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The Effect of PHC Digital Innovations and Performance-Based Incentives on Uptake of Maternal and Child Health Services in Selected Pilot Sites in Kenya

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Abstract

Background: While global efforts have led to a decline in maternal and neonatal mortality, Sub-Saharan Africa continues to face disproportionately high rates, remaining far above the Sustainable Development Goal (SDG) targets. In Kenya, as the 2030 SDG deadline approaches, the gap in maternal, neonatal, and child health services remains significant. Addressing these challenges is critical to improving Maternal, Neonatal, and Child Health (MNCH) outcomes. **Objective:** This study explores how integration of digital health innovations into the MNCH chain of service delivery affects the quality of MNCH care within the selected PHC settings in *Kajiado*, *Kisii* and *Migori* Counties in Kenya. **Methodology:** This Quasi-experimental study was conducted 1-year post-intervention targeting a total of 482 pregnant women from intervention and control sites in *Kisii*, *Kajiado* and *Migori* Counties, Kenya. Data was analysed using Chi-Square test comparing frequencies between intervention and control groups when both variables are categorical. **Results:** Pre-intervention data revealed an increase in first ANC coverage within first trimester, from 167 to 278 post-intervention ($p < 0.001$). Fourth ANC coverage rose from 984 to 1177 women while *Linda mama* social health insurance registrations increased from 1008 to 1135. At the intervention sites, 938 pregnant women got screened by midwives using portable mobile Obstetric Point-of-Care Ultrasound (OPOCUS) technology compared to the 27 cases that accessed ultrasound services in the noncontiguous control sites. The pilot sites midwives earned themselves an incentive income totaling Ksh 400,000 while the Community Health Promoters (CHPs) who created demand for OPOCUS earned an incentive income totaling Ksh 327,195 from their IGAs that were project supported. There was a

significant increase in mobile health application usage and e-resources access for health information in the intervention group ($p < 0.001$). Nutritional behaviors also improved, with higher fruit and vegetable consumption in the intervention group ($p < 0.001$ for fruits, $p = 0.048$ for vegetables) and lower meat consumption ($p = 0.014$). Although no significant differences were found in BCG and OPV birth dose coverage, vaccination dropout rates were notably lower in the intervention group (17%) compared to the control group (48%). Qualitative data indicated that mobile app-based ANC services enrolment and health education had enhanced pregnant women's confidence and utilization of *services and* improved adherence to referrals. **Conclusion:** The success of digital health interventions in improving health-seeking behaviour, knowledge, and service uptake highlights the potential of such innovations to strengthen health systems and achieve universal health coverage. We recommend the intervention for a scale-up in other PHC settings in Kenya.

Keywords

Maternal and Child Health, Digital Health Innovations, Performance-Based Incentives, Antenatal Care, Health Service Utilization

1. Introduction

Despite significant global efforts to reduce maternal and neonatal mortality, Sub-Saharan Africa (SSA) continues to bear a disproportionate burden, accounting for around 70% of maternal deaths and 57% of neonatal deaths [1] [2]. Maternal mortality remains alarmingly high at 545 deaths per 100,000 live births, while neonatal mortality stands at 27 per 1000 live births [3], compared to countries such as Finland and Japan with less than 2 neonatal deaths per 1000 births [4], highlighting the severe disparities in healthcare outcomes between Sub-Saharan Africa and High-Income Countries.

The primary challenges driving these poor outcomes in Sub-Saharan Africa include inadequate access to high-quality, affordable healthcare, especially in rural areas [5]. A significant proportion of women in the region give birth at home without skilled birth attendants, contributing to the persistently high maternal and neonatal mortality rates [6] [7].

The underutilization of maternal and neonatal healthcare services is further exacerbated by cultural barriers, limited understanding of the importance of antenatal care, and the high costs associated with care [8]. These challenges point to the broader issue of weak health systems and slow progress toward achieving Universal Health Coverage (UHC) across most African Countries, including Kenya, where accelerated progress is needed the most to achieve the neonatal mortality Sustainable Development Goals (SDGs) target 3.1 (reduce global MMR to less than 70 maternal deaths per 100,000 live births and NMR below 12 deaths per 1000 by 2030) [9]. In Kenya, 11% of live births and stillbirths are assisted by unskilled providers, and 18% of mothers deliver outside health facilities without skilled personnel

[10].

Kenya faces considerable disparities across counties in achieving maternal and neonatal health targets. Counties with the highest maternal mortality rates struggle with limited access to skilled birth attendants, emergency obstetric care, and delayed care-seeking behavior [11]. Financial barriers remain significant, with three in four women in Kenya lacking health insurance, a disparity that is especially pronounced in rural areas [10].

In 2010, the Kenyan government embraced Science, Technology, and Innovation (ST&I) as a critical enabler of its Vision 2030 development agenda and SDGs [12]. This policy aims to strengthen digital health innovations, such as mHealth, telemedicine, and health information infrastructure, particularly for application in Maternal, Neonatal, and Child Health (MNCH) care. These innovations address issues like workforce shortages, inadequate health information, limited training for health workers, and difficulties in tracking patients [13].

Digital technologies also add value in areas such as monitoring and data collection, facilitating data-driven decision-making, policy development, and resource allocation. Quality of healthcare can get improved by integrating digital innovations into existing healthcare workflows and involving users at multiple levels of implementation [14]. However, many women, especially in rural areas, still lack access to critical health information, particularly regarding pregnancy-related complications [15].

As Kenya strives to meet the SDG 3 targets, leveraging the potential of digital health innovations presents a critical opportunity to accelerate progress. These technologies can enhance service delivery, improve maternal and neonatal outcomes, and bridge the gap between communities and health facilities, contributing to more equitable access to MNCH services.

2. Project Interventions

A pilot project dubbed Tekeleza (let's do it) was launched in selected facilities drawn from three counties in Kenya: Kajiado, Kisii, and Migori. The project took an integrated approach of interventions focusing on issues that affected demand, supply, and financing components of MNCH services in PHC level. The components of the intervention comprised of an electronic referral and MNCH data collection tool, a health education platform for pregnant women and a portable ultrasound screening tool to improve access to quality, affordable, and financially sustainable MNCH services. The data collection tool integrated with the O-POCUS module enabled CHPs to conduct registration of mothers during routine household visits for follow-up and referral to the health facility when necessary. In addition to this, the CHPs assisted to enroll mothers in a digital learning platform, which gave them with the opportunity to obtain gestation-specific health information based on their gestation. The targeted messages were sent to the mothers up to 3 weeks post-Nataly. To incentivize CHPs from the three pilot CHUs and create demand for skilled pregnancy care, they were given some seed capital and mentored to implement various Income Generating Activities (IGAs). In addition

to this, both Midwives and CHPs in the pilot sites were given access to mobile platforms, which enabled them to access refresher courses to improve on their skills and knowledge.

The scope of health education for pregnant women entailed awareness creation on ANC services on offer in local community's PHC facilities for the entire pregnancy spectrum, individual birth planning process and requirements, ANC visits and their relevance, danger signs in pregnancy, immunization services and growth monitoring for the newborns. In the pilot phase, a total of forty-five midwives and 30 CHPs were trained both physically and electronically (online) on how to offer OPOCUS and household MNCH health education services respectively. The project further embarked on capacity building of NHIF clerks in the pilot PHC facilities level to ensure there are minimal errors in processing of *Linda mama* re-imbursements. To ring-fence *Linda mama* reimbursements, Tekeleza project carried out advocacy meetings with CHMTs in the pilot counties and successfully negotiated to have *Linda mama* reimbursements spent at the primary facility on MNCH services instead of being remitted to the county central revenue account.

3. Methodology

3.1. Study Design

The pilot project assessment adopted a Quasi-experimental study design that combined quantitative and qualitative data collection methods to evaluate the effect of Tekeleza project's interventions on utilization, access to, and quality of MNCH services in selected intervention and control sites. The non-contiguous control sites only had the routine government MOH-sponsored MNCH services without any complimentary digital interventions similar to those in *Tekeleza* project sites. Quantitative data was collected through a household survey administered to women of reproductive age bracket 15 - 49 years under perinatal care. Other data sources included the facility database and perinatal care checklist. The Key Informant Interviews and In-depth Interviews were used to obtain qualitative data using a semi-structured questionnaire. The mixed-method approach enhanced data triangulation from various sources and increased access to nuanced insights not readily available in other data collection methods.

3.2. Study Population

The study was conducted in *Kajiado*, *Kisii*, and *Migori* Counties in Kenya. A total of 428 Women (Kajiado n = 146, Kisii n = 166, and Migori n = 116) were recruited for the Household (HH) survey in both intervention and control sites to reflect the uptake of MNCH services. On Key informant interviews 18 midwives and 19 CHPs were interviewed. The study identified the intervention and control sites within the Project implementing counties. The questionnaires were administered to women of reproductive age and the inclusion criteria used included:

1) A woman who at the time of the survey was pregnant.

2) A woman who had an infant whom she delivered within the past 6 months.

3) An eligible pregnant or post-partum woman who had stayed in the selected CHU for at least 3 months.

4) An eligible pregnant or post-partum woman who has agreed or consented to be interviewed.

3.3. Sample Size and Sampling Procedure

The sample size was calculated using the formula for estimating proportions that yielded a minimum of 194 respondents in each of the two arms (intervention and control site.

$$n = \frac{2(p)(1-p)\left(Z_{\beta} + Z_{\frac{\alpha}{2}}\right)^2}{(P_1 - P_2)^2}$$

where n is the sample size needed;

p is the estimated proportion of the population;

Z_{β} is the Z-score corresponding to the power of the test: 84%;

$Z_{\frac{\alpha}{2}}$ is the Z-score corresponding to the significance level: 1.96 at 95%;

$P_1 - P$ is the difference between the proportion of the two population.

$$n = \frac{2(0.53)(1-0.53)(0.84+1.96)^2}{(0.2)^2}$$

$$n = 194$$

Given that the project was running in three sites with heterogenous populations, the sample size calculation applied a design effect of 2. Total sample size for both arms came to 388 and upon factoring 25% drop out factor, a total sample size of 485 was arrived from both the control and intervention sites. The sample size was distributed across the three sites as shown in Table 1.

Table 1. Sample size distribution.

County/Sites	***Kajiado***		***Kisii***		***Migori***	
# of women of rep. age	3937		4427		3095	
Ratios to apply in sample size allocation	34% (0.34)		39% (0.39)		27% (0.27)	
Proportions in control & intervention group	Control	Intervention	control	Intervention	Control	Intervention
	83	83	95	95	65	65

3.4. Statistical Analysis

The quantitative data collected through ODK was cleaned and analyzed using the Statistical Package for the Social Sciences (SPSS) version 23. Exploratory data analysis was performed to identify outliers and missing responses and guide further analysis. Outliers were replaced with the mean values to minimize their influence on the analysis, and sensitivity analyses were conducted to assess the impact of this

imputation. Missing data due to participant withdrawal or incomplete responses were addressed through complete removal from the data frame, where cases with missing data were excluded from the analysis.

The study population was characterized by study sites, age, marital status, religion, level of education, income quartile, and relationship to the household head. Continuous variables, such as the age of mothers, were summarized as means with 95% Confidence Intervals (CIs) while categorical variables were presented as frequencies and percentages in tables and graphs.

Chi-Square (χ^2) tests were used to assess the association between digital health adoption rates (a categorical variable) and categorized dietary consumption levels (categorized as poor, borderline, or acceptable) between the control and intervention groups. The Chi-Square test was selected because it is appropriate for comparing frequencies between two or more groups when both variables are categorical. A significance level of $p < 0.05$ was used to determine statistical significance.

For the qualitative data, verbatim transcripts were translated to English where necessary, and reviewed for accuracy and completeness. Nvivo software was used to generate themes while excerpts from the transcripts were included as direct quotes to support and illustrate the identified themes.

3.5. Ethics

Prior to data collection, the research team sought ethical approvals to ensure the study adhered to the research ethical principles. Final authorization for data collection was obtained from the relevant administrative authorities in *Kajiad*o, *Migori* and *Kisi*i Counties in Kenya. Study participants from both the intervention and control groups provided written informed consent, acknowledging that their participation was voluntary and that they could withdraw from the study at any time during the research process. Further to this, all the questionnaires were coded, and participants were anonymized during data analysis and report writing to avoid linking the identification of any individual participant to the study.

3.6. Socio-Demographic Characteristics of Respondents

The study enrolled a total of 482 women aged 15 - 49 years, 254 were from the intervention and 228 from control sites in Kajiado, Migori, and Kisii counties, with their mean age of 25 (95% CI: 21.30) and 26.5 (955 CI: 22.31) in intervention and control sites respectively (Table 2). The majority of the respondents were married in both the intervention and control groups, 190 (75%) and 188 (82%), respectively, while 89% (227) in the Intervention and 100% (228) in the control group identified as Christians. Educational backgrounds varied significantly between the control and intervention groups ($p = 0.011$), with 46% (116) of participants in the intervention group having completed secondary education compared to 33% (76) in the control group. The lowest economic level (1st Quartile) constituted less than half of the respondents in both the intervention (84.33%) and the control groups (86.38%). The income quartile distribution did not display a significant difference

between the two groups (p = 0.14). Some of the participants identified themselves as household heads (decision makers), with a notable discrepancy between the intervention and control groups (25% vs. 14%, p = 0.002).

Table 2. Social demographic characteristics of respondents.

Characteristics	Overall (N = 482)	Control (N = 228)	Intervention (N = 254)	p-value
Study counties				
Kajiado	185 (38%)	90 (39%)	95 (37%)	
Kisii	178 (37%)	78 (34%)	100 (39%)	
Migori	119 (25%)	60 (26%)	59 (23%)	
Age (years)	**25.0 (21.0, 30.0)**	**26.5 (22.0, 31.0)**	**25.0 (21.0, 30.0)**	
Marital status				*0.11*
Married	378 (78%)	188 (82%)	190 (75%)	
Single	92 (19%)	37 (16%)	55 (22%)	
Divorced	4 (0.8%)	2 (0.9%)	2 (0.8%)	
Separated	4 (0.8%)	1 (0.4%)	3 (1.2%)	
Widowed	4 (0.8%)	0 (0%)	4 (1.6%)	
Religion				*<0.001*
Christian	465 (96%)	227 (100%)	238 (94%)	
Muslim	17 (3.5%)	1 (0.4%)	16 (6.3%)	
Level of education				*0.011*
Primary	241 (50%)	131 (57%)	110 (43%)	
Secondary	192 (40%)	76 (33%)	116 (46%)	
College	47 (9.8%)	20 (8.8%)	27 (11%)	
University	2 (0.4%)	1 (0.4%)	1 (0.4%)	
Income distribution				*0.14*
1st Quartile	170 (35%)	86 (38%)	84 (33%)	
2nd Quartile	72 (15%)	33 (14%)	39 (15%)	
3rd Quartile	145 (30%)	58 (25%)	87 (34%)	
4th Quartile	95 (20%)	51 (22%)	44 (17%)	
Head of household (N = 482)				*0.002*
Household head	94 (20%)	31 (14%)	63 (25%)	
Not household head	388 (80%)	197 (86%)	191 (75%)	

3.7. Maternal, Newborn, and Child Health Care Seeking Behaviour

Individual skilled pregnancy health-seeking behavior was assessed before and after the intervention at the project sites in the 3 pilot counties. The project Interventions positively impacted on various aspects of MNCH care in ($p < 0.001$ for each of the pilot sites from the three counties), reflecting the importance of integrated approaches in addressing maternal and child health challenges. Before the intervention, out of 1552 mothers attending their First ANC visits, only 167 (10.8%) mothers initiated the First ANC in their First Trimester (Figure 1); however, after the intervention project intervention ,524 (16.4%) mothers out of the eligible 3197 went for their First ANC in their First Trimester. There was a little improvement although still the data depicts low utilization of 1st ANC Visits within the first pregnancy trimester. Following the Intervention, 4th plus ANC visits increased from 984 (baseline) to 2080, while *Linda mama* registrations increased from a baseline of 1008 to 2747, and a total of 938 pregnant women underwent O-POCUS screening (Figure 2).

The finding is consistent with the Key Informant Interviews (KIIs) showing that App-based enrolment of pregnant mothers for ANC services has led to increased uptake of Social Health Insurance services by pregnant women. The key informants also observed that, through the Project's support, referrals of pregnant mothers from the community to PHC health facilities in intervention sites had increased. The introduction of ultrasound services in selected facilities had increased women's confidence in the quality of care available thus reducing dropouts among those referred.

"*…currently ANC mother's adherence to referrals from the community to the facility is at* 100%. *This is because of the motivation the CHPs get from Tekeleza project supported IGAs for community health promoters…and availability of ultrasound scanning services in the nearby health centers. In fact, our CHPs are doing it well….*"

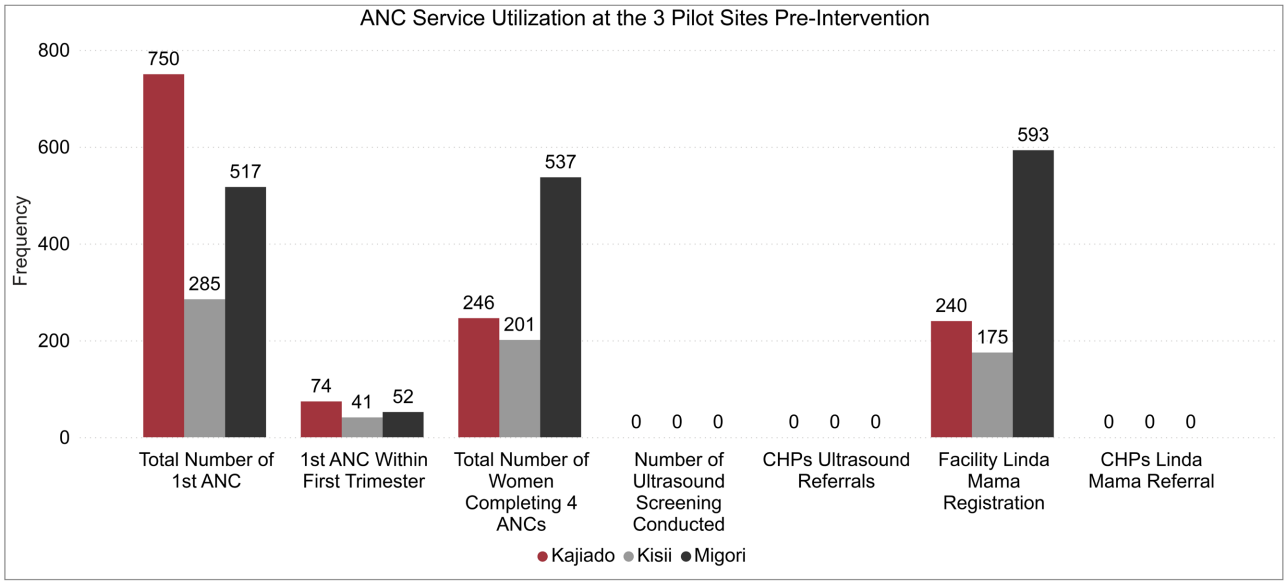

Figure 1. Status of ANC services utilization pre-intervention.

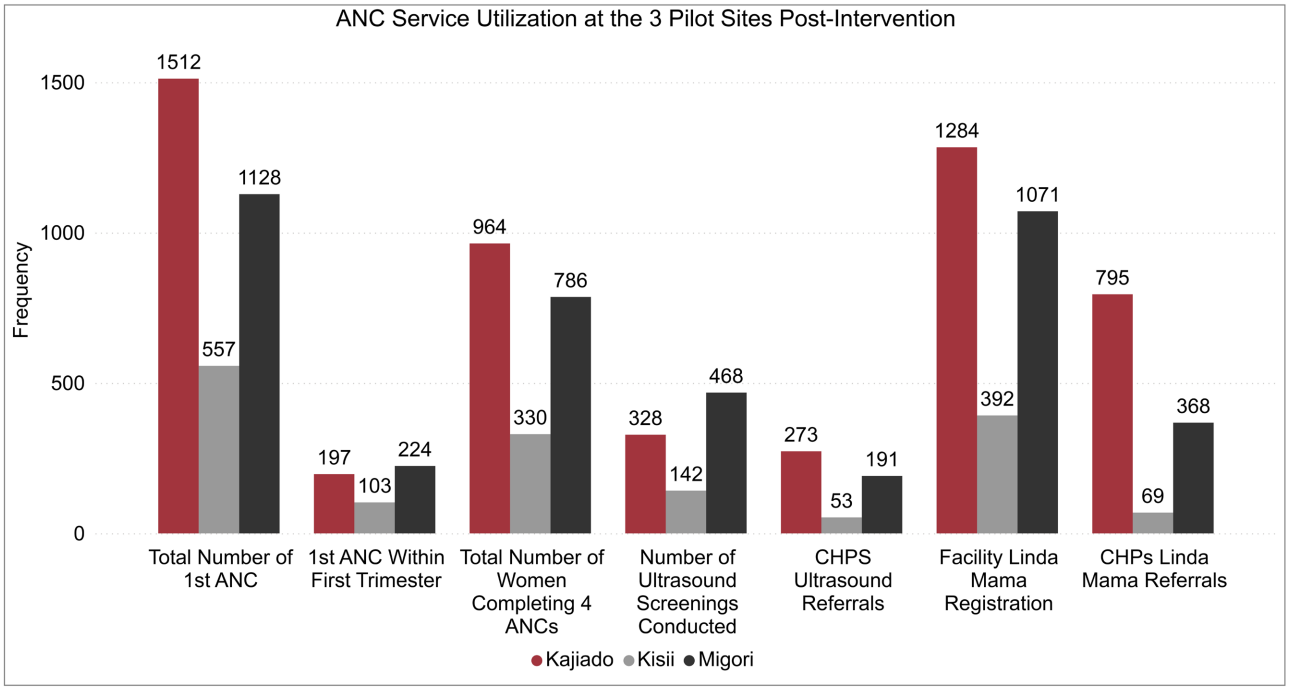

Figure 2. Status of ANC services utilization post-intervention.

3.8. Digital Platforms Access and Usage

Notably, there was a significant difference between the control and intervention groups on the adoption of mobile health applications to access gestation specific perinatal care health information. Mothers in the intervention group showed greater use of mobile health applications and the Internet for pregnancy-related information, with 38% utilizing digital platforms, compared to only 1% in the control group. However, Community Health Promoters (76% in the intervention group, 68% in the control group) and Healthcare Providers (41% in the intervention group, 54% in the control group) remained the primary and most trusted sources of pregnancy information across the three pilot counties (Figure 3).

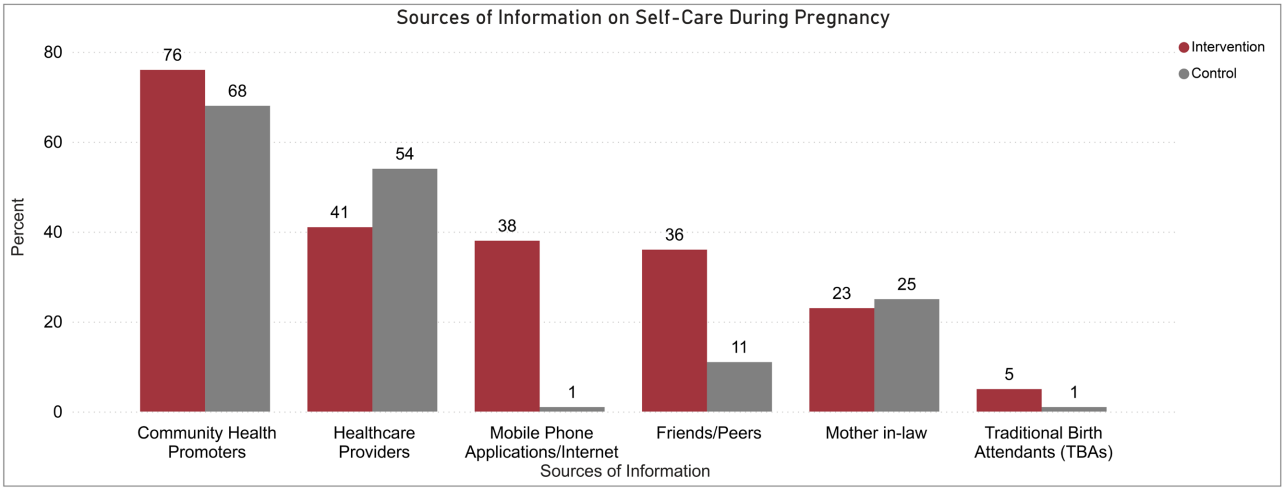

Figure 3. Sources of information on self-care during pregnancy.

To corroborate this finding, some key informants concurred that through the project, pregnant women's knowledge had improved to the extent of changing their health-seeking behavior in favor of skilled pregnancy care and Skilled Birth Attendance (SBA).

"Okay, the project has been able to support mothers in many ways and I think it has a good approach because most mothers nowadays, they say they don't deliver at home because CHPs are linking them to insurance services. Previously, some mothers used to be afraid to come to the hospital because they might be asked for money to access any service but they have now known that *Linda mama* covers nearly everything…."—KII Informant

"We were introduced to an e-learning App by the project. So, through the project, you could do online learning on antenatal care services. Whereby there's everything to do with MNCH. So, there's information you go through, followed by questions that the user answers before getting issued a certificate at the end of it"—KII Informant

3.9. Dietary Intake and Nutrition Related Self-Care Behaviour

Mothers in the intervention group exhibited improved nutritional behaviors. A higher consumption of fruits and vegetables was noted, alongside a lower frequency of meat consumption, indicating the positive impact of nutrition-focused health education on dietary behaviors and the importance of promoting healthy eating habits during pregnancy and early childhood. The results indicate that the intervention group had a significantly higher consumption of fruits ($p < 0.001$) and a higher frequency of green vegetable intake ($p = 0.048$). Conversely, there was a significant difference in meat consumption with the control group consuming meat more than twice as frequently as the intervention group ($p = 0.014$). The food consumption score, reflecting dietary diversity and food frequency, was generally higher among mothers visited by CHVs in the intervention sites. The intervention group mothers had higher scores as a result of accessing digital health information through their mobile phones and the regular visits they received from the motivated (incentivized) Community Health Promoters (**Figure 4**).

3.10. Barriers to MNCH Care Uptake

Figure 5 reveals the intricate relationship between the number of ANC visits and distance from the nearest health facility. Notably, mothers residing in close proximity to healthcare facilities, especially within the intervention group, had a heightened frequency of ANC visits, highlighting the pivotal influence of distance ANC mothers travel on their healthcare-seeking behavior. This prompted the pilot health facilities to conduct outreach clinic services to reach the remote rural catchment areas. Findings from Key informant Interviews revealed that incentives contributed to midwives and CHPs motivation to offer community-based outreach services thus increasing the number of those seeking skilled pregnancy care and skilled Birth Attendance (SBA).

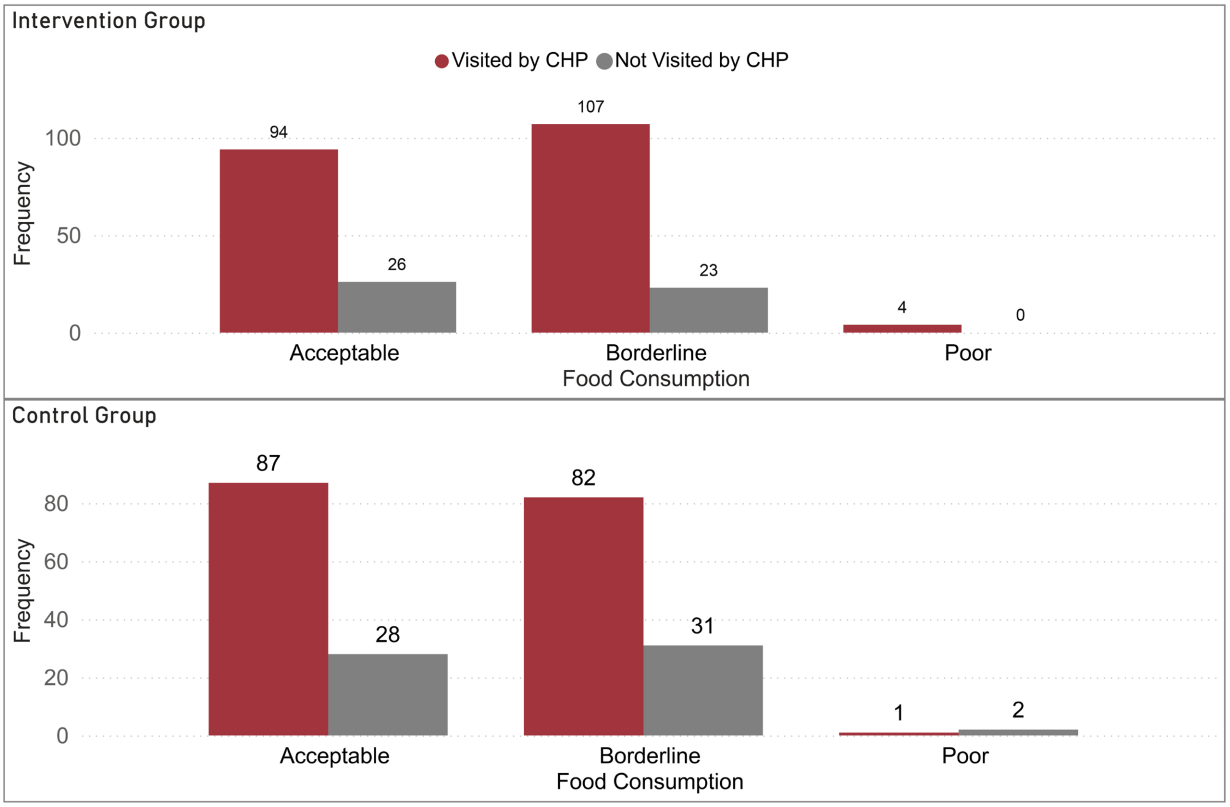

Figure 4. Food consumption dietary diversity score among pregnant mothers.

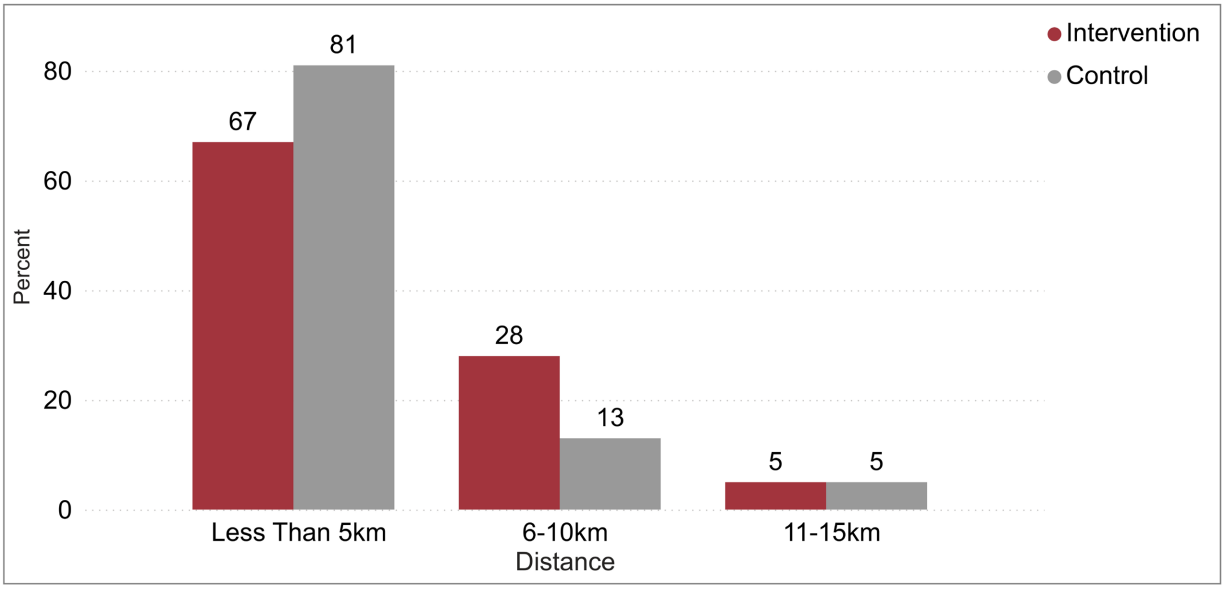

Figure 5. ANC attendance by distance to health facility.

"Yes (Project has contributed to MNCH staff's motivation), you know, even having them go for the training and now able to do the ultrasounds, you know, that is motivation enough. Then there are several sensitization meetings that Tekeleza has had with the midwives and CHPs to motivate them"—KII Informant

3.11. Vaccination Coverage

The study could not determine the vaccination coverage in the intervention and control sites since the target population included mothers with children aged 0 - 6 months. However, no significant disparities were observed between the intervention and control groups in the uptake of BCG and OPV birth doses. BCG coverage rates were 97% in the intervention group and 100% in the control group and OPV birth dose coverage rate of 97% in both groups. Further to this, the vaccination dropout rate was estimated using Penta 1 and Penta 3 vaccination coverage. Dropout rate was highest in the control group, at 48% compared to 17% dropout rate in the intervention group (**Figure 6**). This finding underscores the significant role digital access to health information played in the intervention sites.

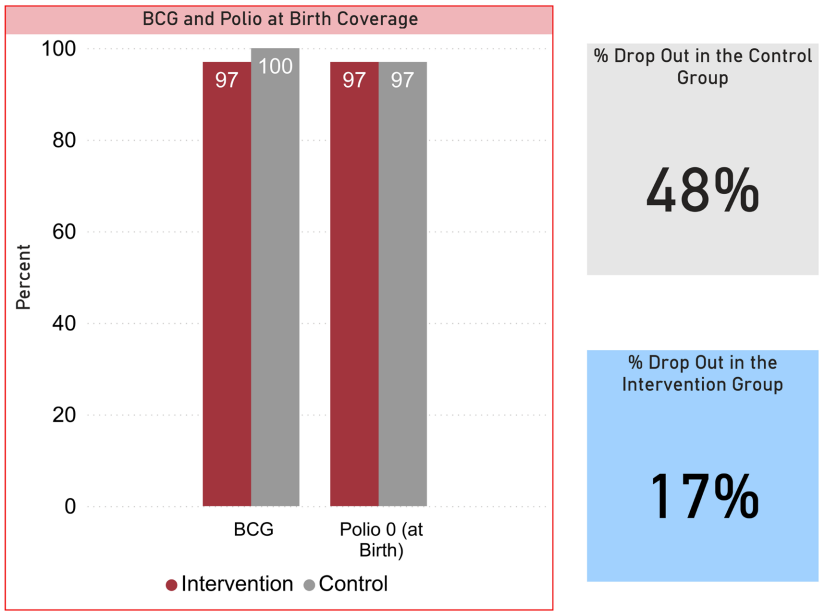

Figure 6. Vaccination coverage in the intervention and control sites.

3.12. Performance Incentives and Uptake of MNCH Services

Through the project's efforts, it is evident that the incentives motivated midwives and CHPs, resulting in an increase in services provided to clients at the intervention sites compared to the period before the intervention (**Figure 7**). Additionally, the value of *Linda mama* claims submitted by the pilot health facilities reached their highest levels, with increases of 40% in Kisii, 65.9% in Migori, and 230% in Kajiado. This marked improvement from the baseline is due to the submission of more ANC and PNC claims and a proactive approach to tracking pending claims, leading to reduced revenue loss. The project had also trained the facility NHIF clerks on how to process *Linda mama* claims and it led to elimination of errors that often led to rejection of the claim forms by the insurance scheme.

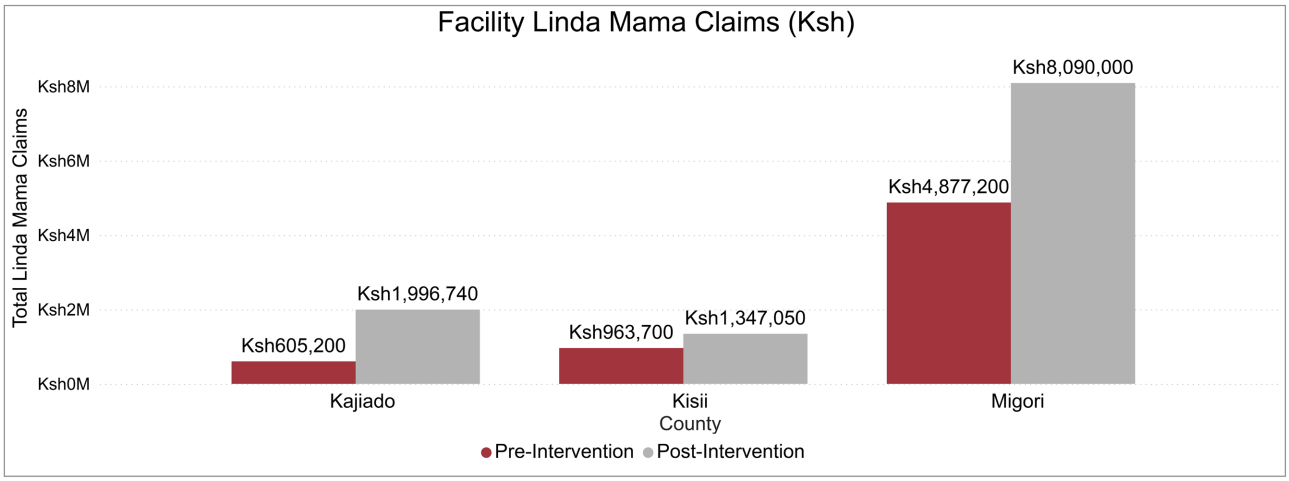

Figure 7. The effect of performance-based incentives on *Linda mama* enrolments and claim.

4. Discussion

This study delved into the multifaceted barriers influencing the utilization of skilled pregnancy and birth attendance within purposefully selected pilot sites from three counties in Kenya. Health seeking behaviors are shaped by many factors; quality of care in health facilities, women's health information literacy, access to health care and culture among others [16]. However, PHC digital innovations are becoming more versatile with each passing day, creating opportunities of integrating them into the MNCH chain of services delivery and continuum of care to improve the quality of services delivery [17]. PHC digital innovations have inherent potential to improve on the traditional based health delivery systems especially in data collection, health financing management, referral systems, refresher training of PHC services providers, health education and promotion [18]. From our study findings, the intervention sites exhibited improved health-seeking behaviour and knowledge levels in maternal, new-born, and child healthcare. The project further adopted digital solutions to successfully deliver electronic training content to both clinical and non-clinical staff in the selected pilot sites. It is now evident that a well-trained registered midwife can be trained in the use of handheld, mobile and portable technologies, e.g. OPOCUS technologies to mitigate on risks that lead to preventable maternal deaths in PHC settings [19].

Our study further revealed that uptake of digital solutions in PHC settings is seen as extra workload to the already understaffed service providers, thus there is need to motivate staff to adopt them [20]. Performance based incentives positively impacted on creation of demand for services by Community Health Promoters and further motivated the midwives to extra workload despite the staffing shortages in the Primary Health Care (PHC) facilities [21]. Uptake of PHC digital innovations in PHC settings is also influenced by access to handheld technologies, e.g. obstetric ultrasound kit. To attain universal health coverage through adoption of transformative and evidence based digital innovations in PHC settings, National and local governments need to invest in acquisition of emerging and transformative

digital innovations [22].

When PHC facilities offer innovative technology enabled services, there is evidence that it stimulates an increase on utilization of ANC services [23]. Notably, when midwives have access to O-POCUS resources among other ANC profile testing resources, mother's confidence in the quality of services in a given facility does increase leading higher uptake of skilled pregnancy and birthing services [24]. This observation is in tandem with findings from our study in the selected sites in Kenya. The converse of this is expected to happen where PHC facilities are perceived to be having limited resources for MNCH care.

In line with existing studies, our findings demonstrate that women in prenatal and postnatal stages greatly benefit from mHealth applications for self-care, particularly in rural and underserved communities especially on knowledge and selfcare practices [25]. Our findings are consistent with analysis from previous studies and highlight the role of mHealth and other digital health interventions in bridging gaps on accessing quality antenatal and postnatal services in low economy settings [26]. Provision of ANC services in resource limited settings can be enhanced through personalised sharing of health messages [27], sending reminders on ANC visits, Immunizations and even post-natal bookings [28]. The evaluation's results revealed that the intervention group which adopted use of mHealth enabled solutions had significantly higher consumption of recommended food items (<0.001) and a higher likelihood of attending all recommended vaccinations, consequently lowering the vaccination dropout rate to 17% in the intervention group. These findings align with studies conducted by Abdul *et al.* (2022) [29], and Till *et al.* (2023) [30].

A recent MNCH related pilot intervention in Ghana [31], demonstrated that digital health enabled health interventions have the potential to strengthen health systems and help achieve universal health coverage. The Ghana project embraced microlearning to send specific health messages to ANC mothers; it led to increased utilization and access to emergency care among pregnant women [32]. A similar effect has been observed in building capacity of Community Health Promoters (CHPs) to create demand for PHC services [33].

The study revealed a significant increase in uptake of MNCH care services post-intervention; this included higher Attendance at Antenatal Care (ANC) clinics, increased uptake of ultrasound screenings, and better adherence to immunization schedules. These improvements were attributed to effective enrolment of pregnant women to the national social health insurance scheme (*Linda mama*) and their end-to-end follow-up using evidence based digital innovations. In addition, the project leveraged on capabilities of digital innovations to enhance the referral system that existed between the households and nearby PHC health facilities. This led to an increase in the number of mothers attending the 1st ANC visits; from 167 to 524 mothers after the intervention. In general, findings from related studies have also demonstrated that digital innovations deployment in PHC settings has potential to increase MNCH services coverage [34].

5. Study Limitations

While our study provides valuable insights into the impact of digital health interventions on Maternal, Newborn, and Child Health (MNCH) service utilization, several limitations must be considered. The study relied heavily on health records and self-reported data, which may be incomplete or inaccurate. These data quality issues can affect the reliability of our findings and may introduce bias into the analysis. The study also had a risk of selection bias, leading to skewed results and reduced validity of conclusions drawn from the data. To prevent biases arising from participant selection, including sampling bias and participant dropouts, the study adhered to predefined selection criteria to ensure that only participants who met these criteria were included. Additionally, a 25% adjustment was made to the sample size to account for potential non-response and dropout rates, ensuring that the final sample remained representative of the target population. The effectiveness of digital health intervention may vary depending on how consistently and thoroughly it is implemented. The study assumed that the intervention regions are not being compared but are complementing, however, some sites might have implemented the intervention more rigorously than others, this could lead to variation in its effectiveness and potentially obscure the true impact of the intervention on MNCH service utilization. While our study demonstrates the potential benefits of digital health interventions in improving MNCH service utilization, these limitations highlight the need for cautious interpretation of the results.

6. Conclusion and Recommendations

The study underscores the effectiveness of digital health integration in enhancing MNCH care quality and outcomes, particularly in resource-limited PHC settings. The success of digital health interventions in improving health-seeking behaviour, knowledge, and service uptake highlights the potential of such innovations to strengthen health systems and achieve universal health coverage. We recommended the intervention for a scale-up in other PHC settings in Kenya.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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