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Promoting childbirth in a rural health facility: A quasi-experimental study in western Kenya

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Abstract

Background: The high maternal and neonatal mortality rate in sub-Saharan Africa could be reduced by using navigation by means of mobile devices to increase the number of women who choose to give birth in a health center (HC) with a skilled healthcare practitioner.

Methods: A quasi-experimental design was used to test a midwife-delivered navigation by means of mobile phone. A total of 208 women were randomized to two groups (intervention and control). Women in the intervention group received up to three navigation calls from midwives. Women in the control group received usual antenatal education during prenatal visits. Data were collected using semi-structured questionnaires. Childbirth location was determined through medical records.

Results: Overall, 180 (87%) women gave birth in a HC with a 3% advantage for the intervention group. A total of 86% (88/102) of the control group gave birth in a HC versus 89% (92/103) for the intervention group ($X^2 = 0.44$, p-value = 0.51), with an unadjusted odds ratio of 1.33 (95% CI: 0.57, 3.09). Among those with personal phones, 91% (138/152) had a birth in a HC versus 79% (42/53) in those without a personal phone ($X^2 = 4.89$, p-value = 0.03).

Conclusions: The results of this study indicate that it is feasible to deliver phone-based navigation to support birth in a HC; personal phone ownership may be a factor in the success of this strategy.

KEYWORDS
birth, intervention, Mobile, phone

1 | INTRODUCTION

The global maternal mortality rate is 287/100,000, but in Kenya, the maternal mortality rate is higher at 355/100,000.[1,2] Many maternal deaths could be averted if childbirth took place in a health center (HC) with a skilled healthcare practitioner.[3] Often, maternal mortality can be attributed to a lack of antenatal care, poor quality of care, and/or to home birth without a trained attendant. The most frequent causes of death are hemorrhage and sepsis, both preventable complications if birth takes place in a healthcare facility with adequate personnel and supplies.[1,4] In Kenya, healthcare facility birth has improved from 62% (2014)[5] to 89% (2022) of women.[6] Characteristics of women

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who deliver in a HC include higher education, attending antenatal appointments, and being a primipara.[7,8] Frequency of antenatal care in Kenya is improving, with 98% of women attending at least one antenatal visit compared with in 2003 when 88% had antenatal care with a skilled healthcare practitioner.[9] The availability and use of antenatal care services provides an opportunity for the midwife to establish a relationship with the pregnant woman that stresses the importance of childbirth in an accredited HC. However, research indicates that some women, particularly in rural settings, believe a normal antenatal visit makes delivery at a HC unnecessary.[10] Women in rural areas may avoid a HC birth for various reasons, such as dislike for institutional processes, cultural birth practices, distrust of personnel, a history of mistreatment, and concerns over invasive and involuntary hospital procedures.[11]

In the past decade, a proliferation of mHealth technologies has been piloted in both low and middle-income countries in Africa, and mobile phones have provided a mechanism to deliver interventions remotely. The use of mobile cell phone strategies to encourage client adherence to healthcare directives includes short text messaging, mobile applications, and mobile phone consultation/navigation.[12] In Ghana, mobile phones have been used to register pregnant women and nursing mothers and to enable midwives and community health nurses to interact frequently with women throughout pregnancy and childbirth.[13] In Liberia, mobile technology has been shown to be a viable method of data collection in rural remote areas.[14–16] One study demonstrated positive responsiveness among antenatal women to the use of a mobile phone short text message service, which in turn improved utilization of maternity services.[16]

Although not all households have a personal phone, most of the Kenyan population has access to a mobile phone through relatives and friends.[17] Building on this technology, the current study sought to test a mobile phone intervention that provided an educational intervention for women seeking antenatal care by means of a licensed midwife trained to use the technology. The hypothesis was as follows: *The use of a mobile phone intervention will significantly increase the number of women who give birth in a HC compared with home births when controlling for demographic/personal characteristics*. A quasi-experimental prospective trial was conducted between January 2014 and January 2015 to test this hypothesis.

2 | METHODOLOGY

2.1 | Sample

An a priori power analysis was conducted, indicating that a sample size of 188 total or 94 women per group had 80% power to detect a 20% difference in the proportion of HC births (60%) compared with a control group (40%) using a two-sided chi-squared test and alpha level of 0.05.[11] To allow for 10% attrition, a total sample of 208 women were enrolled.

Home birth in the study area was associated with lack of a written birth plan for preparedness and readiness, an incomplete number of ANC visits, and home preference as place of birth.[17] Other factors included barriers such as staff shortages, inadequate supplies and space, poor interpersonal relations, few trained staff, distance to services, poor transportation infrastructure, and limited service hours.[18]

The target population for this study was pregnant women seeking antenatal care in Eldoret West District through Moi's Bridge health center, in the rural western horn of Uasin Gishu County. The County is within the vast Kenyan Rift Valley with an area of 3345 km^2 and is home to 894,179 inhabitants.[19]

The health center was established in 1989 as a government rural health dispensary (Level 2) offering basic outpatient services, including antenatal care, family planning, and child immunization services. It upgraded in 1990 to a rural health center (Level 3) to include maternity services.[20] It currently serves about 100 outpatients per day, and the maternity unit records about 60 births per month. The healthcare practitioners are clinical officers, nurse/midwives, and pharmacy and laboratory technologists. The facility does not offer in-patient services. This study was approved by the Institutional Research Ethics Committee of Moi University.

Of the 660 women assessed for eligibility, 208 met the inclusion criteria, which included: being pregnant at 22–39 weeks gestation, having a singleton pregnancy, and either possessing a personal phone or having access to a phone through friends or family. All eligible women consented to the study (Figure 1).

2.2 | Procedure

Midwives were selected as research assistants if they were willing to be trained, were registered, and were licensed to practice, having completed a three-year diploma program, and graduating with midwifery competencies. Four research midwives were trained to deliver the intervention using mobile phones. Following consent, the principal investigator (PI) or research assistant (RA) collected baseline demographic data and endline data from the participants.

2.3 | Intervention

In addition to routine antenatal care, the intervention group received a phone call from their RA midwife 1 week after entry into the study and every 4 weeks from entry

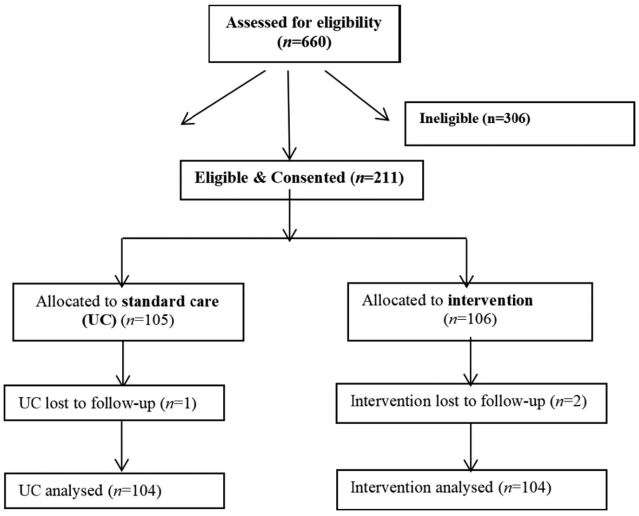

FIGURE 1 CONsolidated Standards of Reporting Trials (CONSORT) diagram.

into the study until birth. The average time spent on each call was 15 min.

RAs received training during a one-day workshop led by the PI that covered how to share the following information with service users by means of cell phone messaging: (1) a description of what they could expect from antenatal care experiences, (2) overview of physical and psychological discomforts of pregnancy, (3) antenatal profile information, (4) preparation for infant care, (5) labor and birth processes to be expected, and (6) the development of individual birth plans.

2.4 | Control

The control group received only routine antenatal care at the HC. All women, whether in the intervention group or the control group, were encouraged to deliver in a HC.

2.5 | Measures

Following consent, demographic data were collected from study participants by means of a baseline survey. All participants received a phone call at 40 weeks' gestation and up to a week after their anticipated date of delivery to obtain information about their place of birth, mode of birth, newborn outcome, and initiation of breastfeeding.

2.6 | Outcome

The outcome measure (location of birth) included births that occurred at home, at a HC, on their way to a hospital, or at a referral hospital.

3 | STATISTICAL ANALYSES

Demographic and clinical characteristics were compared between the intervention and control groups using two-sample *t*-tests and chi-squared tests. The primary analysis was a chi-squared test to determine whether there were differences between the intervention and control groups in proportion of births that took place in a HC. Chi-squared and *t*-tests were also used to examine the bivariate association between the intervention and each of the demographic and clinical characteristics, with the outcome (location of delivery). Multivariable logistic regression analysis was conducted to examine the intervention effect, adjusting for parity and other covariates that were imbalanced between the two groups. Analyses were conducted in SAS version 9.4.[21] A *p*-value of 0.05 was considered statistically significant.

4 | RESULTS

Participants' ($n=208$) sociodemographic and health-related characteristics by group (control vs. intervention) are reported in Table 1. The age of participants in the intervention group (mean = 23.63, SD = 5.79) was not statistically different from the control (mean = 24.46, SD = 6.13). Educational level was categorized as having either primary education or more than primary education. A total of 55% of the control group had more than a primary education while only 38% of the intervention group had more than a primary education, a significant difference ($X^2=5.58$, $p=0.02$). Randomization was stratified by whether the women did not have a previous live births (primipara) versus those having one or more previous live births (multipara); thus, the sample was evenly distributed. The percentage of women entering the study at 22–30 weeks' gestation was 21% for the intervention group and 18% for the control group. Gestation at entry to the study was similar for both intervention and control groups. Personal phone ownership was significantly different ($X^2=11.17$, $p<0.001$) between the intervention (64%) and control group (85%). About 29 (28%) of the control group had a previous home birth, while only 24 (23%) of the intervention group had a previous home birth; the difference was not significant.

Bivariate analyses were used to determine associations between study group and covariates (demographic or prior obstetrical history) and the dependent variable (birthplace at home vs. birthplace at healthcare center) as reported in Table 2. A total of 86% (88/102) of the control group gave birth in a HC versus 89% (92/103) for the intervention group ($X^2=0.44$, *p*-value = 0.51), with an unadjusted odds ratio of 1.33 (95% CI: 0.57, 3.09). To obtain adjusted odds

TABLE 1 Baseline sociodemographic characteristics by randomized group.

Variable	Total ($n=208$)	Usual care ($n=104$)	Intervention ($n=104$)	X^2 *or t*-value (*p*-value)
Age, mean (SD)	24.05 (5.96)	24.46 (6.13)	23.63 (5.79)	1.00 (0.32)
Phone ownership, *n* (%)				
No	53 (25%)	16 (15%)	37 (36%)	**11.17 (<0.001)**
Yes	155 (75%)	88 (85%)	67 (64%)	
Education level, *n* (%)				
Primary	111 (53%)	47 (45%)	64 (62%)	**5.58 (0.02)**
Secondary or more	97 (47%)	57 (55%)	40 (38%)	
Parity, *n* (%)				
0	106 (51%)	53 (51%)	53 (51%)	0.00 (1.00)
≥1	102 (49%)	51 (49%)	51 (49%)	
No. of previous home births, *n* (%)				
0	155 (75%)	75 (72%)	80 (77%)	0.63 (0.43)
≥1	53 (25%)	29 (28%)	24 (23%)	
Antenatal visits, *n* (%)				
1–2	127 (61%)	64 (62%)	63 (61%)	2.02 (0.36)
3–4	79 (38%)	40 (38%)	39 (37%)	
>4	2 (1%)	0 (0%)	2 (2%)	
Gestation at entry, *n* (%)				
22–30 weeks	41 (20%)	19 (18%)	22 (21%)	4.79 (0.09)
31–34 weeks	92 (44%)	40 (39%)	52 (50%)	
35–40 weeks	75 (36%)	45 (43%)	30 (29%)	

Note: Bold values indicate a significant association $p < 0.05$.

ratio estimates, three covariates were included in the logistic model. Parity was included as a stratification factor. In addition, educational level (dichotomized as primary or not) and phone ownership were imbalanced between intervention and control groups and were thus included as covariates. Personal phone ownership was the only demographic or clinical characteristic associated with the outcome. Among those with personal phones, 91% (138/152) had births in HC versus 79% (42/53) in those without a personal phone ($X^2=4.89$, *p*-value = 0.03).

The multivariable logistic regression results are reported in Table 3. The adjusted odds ratio for the intervention effect was 1.80 (95% CI: 0.73, 4.42; $X^2=1.63$, *p*-value = 0.20). Because the imbalance with phone ownership was pronounced and phone ownership was strongly related to birth in the healthcare system, an exploratory post hoc analysis was conducted to estimate and test the intervention effect by phone ownership. For those who had personal phones, the differences in proportions of participants having a birth in the health system between the intervention and control group were 62/66 = 93.3% versus 76/86 = 88.4%, respectively. For those that did not have personal phones, the percentages were 30/37 = 81.1% versus 12/16 = 75.0%, respectively, an absolute difference of about 6% in both cases. In a logistic model adjusting for covariates and including an intervention-by-phone-ownership interaction (Table 3), for participants who owned their own phones, the intervention effect estimate was 2.10 (95% CI: 0.62, 7.11; $X^2=1.44$, *p*-value = 0.23), whereas for participants who did not own their own phones the intervention effect was 1.45 (95% CI: 0.36, 5.90; $X^2=0.27$, *p* value = 0.60). The intervention effect was not significant ($p=0.69$), indicating there was not enough evidence to conclude a differential intervention effect for those with and without personal phones.

5 | DISCUSSION

Past research indicates that mobile technology interventions in other African countries increase the number of women giving birth in a HC, but a mobile technology education intervention had not yet been tested in Kenya.[22–24] Community-based characteristics[25] such as social status as indicated by personal phone ownership by pregnant women may be linked to women's ability to access information to support the decision for a HC birth. According to DeNicola,[26] mobile apps have the potential to be used

TABLE 2 Bivariate results for location of birth.

Variable	Total ($n=205$)	Birth at home ($n=25$)	Birth in healthcare center ($n=180$)	X^2 or t-value (p-value)
Study group *n* (%)				
Usual care	102	14 (14%)	88 (86%)	0.44 (0.51)
Intervention	103	11 (11%)	92 (89%)	
Age, mean (SD)	24.02	23.56 (6.56)	24.08 (5.92)	−0.41 (0.68)
Phone ownership, *n* (%)				
No	53	11 (21%)	42 (79%)	**4.89 (0.03)**
Yes	152	14 (9%)	138 (91%)	
Education level, *n* (%)				
Primary	110	14 (13%)	96 (87%)	0.06 (0.80)
Secondary or higher	95	11 (12%)	84 (88%)	
Parity, *n* (%)				
0	105	12 (11%)	93 (89%)	0.12 (0.73)
≥1	100	13 (13%)	87 (87%)	
No. of previous home births, *n* (%)				
0	154	16 (10)	138 (90)	1.88 (0.17)
≥1	51	9 (18)	42 (82)	
Antenatal visits, *n* (%)				
1–2	126	16 (13%)	110 (87%)	0.32 (0.85)
3–4	77	9 (12%)	68 (88%)	
>4	2	0 (0%)	2 (100%)	
Gestation at entry, *n* (%)				
22–30 weeks	41	4 (10%)	37 (90%)	0.79 (0.68)
31–34 weeks	90	13 (14%)	77 (86%)	
35–40 weeks	74	8 (11%)	66 (90%)	

Note: Bold values indicate a significant association $p < 0.05$.

TABLE 3 Multivariable logistic regression models for birth in the health system ($n=205$ with 180 births in the health system).

	Main effects model		Model with phone-ownership interaction	
Predictors	**OR (95% CI)**	**X^2 (p-value)**	**OR (95% CI)**	**X^2 (p-value)**
Intervention (ref: usual care)	1.80 (0.73, 4.42)	1.63(0.20)	1.45 (0.36, 5.90)	0.27(0.60)
Parity (ref: primigravidas)	0.97 (0.41, 2.30)	0.00(0.94)	0.98 (0.41, 2.34)	0.00(0.97)
Education (ref: primary)	1.22 (0.59, 2.52)	0.29(0.59)	1.23 (0.59, 2.55)	0.30(0.58)
Phone ownership (ref = no)	2.82 (1.10, 7.21)	4.67 (0.03)	2.33 (0.61, 8.91)	1.53(0.22)
Intervention–phone-ownership interaction[a]			1.45 (0.23, 9.32)	0.16(0.69)

Note: Intervention effect when phone ownership = Yes: OR: 2.10 (95% CI: 0.62, 7.11), $X^2 = 1.44$, p value = 0.23).

[a]The intervention effect for women who owned a telephone handset was not statistically significant.

for prenatal care, postsurgical follow-ups, informing patients about complications requiring care, and helping with personal healthcare choices. The preponderance of women in the current study (75%) had a personal phone and the remainder had access to a functional mobile handset, which is similar to other findings which showed that over 75% of people living in sub-Saharan Africa have access to mobile networks[27]; 90% of the world's population have access to mobile phones.[28]

The current study did not find an intervention effect; that is, the percentage of women giving birth in the HC was only 3% lower in the control group than in the

intervention group. However, several factors could have influenced intervention efficacy. First, there was an overall increase in the number of women giving birth at the HC from 3 to 5 deliveries/month in the months before the study (June 2013–December 2013) to a peak of 49 deliveries/month at the end of this study, creating a ceiling effect which made identification of an intervention effect difficult.

Second, there were differences between the control group and intervention group related to educational level, with only 38% of women in the intervention group having a secondary education or higher compared with 55% in the control group—a difference that was significant ($p = 0.02$). Other investigators have found that women with at least a secondary education are more likely to give birth in a HC, and higher education could be linked to other factors such as higher socioeconomic status and valuing modern beliefs related to health care.[7,15] Most importantly, women in the intervention group were significantly less likely to own a personal phone than women in the control group ($p < 0.001$); thus, the intervention group women relied on using a phone from a family member or neighbor to take intervention calls, potentially decreasing the intervention effect. Overall, 87% of women gave birth in a HC compared with other studies in Kenya that have indicated that although 95% of women receive antenatal care, only 62% access skilled care at a HC for childbirth.[28] This trend has continued to improve over time.[6] Women's choice of birth location may be influenced by financial access, availability, physical access, fear of hospitals, and social stigma,[29] factors that may not have been present in our study population. In this study, women had access to health education that promoted birth in a HC, which may have influenced women who would normally have given birth at home to choose a facility birth.[30]

5.1 | Limitations

This study was underpowered as the a priori assumption was that the percentage of births in a HC would be 40% in the control group based on historical data, whereas the actual percent was closer to 85%. To have observed a difference of 5% between intervention and control groups, a sample size of 686 per group would have been needed for 80% power using a two-sided chi-squared test and alpha level = 0.05.

6 | CONCLUSIONS

The proportion of HC births compared with home births was not significantly different in the intervention group compared with the control group. However, the odds ratio for the intervention effect was greater in the group of women who had a personal phone versus those who did not. The results of this study indicate that it is feasible to deliver a phone-based navigation to support choice of birth in a HC, and personal phone ownership may be a factor in the success of this strategy. Our findings also suggest that a mobile phone intervention may not be sufficient to help move a significantly higher percentage of women into facilities for birth, especially given the current resources available in many such facilities. Therefore, we would caution against the assumption that a technological innovation as the one studied here, will produce the desired change in birth setting. Removing barriers to high-quality, timely, respectful, well-resourced, facility-based maternity care will likely require far greater investment.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in Synapse docs at https://www.synapse.org/, reference number syn51081885.

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ENDNOTE

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