) were recruited from 16 primary care health facilities in Malava subcounty, Kakamega County, Kenya. Facilities were randomized to either a higher- or lower-calcium supplement regimen; all facilities received the same types of supplements. The calcium supplement was a hard pill with 500 mg of elemental calcium as calcium carbonate and 200 IU cholecalciferol. The IFA supplement was a hard pill with 60 mg Fe and 400 μg folic acid. ANC staff were responsible for supplement dispensing and counseling. Based on the assigned regimen, the study team provided health facilities with sufficient supplies of calcium and IFA supplements, 1-d training for ANC providers on calcium and IFA supplements and counseling skills, calcium and IFA counseling cards,

and take-home reminder calendars for women (12). An adherence partner strategy was included at all facilities regardless of regimen. An “adherence partner” is someone, typically a family member, whom pregnant women select and ask to provide adherence reminders and support (13). The study team trained all health workers about adherence partners, included information about adherence partners in the counseling cards and calendars, and provided posters with motivating messages for adherence partners that women could take home (12). Adherence partners did not have any direct interaction with the health system or receive any guidance from ANC providers about how to support women. ANC providers gave women the poster to share with their adherence partner and counseled them to ask for adherence support. All training, counseling, and adherence partner materials are freely accessible from the study website (12).

MiCa trial findings suggest that incorporating calcium supplementation into ANC is feasible (14), and mean adherence to calcium and IFA was high (>80%) for both regimens (5, 14, 15). Adequate supplies of calcium and IFA supplements and counseling job aids were available during 94%, 98%, and 97% of unannounced facility spot checks, respectively (14). Adherence partners were selected by 90% of trial participants (15).

Process evaluation

This process evaluation included in-depth interviews with ANC providers from trial-affiliated health facilities, MiCa trial participants, and their adherence partners, plus structured observations of ANC visits (Figure 1). We purposively recruited a subsample of trial participants for the in-depth interviews. Women were sampled to reflect diversity in the type of facility at which they accessed ANC (i.e., health centers, small dispensaries with 1–2 staff), assigned regimen, calcium supplement adherence levels (high, low), and having an adherence partner. Adherence partners of women participating in the process evaluation were invited to participate in independent interviews. Everyone invited agreed to participate. For the structured observations, the study team sought to observe 9–15 consultations at each facility, divided evenly between women's first, second, and third ANC visits.

Data collection

In February–April 2015, a PhD-level qualitative researcher (VW) and graduate student (HO) conducted semistructured interviews with ANC providers, women, and adherence partners using separate semistructured interview guides (Supplemental Material). Interviews were conducted in Kiswahili, Luhya, or English based on participant preference, and lasted between 45 and 75 min. To reduce social desirability bias, the 2 interviewers had not participated in data collection for the larger trial and conducted the interviews separately from trial data collection. The interviewers interviewed ANC providers in a private room at the health facilities, and women and adherence partners individually at home. The interviewers assured participants that the study team was interested in their experiences with supplementation, both negative and positive. All interviews were audio recorded, transcribed, and translated into English.

Trained data collectors used an observation checklist adapted from Phillips et al. (16) to conduct ANC consultation observations at 16 facilities. Observers identified trial participants whose consultations were consistent with the sampling guidelines. Observers obtained

Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Provider training	Cluster-randomized trial									
					ANC consultation observations					
						In-depth interviews				

FIGURE 1 Process evaluation timeline. ANC, antenatal care.

consent from all health care providers and clients to stay in the room during consultations, but did not describe what was being observed. They observed sequential consultations until reaching the required number.

Analysis

We analyzed interview transcripts thematically, based on the constant comparative method (17). The qualitative analysis team comprised 5 members. To foster coding consistency across the team, all analysts identified and coded each ANC provider transcript using principles of grounded theory (17). Key themes were discussed during frequent peer debriefings and summarized in a matrix. Because of the larger number of women's and adherence partners' interviews, the team used Atlas.ti version 7 (Scientific Software Development GmbH, Berlin, Germany) to analyze women's and adherence partners' interview transcripts. For the women's interviews, all analysts independently read and coded the same 2 transcripts. The team then reviewed the codes as a group and collaboratively created a codebook. To ensure coding consistency, we agreed on code names, definitions, and inclusion and exclusion criteria (18, 19). Through the debriefings and code book development, we determined that the level of agreement when coding was quite high across the analysis team, and no longer necessitated all team members reading each transcript. All transcripts were then coded with the use of Atlas.ti version 7 with ≥ 2 analysts independently coding each transcript. The analysts met frequently to discuss emergent codes and any discrepancies, iteratively revising the codebook. Any discrepancies in coding that occurred were deliberated until reaching consensus. Major themes and findings were discussed during peer debriefings. The analysis team followed the same approach for the adherence partner transcripts. Observation data were managed in Excel (Microsoft, Redmond, WA) and summarized for each category of ANC consultation (i.e., first, second, or third visit).

In-depth interview participants provided written informed consent before enrollment. The Institutional Review Board at Cornell University and Kenyatta National Hospital and University of Nairobi Ethics and Research Review Committee approved this study.

Results

Participants

We interviewed 7 ANC providers (4 women, 3 men) from 4 health centers and 3 dispensaries. Their median years of professional experience was 3 (range 2–21). The characteristics of the 32 women in the sample are summarized in Table 1. We also interviewed 20 adherence partners, including 13 husbands, 4 mothers-in-law, 2 mothers, and

1 grandmother. We observed 200 ANC consultations; 68% were conducted by female ANC providers.

ANC providers

ANC providers were generally positive when asked about their experiences with calcium supplementation, but they identified a few ways to improve the delivery of calcium supplementation through ANC.

Training. Although all ANC providers reported that the training they received was sufficient to implement the program, more than half wanted additional information about calcium supplementation and more detailed information to better answer women's questions (Table 2).

Delivery. All ANC providers reported positive feelings about the addition of calcium supplementation (Table 2). They said that women liked the calcium pills and appreciated the information they received. The results of the observations suggest that ANC providers counseled participants with a high level of fidelity (Table 3).

Providers felt that women were motivated to adhere to calcium and IFA supplementation because of the health benefits for themselves and their infant. Most providers reported observing improvements in women's health since the calcium supplementation program began. Several ANC providers associated the availability of calcium with increased numbers of pregnant women seeking care, and mentioned that women knew that the supplements were available and it motivated them to come for ANC.

When asked about difficulties they experienced implementing the program, almost all ANC providers mentioned increased workload as their main challenge. ANC providers also discussed the challenge

TABLE 1 Women participants' demographic characteristics

Characteristic	(n = 32)
Age, mean (range)	25.4 (17–40)
Ethnicity, n (%)	
Luhya	28 (87.5)
Luo	2 (6.3)
Other	2 (6.3)
Education, n (%)	
Some primary	4 (12.5)
Completed primary	20 (62.5)
Some secondary	6 (18.8)
Completed secondary or higher	2 (6.3)
Married or cohabitating, n (%)	29 (90.6)
Number of children, mean (range)	2.1 (0–10)
Primigravid, n (%)	8 (25)
Had an adherence partner, n (%)	20 (62.5)

TABLE 2 Illustrative quotes from antenatal care providers about calcium supplementation

Themes	Illustrative quotes
Training was sufficient, but more depth was desired	We never went so deep into it. But, we got the essence, we got that this is calcium, it is there to do this and this for the mother... but if there was time, we could have gone deeper... but the training we got, we are using it and we are performing. —Health center nurse, #03-06
Perceived improvements in women's health as a result of calcium supplements	I know it is essential to give women the supplements because... before this program was introduced these women had difficulties during pregnancy... When we started giving out this calcium, those problems with pregnancy reduced... women are taking it positively because they find someone to encourage them at home and remind them to take these supplements. The way that we counsel them, they usually find it essential for them to take these pills because they know the benefits. —Dispensary nurse, #11-31
Observed increased attendance at antenatal care	I have liked [calcium] because initially when you give pregnant women health education, it really spreads and everybody is eager. Whenever they come, they will even remind you, "What about the calcium and IFA?" Compared to places where they are not giving calcium, they prefer coming here because they say they understand there is a new pill. —Health center nurse, #17-48
Experienced increased workload	[The addition of calcium] has led to more work on our side. You see, I have to do the counseling and the dispensing... but there is nothing you can do about the workload because we [providers] are few. —Health center nurse, #15-43
Comorbidities made adherence challenging	We are giving them anti-malaria medicine, IFA, and now calcium... for some, it is like you are overloading them. Even some will tell you, "Doctor, there are so many medicines." Others say they don't like swallowing tablets. After counseling, they come to see the benefits and will take them, but she will tell you she doesn't like taking all these medicines. —Health center nurse, #03-06
Suggestions to improve supplementation programs	What I have heard from almost all my clients, in fact all of them, is that these tablets are too many to take. At least, if it could have been 1, it would be OK. If there was a way they could make 1 tablet taken once, however big or small, at least it will be a combination. There wouldn't be a lot tablets being carried all over. —Dispensary nurse, #04-13
Opinions about adherence partner strategy	It is also good when you have somebody who is encouraging you to take it; at least you feel you have somebody who is caring for you, who is concerned. —Health center nurse, #17-46

of counseling women with comorbidities (e.g., HIV, malaria) and the associated high daily pill burden. Additional counseling challenges included concerns about information overload, women with side effects, and women worrying about being perceived as HIV positive. No ANC providers mentioned supply challenges.

ANC providers said they used the counseling materials often, and that they were easy to use, facilitated counseling, saved time, and women liked them. One provider felt that the images of recommended food items were excessive because some women interpreted the images to mean they needed to eat all of the foods, rather than a diverse diet in pregnancy as was intended.

We asked ANC providers for suggestions about ways to improve calcium supplementation delivery and uptake. Many suggested additional strategies to inform women and the community about calcium and IFA, such as radio spots and community health workers. Several suggested reducing the calcium regimen or creating a combined calcium and IFA supplement to address pill burden. All ANC providers were in favor of the adherence partner concept, saying it helped women remember to take the pills, served as a source of encouragement, and involved the husband in the pregnancy.

Women's adherence to supplementation

Most women reported positive experiences with calcium and IFA supplements and the counseling and materials they received (Table 4). Several women identified the counseling as their reason for taking the calcium and IFA supplements. They felt ANC providers were

knowledgeable about calcium and IFA supplementation, explained information thoroughly, counseled them about what to do if they experienced side effects, and answered their questions. However, when we asked women whether they had questions about either supplement, half asked about taking calcium supplements outside of pregnancy. They wondered whether they should stop taking them after delivery, and whether others, including children, could take them.

Women listed several factors that motivated their adherence to calcium and IFA supplementation. Most mentioned anticipated and experienced benefits, including feeling strong, having more energy, increased appetite, compensating for inadequate diets, and overall well-being. Almost all listed reminders from family members, the calendar, and the adherence partner poster as facilitators.

Although women generally felt positively about calcium and IFA supplementation, several highlighted factors that made adherence challenging. A few women reported being discouraged from taking calcium supplements by neighbors or others in their community who said supplements could harm them or their fetus. Most women reported other pregnant women and peers giving this advice, whereas others referred to "people" in the community. However, all of the women who reported this continued to take their supplements. A few women reported that other people thought they were HIV positive when they saw their calcium pills or the poster, but this also did not influence their adherence. More than half of the participants reported experiencing side effects (e.g., dizziness, vomiting, stomach pains) when they first started to take calcium and IFA supplements, but they said they

TABLE 3 Observations of providers counseling clients during first, second, and third ANC visits¹

Information ANC providers shared	First visit (n = 73), n (%)	Second visit (n = 63), n (%)	Third visit (n = 64), n (%)
Purpose of calcium pills			
Reduce risk of preeclampsia or high blood pressure	73 (100%)	55 (87.3%)	54 (84.4%)
Protect the health of women and infant/protect against health problems	73 (100%)	58 (92.1%)	49 (76.6%)
Prevent fits that can lead to death of mother and infant	63 (86.3%)	23 (36.5%)	26 (40.6%)
Purpose of iron-folic acid pills			
Reduce risk of anemia or weak blood	73 (100%)	54 (85.7%)	48 (75.0%)
Protect the health of women and infant/protect against health problems	72 (98.6%)	58 (92.1%)	45 (70.3%)
Prevent feeling tired, dizzy, weak or give strength/energy	69 (94.5%)	44 (69.8%)	20 (31.3%)
Reduce risk of bleeding during delivery	45 (61.6%)	4 (6.35%)	6 (9.38%)
How to take supplements			
What times of day to take supplements	73 (100%)	60 (95.2%)	60 (93.8%)
Take calcium with food	66 (90.4%)	58 (92.1%)	56 (87.5%)
How many iron-folic acid pills to take each day	72 (98.6%)	59 (93.7%)	54 (84.4%)
Strategies to cope with side effects			
Side effects are not harmful and usually go away if you keep taking the tablets	61 (83.6%)	33 (52.4%)	11 (17.2%)
Talk to a health care provider if side effects continue	60 (82.2%)	32 (50.8%)	18 (28.1%)
Taking tablets with food can help	59 (80.8%)	39 (61.9%)	14 (21.9%)
Specific side effects			
Black stools	59 (80.8%)	23 (36.5%)	2 (3.1%)
Diarrhea	58 (79.5%)	15 (23.9%)	3 (4.7%)
Nausea	45 (61.6%)	17 (27.0%)	7 (10.9%)
Constipation	33 (45.2%)	12 (19.1%)	2 (3.1%)
Counseling cards and take-home materials			
Gave a reminder calendar	72 (98.6%)	60 (95.2%)	64 (100%)
Gave adherence partner poster	68 (93.2%)	55 (87.3%)	64 (100%)
Used counseling cards to suggest asking someone to support adherence	61 (83.6%)	8 (12.7%)	4 (6.3%)
Used counseling cards to discuss calcium and iron-folic acid supplements	61 (83.6%)	8 (12.7%)	2 (3.1%)

¹Some regimen and counseling information is less relevant at the second and third ANC visits. ANC, antenatal care.

continued to take the supplements in spite of this, and the side effects stopped with time. Several women complained about the organoleptic properties (e.g., taste, smell, size) of both supplements, but said this did not influence their adherence. We asked for suggestions about how the supplements could be improved. Several women suggested making the calcium supplements smaller and coating both supplements to make them more palatable.

Women talked about the relation between food and calcium adherence. Meals served as a reminder to take calcium pills and helped reduce side effects. However, almost half of the participants reported that food availability was an issue. A few women reported that the calcium and IFA supplements caused them to stop eating soil, which they had previously craved.

Women's experiences with calcium and IFA supplementation presented here did not vary by calcium regimen, and they were similar among women with high and low calcium adherence. However, some challenges were far more common among women with low calcium adherence (Table 5). Being away from home was a common barrier reported by women with low calcium adherence. This included women who traveled out of town or were away from home during the day. A few women attributed their low calcium adherence to forgetting because of their busy schedules. Several reported that illness or taking other medications led them to stop taking their calcium and IFA supplements, either permanently or for long periods. Only 1 participant reported

running out of IFA supplements; none reported running out of calcium supplements.

Participants with adherence partners. Almost all of the participants who had adherence partners appreciated the experience (Table 6). Women reported that adherence partners provided reminders, and helped provide or prepare food. Several women reported improved relationships with their adherence partners, and increased involvement with their pregnancy. A few women reported their spouses initially served as their adherence partner, but with time their spouses were no longer available to remind them, mainly because of long work hours or travel. Women who reported never having an adherence partner described their husbands or other family members as not being available to help, or felt they did not need help.

Women without adherence partners described aspects of their experience with calcium and IFA supplementation that were distinct from those with adherence partners. Several women without adherence partners mentioned being encouraged by family members to take their supplements, but most reported receiving daily reminders from their young children, and not from their spouse or female family members. Women without adherence partners who identified not having food as a barrier to adherence did not talk about receiving help with food in the same way as did women with adherence partners.

TABLE 4 Illustrative quotes from women about their experiences with calcium and iron-folic acid supplementation

Theme	Illustrative quote
Valued the counseling from providers	They talked with us in a good, gentle way. If you didn't understand something they would repeat the explanation until you understood it well. —20-y-old primigravida, #17-011
Motivated by perceived benefits	Here we don't have good food that has all the required nutrients for good health. When you take those medicines, they kind of bring about a balance. —23-y-old multigravida, #17-001
Visual cues supported adherence	On this poster, I can see the pills, there is a person who is helping you take your pills... To me, I feel [the poster] is helpful because it is a reminder that I should continue taking my pills and when it is hanging there, when I sit there I remember that I need to take my pills. —19-y-old multigravida, #04-064
Neighbors discouraged pill taking	She told me that if I take those pills, I will be bedridden and never be able to wake up again. She told me that I will be very tired, and I will not be able to do any work and who will do it for me. I should just leave [the supplements] alone. I told her that I am going to try them and see for myself. —30-y-old multigravida, #04-049
Concerns about being perceived as HIV positive	I was given [the poster] and hung it here, but removed it when I heard people saying I have HIV... I tried telling them that this is just a picture and when I look at it I remember to take my pills but they insisted and told me to remove it otherwise people will think I have the disease. —25-y-old multigravida, #14-057
Taking pills with food helped with adherence	What helped me was that when I eat and then take them I would feel good, but if I take them before having a meal, then I would feel so nauseated and then become very weak... But once I eat and then take them, all would be well. —20-y-old primigravida, #17-011
Food insecurity was a barrier to adherence	It is a must that you have to eat before taking that medicine and so you start worrying about how you will take your medicine and you have not eaten. That is the one thing that really makes it difficult for me. —19-y-old multigravida, #04-064
Taking supplements reduced pica	When I started taking those tablets, my urge to eat soil disappeared and I developed an appetite for food. —25-y-old multigravida, #03-004

Adherence partners

All adherence partners described their role as reminding women to take their supplements; several also talked about providing healthy foods, helping with chores, and reducing stress (Table 7). Several adherence partners said that being an adherence partner was consistent with their responsibility as a spouse, mother, or mother-in-law. Adherence partners also helped women manage side effects and provided food. Almost all adherence partners said they were assisting the woman because they wanted her to have a safe delivery and, for a few, a healthy child.

A few husbands talked about closely monitoring supplement adherence; women talked about this monitoring differently. One woman found her husband's monitoring to be positive; another viewed it negatively (Table 7).

Discussion

ANC providers, pregnant women, and adherence partners identified several factors that facilitate and impede the implementation of calcium supplementation delivered alongside IFA through ANC (Figure 2). We found that in western Kenya calcium supplementation was acceptable to providers, women, and their families, but there are modifiable factors that can be addressed to improve implementation.

Provider training and counseling

Although ANC providers had positive views of calcium supplementation, they identified 2 issues of concern. First, an increase in their workloads, in terms of both counseling clients and dispensing supplements. Based on ANC providers' suggestions, task-shifting approaches could

TABLE 5 Illustrative quotes about barriers to calcium and iron-folic acid supplementation from women with low adherence

Theme	Illustrative quote
Traveling	I only forgot once... only those 2 weeks when I went home [to parents' house] for my father's funeral and it was because I was in a hurry and only remembered when I had reached home. —23-y-old multigravida, #11-035
Being out of the house during the day	Maybe before I go to church I remember to take them, but we usually go very early and then come back by 2:00 pm. That is how I got defeated. —25-y-old multigravida, #03-004
Being busy	I wake up and start with my chores, by 10:00 am you have forgotten that you were supposed to take any pills. —29-y-old multigravida, #11-052
Taking other pills for comorbidities	When I went for treatment, I was given some drugs and when I looked at these ones, I felt they are too many for me to take at one go. I took those ones for healing purposes, since it was just for a short period and then I continued with IFA and calcium. —22-y-old primigravida, #03-032

TABLE 6 Illustrative quotes from women about their experiences with adherence partners

Theme	Illustrative quote
Adherence partners provided food	When I told her that if I take the medicine before eating I feel weak, she would ask me if I had eaten before I take the medicine. If I hadn't eaten anything, she would bring me something to eat. —31-y-old multigravida, #03-033
Relationships with adherence partners improved	We sit together and chat away and when it is time for medicine she [mother-in-law] reminds me. Before we never used to sit together and talk. She used to go away at lunchtime, but these days she makes sure she is around so that I can take my medicine. —17-y-old primigravida, #03-052
Not all adherence partners provided support	I thought it [having an adherence partner] was a good idea and since I am usually with my husband, I chose him. But, it reached a point whereby he was coming home late and would even find us asleep... so I got tired with him and I decided to encourage myself and try to remember to take the medicine. —29-y-old multigravida, #04-006

be considered for improving the delivery of calcium supplementation. Community health workers have counselled women and dispensed supplements in micronutrient supplementation programs (3, 20) and specifically for calcium supplementation (6, 7). Second, providers desired additional training about calcium supplementation. In this setting, a 1-d training appeared to be adequate for providers to deliver calcium supplements and counsel women on their regimen and managing side effects with high fidelity at their first ANC consultation. Adding topics could enhance the quality of counseling and women's adherence, as well as meet providers' expressed needs. Based on provider feedback and women's questions, topics could include counseling about food and diet; advising women about supplementation postpartum; and providing strategies to help women who were busy or away from home, taking

pills for other morbidities, or concerned about being perceived as HIV positive. ANC providers, women, and adherence partners all valued the job aids and behavior change materials provided as part of the trial. Providing context-specific materials based on formative research can strengthen the impact of antenatal calcium supplementation programs.

Adherence

Through our formative research when counseling and supplements were delivered at home by study staff, we identified several adherence facilitators and barriers (21). Although this trial differed in that ANC providers rather than study staff delivered supplements and counseling at health facilities, several of our findings were similar. Women identified feeling better and reminder strategies (i.e., calendar,

TABLE 7 Adherence partners' experiences supporting antenatal micronutrient supplementation

Theme	Illustrative quote
Adherence partners provide instrumental, emotional, and informational support	I take care of all the things and any sort of work around the house, including fetching water. For the last 4 months she has never stepped in the river... I also have to leave her food to prepare; at least she can do that without much strain... I vowed that whether in joy or pain, hardships and happiness, I have to be there for her. Any husband is supposed to look after his pregnant wife in all ways possible. —Husband, #04-001 When she is pregnant, I am supposed to keep her from being stressed all the time because the baby in the womb will also be affected. —Husband, #03-005 I have to make sure that she eats something and does not stay without any food; I have to try to find some so that she can eat and then take her pills after the meal. —Mother, #15-004
Support adherence for the woman's health	When your wife is healthy, you feel proud... if she has a safe delivery and the baby is healthy, it is to your benefit. Also, when you are helping and reminding her to take her pills it improves your relationship and brings you closer. It builds your marriage together. —Husband, #03-004
Adherence support was consistent with their role	I am happy because when a girl comes to your homestead and she is pregnant you need to support her so that even when she goes to her home, her people can see that she is healthier than when she left their home. —Mother-in-law, #15-040
A few husbands closely monitored adherence, which women had mixed feelings about	She used to be weak but now that she is taking the pills, she is better... In the beginning when she would cook food and bring it to the table, I would ask her, "Where is the book [calendar]?" She would give me the book and I would tell her to take the medicine. Now it has become easy. Even if I'm not around she takes her pills. —Husband, #03-034 In the morning he looks at the calendar and asks me if I have taken my pills and then I tell him I have just taken it now, and if I have forgotten he will look for [the pills] and bring them to me... Him reminding me has really helped me take the pills as directed. —24-y-old multigravida, #03-034 Sometimes if you are not feeling well or are tired and maybe somebody is persisting, you don't feel good, at times you tell him to get off your case, and he persists. When somebody keeps persisting, I don't like it. —37-y-old multigravida, #15-006

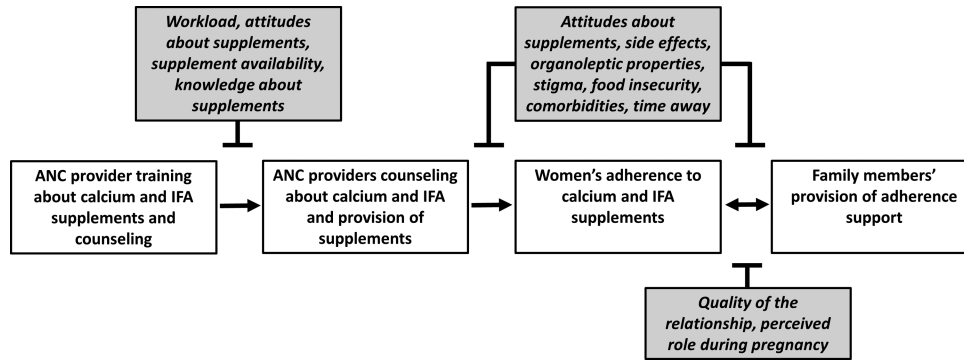


FIGURE 2 Conceptual framework: barriers and facilitators to calcium and IFA supplementation. White boxes indicate research questions guiding the process evaluation; shaded boxes indicate study findings about barriers and facilitators. ANC, antenatal care; IFA, iron-folic acid.

poster, adherence partners) as adherence facilitators, and traveling, being away from home, being busy, experiencing side effects, and negative organoleptic properties as barriers (21). In this study, the most salient adherence motivator women reported was the counseling they received from ANC providers. Benefits of high-quality counseling have been identified in other micronutrient supplementation studies (22). This is notable, because many women reported receiving inadequate IFA counseling in our formative research (10).

The importance of food was prominent in this context and should be considered in training providers and developing counseling materials. Women reported that taking supplements with food helped manage side effects, and mealtimes triggered calcium pill taking. However, in this food-insecure environment, not having food readily available emerged as an issue. Food insecurity was a barrier to calcium adherence in our previous research in Kenya (15, 21) and has been reported as such in Bangladesh (7). The 3-pill calcium regimen lends itself to taking supplements at mealtimes, but only if women eat 3 meals/d. Providers can counsel women to take calcium supplements with food, and our observation data showed that they did so consistently. At the same time, ANC providers should assure women that pills can be taken without food. Counseling materials should emphasize the role calcium and IFA play in helping to supplement women's diets, particularly for women who view their diets as inadequate, which is common in this setting (10). Our observations found that women were consistently counseled about the calcium and IFA regimens, and there is no indication from our analysis that the multiple calcium pill regimen resulted in women consuming additional IFA.

Family support

Family members influence antenatal micronutrient supplement adherence (10, 22, 23). Recognizing this influence, we included the adherence partner strategy in the MICa trial. Engaging family members, particularly male partners, to support maternal health is promoted widely (24). Although our previous research suggested that adherence partners were acceptable to most women (13), we had not previously examined adherence partners' perspectives.

Adherence partners reported providing instrumental, informational, and emotional support to pregnant women, which women confirmed. The support provided was both specific to supplement

adherence (e.g., reminders, food) and related to health and well-being in pregnancy more broadly (e.g., helping with chores). Adherence partners were motivated to support adherence because they believed supplementation was important for women's health in pregnancy, and providing adherence support was consistent with how many husbands and other family members perceived their role. Other maternal and child nutrition studies in Kenya have found that family members want nutrition information, and are willing to support maternal and child nutrition practices (25–27).

In general, women who had adherence partners appreciated the support they received. A limited number of women reported that their adherence partner stopped providing support and 1 reported that the reminders from her husband were excessive. Challenges with adherence support waning over time (28) and overbearing monitoring (29) have been reported in other contexts. Encouraging women to select adherence partners who are supportive in other aspects of their lives should limit the risk of overbearing monitoring. Alternatively, programs can engage men directly and discuss how best to provide adherence support and reminders. Although adherence partners were acceptable and helpful to most women in this process evaluation, the strategy will not be appropriate for all women. It requires that women have a supportive person in their daily life, and women who do not will need other adherence strategies and support.

Another finding of note in relation to family support is that receiving a poster from a provider during ANC was sufficient for most women to have a conversation with a family member about supplementation in pregnancy and ask for adherence support. Male attendance at ANC is positively associated with maternal health outcomes (30), but is not widespread in Kenya (31). The adherence partner strategy was a successful approach for encouraging supplement adherence support without directly engaging family members. Although a poster cannot address larger issues around gender norms, and gender transformative programming is needed to engage family members in maternal health, adherence partners are a low-cost, simple strategy that can be included in ANC.

Limitations

This study had several limitations with respect to the generalizability of the findings. Supply shortages and stockouts are a challenge with

antenatal micronutrient supplementation in Kenya (9, 10) and globally (3, 22, 32), and negatively affect provider and client behavior and inhibit the effectiveness of supplementation programs. Owing to the study team managing supplement procurement and the supply chain (5), our findings may not be relevant to contexts with widespread supply issues. Facility-based calcium supplementation programs will depend upon women seeking ANC early in pregnancy and frequently (6, 7, 22). This study only included participants who sought ANC early enough to be included in the larger study, potentially creating a less representative sample. However, almost all pregnant women in Kakamega County attend ANC ≥ 1 time (33), although typically late in pregnancy. All participants were part of a trial promoting IFA and calcium adherence and social desirability bias may have affected the credibility of their responses. Although ANC providers were not told what we were observing exactly, it is likely that the presence of the research team sensitized them to paying particular attention to issues and counseling points related to calcium supplementation.

Conclusion

Our study provides evidence of the acceptability of antenatal calcium supplementation delivered through ANC and the feasibility of using ANC to recommend adherence partners, a low-cost strategy to engage family members to support supplement adherence. It also demonstrates the insights gained from small-scale research efforts that examine the experiences of program beneficiaries and those who influence them, in our case, family members and ANC providers. Based on the barriers and facilitators identified, ensuring a consistent supply of supplements, high-quality counseling from ANC providers, reminder materials for women to take home, and family support are recommended for the successful integration of calcium supplementation into ANC.

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