Maternal & Child Nutrition

DOI: 10.1111/mcn.12233

Original Article

Translating formative research findings into a behaviour change strategy to promote antenatal calcium and iron and folic acid supplementation in western Kenya

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Abstract

The World Health Organization now recommends integrating calcium supplements into antenatal micronutrient supplementation programmes to prevent pre-eclampsia, a leading cause of maternal mortality. As countries consider integrating calcium supplementation into antenatal care (ANC), it is important to identify context-specific barriers and facilitators to delivery and adherence. Such insights can be gained from women's and health workers' experiences with iron and folic acid (IFA) supplements. We conducted in-depth interviews with 22 pregnant and post-partum women and 20 community-based and facility-based health workers in Kenya to inform a calcium and IFA supplementation programme. Interviews assessed awareness of anaemia, pre-eclampsia and eclampsia; ANC attendance; and barriers and facilitators to IFA supplement delivery and adherence. We analyzed interviews inductively using the constant comparative method. Women and health workers identified poor diet quality in pregnancy as a major health concern. Neither women nor health workers identified pre-eclampsia, eclampsia, anaemia or related symptoms as serious health threats. Women and community-based health workers were unfamiliar with pre-eclampsia and eclampsia and considered anaemia symptoms normal. Most women had not received IFA supplements, and those who had received insufficient amounts and little information about supplement benefits. We then developed a multi-level (health facility, community, household and individual) behaviour change strategy to promote antenatal calcium and IFA supplementation. Formative research is an essential first step in guiding implementation of antenatal calcium supplementation programmes to reduce pre-eclampsia. Because evidence on how to implement successful calcium supplementation programmes is limited, experiences with antenatal IFA supplementation can be used to guide programme development.

Keywords: maternal nutrition, micronutrient supplementation, antenatal care, formative research, pre-eclampsia, anaemia.

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Introduction

Pre-eclampsia, eclampsia and other hypertensive disorders of pregnancy are leading causes of maternal and perinatal morbidity and mortality globally [Khan *et al.* 2006, World Health Organization (WHO) 2013]. A systematic review demonstrated that antenatal calcium supplementation significantly decreases the risk of pre-eclampsia in populations with low dietary calcium intake (Hofmeyr *et al.* 2010). Based on these findings, WHO guidelines recommend antenatal calcium supplementation (at doses of 1.5–2.0 g elemental calcium/day) to prevent pre-eclampsia in countries with low habitual calcium intake – further, that calcium supplementation should be integrated into antenatal care (ANC) alongside iron and folic acid (IFA) supplementation (WHO 2013). However, the complex regimen of three to four daily administrations of 500 mg elemental calcium doses, in addition to once daily IFA, taken separately to avoid potential interference with absorption, presents substantial challenges to logistics, distribution, counselling and adherence (Baxter *et al.* 2014, Hofmeyr *et al.* 2014).

Global nutrition recommendations have been disseminated widely, but there is little guidance on country-level implementation (Stoltzfus 2008, Locks *et al.* 2013). This is especially true for antenatal calcium supplementation, which has yet to be implemented at a national level in any country. Antenatal IFA supplementation offers an example of a long-standing micronutrient supplementation programme delivered through ANC, which can provide insight into potential barriers and facilitators to calcium supplementation and inform programme design and implementation. IFA supplementation programmes face barriers at the health system, health facility, community, household and individual levels (Galloway *et al.* 2002, Yip 2002, Sanghvi *et al.* 2010). The complexity of the recommended calcium regimen will likely exacerbate these challenges. As countries consider implementing calcium supplementation policies and programmes, formative research on antenatal micronutrient supplementation programmes is needed.

Kenya, with high maternal mortality [Kenya National Bureau of Statistics (KNBS) & ICF Macro 2010] and low antenatal calcium intake (Kamau-Mbuthia & Elmadfa 2007), is an appropriate setting in which to explore the potential introduction of calcium supplementation. To support adherence to antenatal calcium and IFA supplements and enhance the effectiveness of antenatal micronutrient supplementation programmes, barriers need to be systematically identified and addressed (Sanghvi *et al.* 2010, Baxter *et al.* 2014). As part of a multi-phase project to assess the feasibility and acceptability of integrating calcium supplementation into antenatal IFA supplementation in Kenya, we conducted formative research to design a behaviour change strategy. Behaviour change interventions have been used successfully in low-resource settings to improve IFA supplementation adherence (Sanghvi *et al.* 2010).

The objective of this research was to use an iterative process to design a context-specific, multi-level behaviour change strategy to introduce calcium and promote adherence to IFA supplements. First, we conducted interviews with pregnant and post-partum women and health workers to learn about their experiences with IFA, as well as their views on anaemia, pre-eclampsia and eclampsia. We then used the results to design a behaviour change strategy with targeted activities, materials and messages. Finally, we revised the messages and materials based on feedback from women and nurses gathered during pretesting and expert review.

Materials and methods

Study setting

This study took place in Malava sub-county, Kakamega County, in western Kenya. Malava sub-county is primarily rural; Malava, the largest town, is the sub-county headquarters. The sub-county has three levels of health facilities providing ANC: a referral hospital in Malava, three health centres, and 15 dispensaries. Health centres provide ambulatory health, preventive and curative services, and dispensaries provide preventive health measures and are often patients' first contact point (KNBS & ICF Macro 2010).

Most women (96.4%) in Kakamega County received ANC from a skilled provider at least once during

Key messages

- Antenatal IFA experiences can provide important lessons to guide the development of approaches for promoting antenatal calcium supplementation.
- Formative research and pretesting are essential to ensure micronutrient supplementation behaviour change interventions and messages are culturally appropriate, well understood and motivating for pregnant women.
- In addition to the reported barriers to IFA utilization, lack of awareness of pre-eclampsia symptoms and risks and greater pill burden are likely to make the promotion of calcium even more challenging than IFA.
- Promoting calcium supplementation will require specialized training for staff, targeted counselling materials and community and household support.

pregnancy, but less than half (47%) delivered in a health facility (KNBS 2015). Although more than 60% of women in Western Province reported taking iron supplements at some point during their most recent pregnancy, only 1% took iron supplements for 90 or more days (KNBS & ICF Macro 2010). Kenya national guidelines recommend women take a combined IFA pill daily throughout pregnancy (Kenya Ministry of Health 2013a); however, supplies available in facilities may be a combined pill or separate iron pills and folic acid pills (Maina-Gathigi *et al*. 2013).

Participants

We recruited participants from four rural health facilities and surrounding communities. Two health centres and two dispensaries were purposively selected to represent different facility levels, geographical spread and proximity to Malava hospital.

We conducted 22 in-depth interviews with pregnant and post-partum women (Table 1). Pregnant women were recruited at health facilities after ANC consultation. To ensure participants could describe experiences over time with ANC and IFA supplements, only women who had attended at least one ANC visit prior to that day's visit were considered eligible. We also recruited women at health facilities who were less than 8 weeks post-partum, to maximize recall. In an effort to include women who were not utilizing ANC, community health workers (CHWs) helped recruit pregnant women at home. To capture health workers' perspectives, we recruited 20 facility-based ANC providers (referred to as nurses), CHWs and traditional birth attendants (TBAs) (Table 1). None of the individuals invited to participate refused.

Data collection and analysis

We developed semi-structured interview guides for each participant category based on literature reviews of ANC and antenatal micronutrient supplementation. The interview guides (Supporting Information) covered topics such as antenatal care-seeking behaviour, experiences and health problems during pregnancy, provision of ANC services and perceptions of micronutrient supplements. We pretested and modified the guides prior to implementation.

In November–December 2012, an experienced qualitative interviewer conducted interviews in Swahili or Luhya, based on participant preference. Each interview lasted approximately 1 hour. Most interviews took place at health facilities, with a small number (mothers and TBAs drawn from the community) in participants' homes. The interviewer audio-recorded all interviews, and a second study team member transcribed the interviews verbatim and translated them into English. The interviewer reviewed all transcripts for accuracy.

Researchers at Cornell University used Dedoose, a mixed-methods research software programme (Socio-Cultural Research Consultants, LLC, Los Angeles, CA, USA), to code interview transcripts, retrieve text segments and conduct thematic analysis. In collaboration with the interviewer and transcriber, coding of transcripts followed open-coding approaches and the constant comparative method (Strauss & Corbin 1990). We used representative transcripts to develop

Table 1. Participants interviewed on antenatal care and micronutrient supplementation, by study site, Malava sub-county, Kenya

Health facility		Participants				
Type	Site	Pregnant women	Post-partum women	Nurses[†]	CHWs	TBAs
Health centre	A	4	2	2	2	1
Health centre	B	2	4	2	1	2[‡]
Dispensary	A	2	3	2	2	1
Dispensary	B	5	0	2	2	1
Total		13	9	8	7	5

CHW, community health worker; TBA, traditional birth attendant.
[†]The facility-based health workers are referred to as 'nurses', although one of the eight was a clinical officer. [‡]Of these two TBAs, one was also trained and acting as a CHW; she is counted only as a TBA in this table.

codes and coding structure in an iterative process until reaching consensus. This structure was followed to code the remaining transcripts, making modifications as new themes emerged. We developed matrices to summarize key themes and reviewed them during regular peer debriefings to ensure consistency. Using an inductive approach, we identified emergent themes, summarizing across participants and comparing responses from different types of respondents.

We used the findings to develop a behaviour change strategy to introduce calcium supplementation and improve adherence to IFA. We developed materials with integrated calcium and IFA messages based on the format of national IFA materials (Kenya Ministry of Health 2013b). In February 2014, a behaviour change communication consultant pretested draft integrated calcium and IFA materials and messages with pregnant women and nurses in Malava sub-county to assess appropriateness, comprehension and acceptability. Four focus group discussions with 10–15 pregnant women each were conducted at health facilities (i.e. one hospital, one health centre and two dispensaries), and three key informant interviews with nurses were conducted at three of the same facilities. Interviews and focus group discussions were conducted in Swahili, audio recorded, transcribed and translated into English. Participants' responses were summarized and guided materials revision.

The Cornell University Institutional Review Board and Kenyatta National Hospital and University of Nairobi Ethics and Research Review Committee approved this study. The interviewers obtained written informed consent from participants before each interview.

Results

Description of participants

Table 2 summarizes participant demographic characteristics. All but four women had been pregnant before, with a mean gravidity of 2.2. The mean gestational age among pregnant women was 7.5 months. Almost all women were married; two were separated and two were single. Eight women were farmers, six were housewives, five had small businesses, two were teachers and one was a domestic worker.

Table 2. Participant characteristics

	Women[†] ($n = 22$)	Nurses ($n = 8$)	Community health workers ($n = 7$)	Traditional birth attendants ($n = 5$)
Mean age[‡]	25.9 (5.5)	31.2 (10.0)	44.4 (2.1)	56.8 (11.3)
Gender				
Male	—	2	2	—
Female	22	6	5	5
Education (years)				
None (0)	1	—	—	1
Primary (1–8)	16	—	2	3
Secondary (9–12)	4	—	5	1
College (4)	1	8	—	—
Ethnicity				
Luhya	21	8	7	5
Luo	1	—	—	—

[†]Pregnant and post-partum women are grouped together as 'women'.
[‡]Numbers are means and standard deviations are in parentheses.

General health concerns during pregnancy

Both women and health workers reported poor diet and malaria as the most important health concerns during pregnancy.

Poor diet

All categories of participants described lack of a balanced diet or inadequate access to food as a primary concern among pregnant women. Several women talked about challenges pregnant women face to access enough food and eat a diverse diet.

> When you are pregnant and you don't eat well, you will have problems… If you can manage you buy what you like, but if it is not possible, you eat what is there…you may sleep hungry… a mother lives in problems and when she gives birth the child will not be healthy.
>
> - 25-year-old pregnant woman, four children

> I've been feeling weak… I feel that I have very little blood… If you had money, you could buy food to boost blood formation. But money is hard to come by.
>
> - 32-year-old pregnant woman, five children

When describing personal experiences in pregnancy, a few women attributed lack of dietary diversity to feeling ill or having food aversions or cravings.

Half of the nurses mentioned pregnant women having poor diets. TBAs also described pregnant women not eating a balanced diet, although attributed this to women not feeling well or having food cravings or aversions. All CHWs mentioned poor diet or lack of food as a key concern.

> There are women who eat one type of food from morning, she is not able to eat a balanced diet and when you look at her, she is not healthy at all.
>
> - CHW

Malaria

Many women, nurses and CHWs identified malaria as one of the most common health concerns for pregnant women. Several women reported having malaria during their current or a past pregnancy. Despite malaria being common, most participants did not consider it a serious health threat for pregnant women. Notably, none of the TBAs identified malaria as a concern in pregnancy.

Other concerns

None of the women mentioned seizures or other serious symptoms related to pre-eclampsia or eclampsia as a health concern. Only one TBA and one nurse mentioned high blood pressure as a serious concern.

In addition, about half of women mentioned the indifference or negative role of husbands during pregnancy. Several CHWs described husbands as unsupportive. However, a few women indicated their husbands did or could play a supportive role. Women appreciated advice and emotional support from female relatives, other mothers or older women.

Health-seeking behaviours

Facility-based care

All women reported attending ANC at a health facility at least once during their most recent pregnancy, including women recruited from their homes. Many women sought care late (at 5 months on average), less frequently than the four recommended visits (Kenya Ministry of Public Health and Sanitation & Ministry of Medical Services 2012) and only when ill or experiencing complications. In contrast, about one-third of the women attended ANC because of specific sicknesses or symptoms they considered more severe, such as bleeding, malaria, abdominal pain, extreme weakness and vomiting. Women did not discuss symptoms perceived as 'normal' (e.g. fatigue or swollen ankles) with nurses, preferring to consult family members or TBAs.

> Last weekend my legs were so swollen. I went to my grandmother…but she told me that nothing was wrong, it was just that I was about to get my child… Right now they are alright…there is nothing to tell [the nurse].
>
> - 25-year-old pregnant woman, two children

Many women attended ANC to obtain an ANC booklet, believed necessary to receive treatment at the facility if complications arose during delivery. Nurses explained that pregnant women do not need the ANC booklet to receive care but acknowledged this misperception motivates attendance.

Several women identified clinic fees and the high frequency of recommended visits as barriers to seeking timely ANC, with some delaying the first ANC visit to limit the total number.

> Attending clinic on a monthly basis is tiring if you are going to start that early. If you start late and attend for three or four months, it is much better.
>
> 28-year-old pregnant woman, three children

A few women described not returning for appointments because they were busy or tired, while others reported fear of poor treatment from staff.

Community-level care

Most participants said it was common for pregnant women to seek care from TBAs, often in addition to clinic visits, but only a few reported personal visits. Most described going to the TBA to have the baby's position checked and for massage. Several women reported never having gone to a TBA, believing TBAs provide improper treatment or could harm the baby.

> But I didn't go [to the TBA], I was scared… They might give me medicine that would make me lose my baby… So, I opted for the clinic.
>
> - 21-year-old post-partum woman, one child

Community health workers described identifying pregnant women and promoting ANC visits as part of their responsibilities, but the women did not mention CHWs as having a role in ANC or pregnancy.

Anaemia knowledge and perceived severity

Women reported a range of knowledge on anaemia, frequently using the terms 'lack of blood' and 'low blood'. About half of women had heard of anaemia or 'low blood' but did not know what caused it, more than one-third were able to describe its causes and treatment, and two had never heard of it before. Although more than half of the women experienced fatigue and several reported low blood, most women did not associate anaemia symptoms with the need for health care and did not report symptoms to nurses.

> Feeling fatigue all the time is not sickness…maybe it is a sickness but I don't think it is serious thing… Feeling fatigue, I never told the doctor about that.
>
> - 31-year-old post-partum woman, four children

In contrast, a few women were familiar with the possible severity of symptoms and the need to go to the clinic for treatment.

All nurses knew about anaemia, its symptoms and treatment. Nurses reported that the protocol is to counsel pregnant women with mild or moderate anaemia symptoms on diet and, when available, provide iron. Severe cases are referred to higher-level facilities. Nurses at health centres reported measuring haemoglobin, but nurses from dispensaries were unable to measure haemoglobin due to lack of laboratory facilities and equipment. All nurses who spoke of anaemia prevalence felt it was uncommon.

Most TBAs knew about anaemia, its symptoms and causes, whereas less than half of the CHWs expressed familiarity with anaemia. Similar to nurses, all but one TBA and all CHWs said anaemia and its symptoms were uncommon in pregnancy.

IFA supplementation

Availability of supplements

Less than half of the women reported receiving IFA supplements. Some women reported not receiving any pills to take home; a few had never heard of taking pills at home during pregnancy. Most women who received IFA, iron or other pills during pregnancy reported minimal communication about the pills and their purpose. About half of women who received pills reported nurses did not provide any information about them. The other half explained the pills were to 'boost the blood' or help with appetite.

Nurses, however, reported most women attending ANC received some iron or IFA supplements. Most nurses at all four sites referenced combined IFA, prescribed once daily, as the standard preventative supplement. Nurses at one dispensary reported they were currently, and often, out of stock of IFA or any iron supplements, causing them to provide supplements only to women with 'alarmingly low haemoglobin, like of 9 [g/dL]' or to prescribe supplements to purchase elsewhere. Nurses at the other dispensary reported they were also out of IFA and were providing iron and folic acid separately. Although health centre nurses did not report current supplement shortages, experiences with limited supplies affected their ability to serve women well.

> Now maybe you don't have enough iron, we don't just give to everybody…if you give everybody and you have a tin, a small one, most likely it will be finished and maybe someone will come with signs of anaemia and there is nothing you can do.
>
> - Health centre nurse

Most nurses reported providing women with insufficient IFA supplements to last throughout pregnancy or between ANC visits.

Adherence

It was difficult to assess factors influencing adherence because so few women received IFA or iron supplements. Most women who received supplements reported high adherence and identified few barriers. A few reported being motivated by a desire to get well.

> I had been cautioned that my haemoglobin level was very low. It was a must that I should take it… It was not easy for me to forget, every morning I had to take it.
>
> - 28-year-old post-partum woman, four children

Although some women mentioned experiencing side effects and an unpleasant taste, these were barriers to adherence for only a few women. When asked how they remembered to take supplements, women reported storing pills where they could see them, taking pills first thing in the morning or reminders from husbands or female family members.

> I cannot forget. That is the first thing grandmother would ask me. If I have forgotten she will tell me to go and take them.
>
> - 22-year-old primigravida

In contrast to high self-reported adherence, most nurses felt that pregnant women did not adhere to supplements because of nausea and pill fatigue. Yet all TBAs and most CHWs reported pregnant women who received supplements typically adhered to them. A few CHWs reported women had difficulty remembering to take supplements or complained about them.

To improve adherence, nurses suggested counselling women to take pills at the same time each day and providing more information on their benefits. One mentioned that CHWs could provide this information and support.

Participants provided inconsistent descriptions of the roles of TBAs and CHWs in IFA supplementation. TBAs and CHWs had limited knowledge and training on supplements, and several had never seen IFA supplements. Women did not mention CHWs or TBAs influencing adherence, but several TBAs and CHWs reported encouraging or reminding women to take supplements.

Pre-eclampsia and eclampsia knowledge and perceived severity

When asked about pre-eclampsia and eclampsia in Swahili or Luhya, women were unfamiliar with the terms and related conditions (e.g. proteinuria, severe edema and seizures). Women did recognize high blood pressure, which they called *presha*, and mild edema. More than half of participants knew pregnant women experiencing lower-extremity edema and considered this to be typical.

> Swelling of the body is not a serious matter; it is because of the pregnancy. She knows that when she gives birth all will be well.
>
> - 25-year-old pregnant woman, four children

About one-third of women had experienced swelling themselves but did not seek care for it. A few women related swollen ankles to high blood pressure.

> I have seen others swelling at the ankles, and when you insert your finger like this [showing] it goes inside… I hear them say it is presha, but I don't know what that is… I have not asked.
>
> - 36-year-old post-partum woman, four children

Nurses also reported that pregnant women in the area do not view edema as a serious concern.

> People tell them 'Your legs will swell during pregnancy and it is just normal, even when I was pregnant, my legs were swollen.' So they tend to believe this is not serious and they may not seek the attention of medics.
>
> - Health centre nurse

One nurse partially attributed women's lack of awareness of pre-eclampsia and eclampsia to difficulty describing the symptoms and risks.

> Pre-eclampsia, you know it's really a bit hard to explain because even when you ask me to tell you in vernacular I don't know what to call it. We just tell them it is a condition that happens during pregnancy, and the signs are this and this…. But it's not easy to explain because I don't even know the Swahili word for eclampsia.
>
> - Dispensary nurse

All nurses were familiar with pre-eclampsia and eclampsia, its symptoms and a protocol for detection and management. They reported screening procedures that included measuring blood pressure and testing for proteinuria when laboratory facilities and tests were available. A few nurses mentioned treating women with medication to manage pre-eclampsia, but in general,

nurses referred women to higher-level facilities for specialized care. Most nurses reported pre-eclampsia and eclampsia and related symptoms were uncommon. Only two nurses reported it was common in the area.

> [Pregnant women] don't really know much about hypertension and they come late… I will take the blood pressure, find it is too high, and refer… High blood pressure has become so prevalent [among pregnant women] in our community.
>
> - Dispensary nurse

Traditional birth attendants appeared to be unfamiliar with pre-eclampsia and eclampsia and displayed varied knowledge about symptoms. One TBA spontaneously mentioned 'high pressure' as an issue for pregnant women in the community, and two other TBAs, when prompted, said they had seen swelling and high blood pressure. Most CHWs reported that swelling was serious enough to require referring women to the clinic. One CHW described swelling and high blood pressure as common in her community, but most reported seeing only a few pregnant women with swelling or *presha*.

Development of a behaviour change strategy for antenatal calcium and IFA supplementation

Based on these findings, we designed a context-specific, multi-level behaviour change strategy to introduce calcium supplementation and promote calcium and IFA supplement adherence. The strategy was organized around the key steps of effective IFA supplementation programmes: (1) supplement availability within the health system; (2) supplement provision and high-quality counselling on regimen and benefits at health facilities; (3) community participation; and (4) willingness, uptake and adherence among pregnant women (Yip 1996, Sanghvi *et al.* 2010). Formative research findings about concerns during pregnancy; awareness of anaemia, pre-eclampsia, and eclampsia; and barriers and facilitators to IFA adherence were valuable for shaping specific activities and messages for health facilities, communities, households and individuals, as illustrated in Table 3. Addressing health system supply chain and distribution barriers was beyond the scope of this strategy; hence, we directly provided supplies to facilities.

We followed the behaviour change strategy to design activities and materials to promote calcium and IFA supplementation. To enhance supplement provision and counselling at facilities, we trained nurses and provided counselling job aids. We trained CHWs to increase community support. To engage family members, we developed 'adherence partner' materials for women to share with supportive family members who could remind and encourage adherence. At the individual level, we created a reminder calendar illustrating the dosing regimen throughout pregnancy and key messages on calcium and IFA supplementation.

We revised the materials through an iterative process, incorporating feedback gathered during pretesting and expert review. During pretesting, pregnant women and ANC nurses suggested the materials were generally appropriate, understandable and acceptable. They reported that the images of pregnant women looked like 'one of us' and that the key messages and regimen instructions were easy to understand. Pregnant women appreciated the take-home calendars, which made them feel 'important', and the small size of the calendar, which could fit inside their bag when they travelled. Nurses and pregnant women found the idea of an adherence partner acceptable and suggested that husbands would be most likely to serve in this role, but acknowledged that currently, most men do not provide this kind of support. We revised the materials based on participant feedback (Table 4), which were then reviewed by nutrition and behaviour change experts. After the materials were further revised, sub-county health officials reviewed and approved the materials (Cornell University & Micronutrient Initiative 2015).

Discussion

This paper illustrates an approach for conducting formative research on IFA supplementation and knowledge and experiences with anaemia, pre-eclampsia and eclampsia, and using the results to develop a behaviour change strategy for antenatal calcium and IFA supplementation in western

Table 3. Examples of activities and messages developed from formative research findings

Formative research findings	Calcium and IFA activities and messages
Health facility level	
Erratic supplies result in most women not receiving IFA supplements	Ensure consistent supply of calcium and IFA at all facilities for all pregnant women
Women are not counselled on how or why to take IFA	Develop counselling cards on the regimens and benefits of calcium and IFA to ensure consistent messages and quality of care
Calcium supplements are not yet part of regular ANC	Train health workers on use of counselling cards and provide general counselling strategies
Health workers have heavy workloads, which limits time for counselling	Incorporate calcium messages into existing national IFA counselling cards and include key messages that can be emphasized when time is limited Develop take-home materials for pregnant women on calcium and IFA benefits and regimen
Women do not share concerns or symptoms with nurses	Train health workers on counselling skills and to encourage women to ask questions Introduce materials that encourage dialogue (e.g. buttons with 'ask me how to be healthy in pregnancy')
Women do not always return for subsequent ANC visits	At the first ANC visit, provide an adequate supply of calcium and IFA supplements to last throughout pregnancy
Community level	
CHWs are not seen as a source of pregnancy information	Train CHWs on anaemia, pre-eclampsia, antenatal micronutrient supplementation, danger signs in pregnancy and the importance of ANC visits Provide materials that encourage dialogue (e.g. buttons with 'ask me how to be healthy in pregnancy')
CHWs lack credibility and need training on maternal health and antenatal micronutrient supplementation	Train CHWs on anaemia, pre-eclampsia, antenatal micronutrient supplementation, danger signs in pregnancy and the importance of ANC visits Provide credentials (e.g. training certificates)
Women seek care from TBAs during pregnancy and delivery	Develop a counselling card on the importance of early and regular facility-based ANC and train CHWs on the same
Household level	
Some women have family members who remind and encourage them to take IFA, which helps with adherence	Develop a counselling card on the benefits of asking someone to support adherence and train nurses on its use Provide contextually appropriate take-home materials (e.g. card, poster) to pregnant women to share with family members or friends to encourage or remind them
Individual level	
Women do not go to ANC as early or as often as recommended	Train CHWs to encourage pregnant women to attend ANC early and frequently
Women report that inadequate diet is the most common health problem in pregnancy and do not eat a balanced diet because of inadequate access to food	Create messages that focus on how supplements can help balance the diet: *It can be difficult to eat a balanced diet. Many pregnant women do not eat enough foods with calcium (such as milk) and enough foods with iron (such as meat).* *Calcium and IFA tablets can help balance your diet if you take them every day.*
Women view anaemia and related symptoms as normal during pregnancy	Counsel women on the symptoms and risks of anaemia and danger signs that require prompt attention
Women have very little knowledge or awareness of pre-eclampsia and eclampsia; high blood pressure, or *presha*, was understood	Rather than informing on risks of pre-eclampsia and eclampsia, focus on the preventive benefits of calcium and IFA: *Calcium and IFA tablets help you to have the balanced diet needed for a safe pregnancy and healthy baby*

(*Continues*)

Table 3. (Continued)

Formative research findings	Calcium and IFA activities and messages
Women view swelling as normal and do not discuss it with health workers	Train nurses and CHWs to discuss early signs of potential risk with pregnant women
Many women do not know what IFA pills are or what they are for	Develop counselling cards for health workers to use when counselling women on calcium and IFA
	Provide supportive take-home materials (e.g. a calendar with a visual calcium and IFA regimen and information on benefits)
Side effects are a barrier to adherence for some women	Provide information on possible side effects as part of counselling cards and calendar
	Train CHWs on possible side effects and strategies to manage them
Women are motivated to attend ANC to receive the ANC booklet	Develop counselling cards on danger signs and prevention to address women's concerns about possible complications

IFA, iron and folic acid; ANC, antenatal care; CHW, community health worker. Final versions of all materials are available at https://blogs.cornell.edu/centirgroup/files/2015/09/CaIFASBCCmaterials-1kqv7hy.pdf.

Kenya. We identified several potential barriers and facilitators at multiple levels and developed strategies to address them.

Health system level

Nurses and women reported IFA supplement shortages and stockouts; most pregnant women did not receive any supplements or received an insufficient supply. Nurses perceived supplement shortages to be so common that even when there were adequate supplies, they provided supplements only to women with very low haemoglobin levels. IFA supplementation shortages have been documented in Kenya (Maina-Gathigi *et al.* 2013) and are a major constraint to supplementation programmes globally (Galloway *et al.* 2002, Galloway & McGuire 1994, Young & Ali 2005). Incorporating calcium supplementation into ANC within this context will require strengthening supply chains by improving procurement at the national level and distribution at the county and facility levels.

Health facility level

Nurses reported inadequate time to counsel women properly on IFA, a finding that was consistent with women's reports of receiving little information about the pills they received during ANC. Previous research on IFA supplementation in Kenya found that women do not receive adequate counselling during ANC (Maina-Gathigi *et al.* 2013). Insufficient counselling on IFA has been identified as an important barrier to adherence in other low-resource settings (Galloway & McGuire 1994, Galloway *et al.* 2002, Ejidokun 2000), and counselling on benefits and regimen can improve micronutrient supplement adherence (Galloway *et al.* 2002, Aguayo *et al.* 2005, Sanghvi *et al.* 2010, Maina-Gathigi *et al.* 2013).

The current inadequate IFA counselling women receive has important implications for the introduction of an additional micronutrient supplement with a more complex regimen. The addition of calcium supplements requires counselling on benefits, regimen, adherence strategies and side effects management. Nurses need counselling training and job aids, and women need easy-to-understand take-home materials to reinforce messages and serve as reminders.

Community level

Although women did not spontaneously identify CHWs as influential to their IFA knowledge or adherence, health workers suggested CHWs could serve in this role. In other settings, CHWs have been identified as potential sources of information and support for IFA (Sanghvi *et al.* 2010). CHWs can be trained to share information on calcium and IFA benefits,

Table 4. Examples of changes to behaviour change materials based on user feedback

Feedback category	Participant feedback	Revisions made
Ineffective illustrations	Nurses and women thought that the large amounts and types of recommended foods were unattainable for pregnant women, many of whom are often hungry	Reduced the amounts and diversity of foods and changed types of foods on the counselling cards and calendar to reflect what was feasible and adequate for women
	Women expected images of recommended foods to include stones eaten during pregnancy (i.e. pica)	Inclusion not considered appropriate
	Nurses and women thought the illustration of the woman experiencing a seizure represented fainting	Revised the illustration to better depict a woman experiencing a seizure
	Women thought the image of a husband reminding his wife about her supplements in the adherence partner illustrations appeared to be angry and scolding	Revised the adherence partner illustrations on the counselling cards, calendar and poster to appear more supportive and happy
Inconvenient format	Women thought the pocket-sized adherence partner card could be easily lost; something to hang on the wall would be better	Changed the adherence partner card to a poster
Unclear wording	Pregnant women said most words were clear, but a few were difficult to understand	Changed difficult words to facilitate comprehension
	Women suggested alternative words and phrasing	Replaced the term for nausea in Swahili to feel like vomiting
		Replaced the term for constipation in Swahili to swelling in the stomach

regimen, adherence strategies and side effects management and encourage early and regular ANC attendance.

Household level

Several women reported that family member support positively influenced IFA adherence, which is consistent with IFA studies within other contexts (Ejidokun 2000, Galloway *et al.* 2002, Aguayo *et al.* 2005, Nagata *et al.* 2012). For some women, family members not only encouraged them but also reminded them to take their IFA supplements. Forgetting is a common challenge to consistent IFA adherence, and new strategies are needed to help women remember (Kulkarni *et al.* 2010, Zavaleta *et al.* 2014). Having a household member provide frequent encouragement and reminders could improve adherence for calcium and IFA supplements.

Individual level

Despite the high prevalence of anaemia in Kenya (Ouma *et al.* 2007, Kenya Ministry of Public Health and Sanitation 2012), neither women nor health workers listed anaemia as an important health concern, and many women viewed anaemia symptoms as normal during pregnancy. Similar attitudes towards anaemia have been found among pregnant women in other low-resource settings (Galloway & McGuire 1994, Ejidokun 2000, Galloway *et al.* 2002, Young & Ali 2005, Chatterjee & Fernandes 2014). High anaemia prevalence can normalize anaemia in pregnancy (Chatterjee & Fernandes 2014), which can reduce the demand for prevention and treatment (Galloway & McGuire 1994).

Women were unfamiliar with pre-eclampsia and eclampsia and did not consider the symptoms important health concerns. Women identified poor diet as the most important health concern in pregnancy. Awareness of gaps in diet will likely be an important motivator for calcium and IFA supplement adherence.

Women generally did not discuss symptoms perceived as minor or normal with nurses nor did they ask questions during ANC consultations. Another study of ANC in Kenya (Pell *et al.* 2013) found counselling was often didactic and women rarely asked questions. Lack of client participation during ANC visits has important implications for calcium supplementation. The introduction of a complicated supplement

regimen to prevent an unfamiliar condition will likely require high-quality counselling and supportive relationships with staff to promote adherence.

Women were motivated to attend ANC by concerns about serious complications and to obtain the ANC booklet, as reported elsewhere in Kenya (Pell *et al.* 2013). Because most women attend ANC at least once during pregnancy, it is important for health worker attitudes and actions to contribute to a positive ANC experience that encourages pregnant women to return for care (Byford-Richardson *et al.* 2013). Training nurses on a new calcium regimen provides an opportunity to address wider issues of ANC quality, including counselling skills. This has been successful when integrating other interventions into ANC (Delvaux *et al.* 2008).

Study limitations

The small, non-representative sample limits generalizability of the findings. However, the study design allowed in-depth exploration of micronutrient supplementation barriers and facilitators, which is critical for designing behaviour change interventions. In addition, we reached theoretical saturation in the interviews, gathering a range of opinions on appropriate care in pregnancy. We recruited most women from health facilities, indicating a possible bias towards women with a greater tendency to seek ANC; this also could reflect that almost all pregnant women in the county attend ANC at least once (KNBS 2015). Most interviews were conducted at health facilities, and despite assurances of confidentiality, this could have influenced participants' responses. Yet women appeared to be honest and forthcoming, reporting lack of supplements and supplies, insufficient counselling and fear of poor treatment from staff.

Conclusion

Past experiences with antenatal IFA supplementation can be applied to future calcium supplementation programmes. This formative research allowed us to learn from women's and health workers' experiences with antenatal IFA supplementation and design a context-specific behaviour change strategy to support the introduction of calcium and improvement of IFA supplement adherence. This process of designing an integrated calcium and IFA supplementation programme for the Kenyan context provides an example for the introduction of antenatal calcium supplementation in other settings. Formative research is the first step in translating new global calcium guidelines into context-appropriate policies and programmes. Subsequent studies will assess antenatal calcium supplementation acceptability and feasibility through household trials and a cluster-randomized trial. Our findings highlight the need to strengthen antenatal micronutrient supplementation at the health system, health facility, community, household and individual levels and address barriers that limit micronutrient supplementation delivery, uptake and adherence. As with IFA, calcium supplementation can only be effective in reducing maternal mortality if women receive adequate amounts of supplements and appropriate counselling and support.

Acknowledgements

We gratefully acknowledge the women and health workers in Malava sub-county who participated in this study and the assistance of Eric Mwanga and the Malava Sub-county Health Management Team. Lanre Omotayo, Gretel Pelto, Rebecca Stoltzfus, (Cornell University); Lynnette Neufeld (Global Alliance for Improved Nutrition); and Jacqueline Kung'u and Emily Gold (Micronutrient Initiative) provided guidance on the design of this research. Carolyne Egesa (African Population and Health Research Centre) transcribed and translated the interviews; Lusine Mehrabyan and Edgar Akuffo-Addo (Cornell University) contributed to the analysis; Catherine Lengewa (Centre for Behaviour Change and Communication) designed and pretested the behaviour change messages and materials, and Marion Roche (Micronutrient Initiative) provided technical assistance on materials development.

Source of funding

The Micronutrient Initiative provided funding for this research.

Conflicts of interest

None declared.

Contributions

KLD conceptualized the research; KLD and SLY designed the study; SW collected the data; SLY supervised data analysis; GLS, SLM, KLD, SLY, SW and GMC contributed to data analysis and interpretation; SLM and GLS drafted the manuscript. All co-authors critically revised the manuscript and approved the final version of this manuscript.

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