A Targeted Mobile Phone Intervention Use in Antenatal Care is Associated with Improved Antenatal and Postnatal Clinic Attendance amongst Pregnant Women in A Pastoralist Community in Narok County, Kenya: A randomized controlled trial

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Summary

BACKGROUND

Antenatal care is a key high impact strategy to improve maternal and child health globally. This study examined the effects of a targeted mobile-phone intervention on ANC and Postnatal Clinic (PNC) attendance in a pastoralist community.

MATERIALS AND METHODS

An RCT was conducted in Narok County on pregnant mothers recruited early in pregnancy, enrolled and followed up to 42 days postpartum starting in June 2018. The intervention was bi-component; an SMS and a phone call reminder were administered in the intervention arm while the non-intervention group received routine care.

RESULTS

The 131 study participants in the intervention arm had a mean of 4.10 visits (SD 0.76, 95% CI 3.97-4.23). The 128 study participants in the non-intervention arm had a mean of 2.84 visits (SD 0.95, 95% CI 2.68-3.01). The difference in means was 1.256 (95% CI 1.044-1.256), which was statistically significant at a 95% confidence level (p-value<0.0001).

For the 60 study participants in the intervention arm, 41.67% (n=25) attended the PNC while 58.33% (n=35) did not attend. The 76 study participants in the non-intervention arm, 21.05% (n=16) attended the PNC while 78.95% (n=60) did not attend. The null hypothesis of there being no difference in the likelihood of a mother attending PNC by study group was rejected (X^2=6.7658, p=0.009).

CONCLUSION

A targeted mobile-phone intervention improved ANC and PNC attendance in a pastoralist community in Narok, Kenya.

Keywords: *Maternal and Child Health, Antenatal Care, M-Health, Mobile Phone Intervention, Postnatal Care.*

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Introduction

Worldwide, complications that occur in pregnancy, at childbirth and in the puerperium are the leading causes of mortality and morbidity among Women of Reproductive Age (WRA)[1]. There has been a 45% reduction in maternal deaths globally between 1990 and 2013[2]. However, the burden remains high especially in the Lower and Middle-Income Countries

(LMICs) despite this impressive reduction. In 2010, the World Health Organization (WHO) estimated that there were 287000 maternal deaths globally[3] translating to almost 800 mothers dying daily. In fact, every 90 seconds a woman dies of the complications occurring during pregnancy and childbirth[4]. The morbidity burden is also huge with millions of women suffering pregnancy-related illnesses or experiencing other severe consequences including infertility, obstetric fistulas and incontinence[5].

The Kenya Demographic Health Survey (KDHS) 2014 estimated Maternal Mortality Ratio (MMR) for Kenya to be 362 deaths per 100000 live births[6]. World Bank models estimated it to be 510 deaths per 100000 live births in 2015[7]. This same ratio was similarly estimated to be 687 deaths per 100000 live births in 1990 in Kenya[7]. Additionally, the Neonatal Mortality Rate (NMR) was estimated by the KDHS 2014 to be 22 deaths per 1000 live births [6]. This rate was 27 deaths per 1000 live births in 1990. Globally, the rate was estimated at 19.2 deaths per 1000 live births in 2015[7]. The Kenyan figures indicate that less than significant progress has been made since 1990 in improving these vital indicators which are key and sensitive indicators of the quality of maternal and child healthcare being offered and by proxy also the general quality of healthcare delivery in a country.

Antenatal care (ANC) remains one of the key high impact strategies to improve maternal and child health globally[1]. World Health Organization (WHO) currently recommends at least 8 visits during the woman's pregnancy arranged based on the impact of each visit during the progress of the pregnancy and the overall cost effectiveness[8] [9]. Women in developing countries face a lifetime risk of maternal death of 1 in 160 compared to 1 in 3700 for those in developed countries[10]. These inequalities are driven by a myriad of causes a major one being limited access to basic preventive services, especially Antenatal Care services. In low and middle-income countries, only about half of pregnant women receive the WHO recommended minimum ANC visits[3]. It is also recommended that women should have at least one or more postnatal visits within 28 days of delivery[11] [12]. Good quality ANC care can reduce maternal morbidity and mortality and perinatal morbidity[13] [14]. Early initiation of ANC and attendance of more visits are associated with higher infant birth weights and lower infant mortality rates [15] [16].

Evidence shows that using technology in maternal health (mHealth) improves outcomes[17] [18]. Studies show that mobile phone technology is effective at changing behaviour to improve antenatal care and postnatal care attendance. However, most of the studies in the literature are observational and a more rigorous evaluation of mHealth is necessary for a broader variety of settings.

The number of mobile subscriptions (SIM Cards) in Kenya was 53.2 million in 2019 compared to a population of 47.5 million Kenyans[19]. This translated to a mobile (SIM) penetration level of 112.0% attributed to the increasing availability and access to mobile networks signal and a range of convenient mobile services available to the population[19]. Leveraging this high mobile phone penetration within the country to improve healthcare services and outcomes is critical.

Problem Statement

Across Sub-Saharan Africa, there is wide variation in ANC attendance[9]. 74% of pregnant women attend formal ANC at least once during their pregnancy[6]. However, only 44% of women attend ANC four or more times[6] [7] [8]. The KDHS 2014 reported that 9 in 10 mothers saw a skilled provider at least once for ANC for their most recent birth in the five years

before the survey[15]. However, only 58 % of women reported 4 or more visits[15]. This proportion varied widely across counties with West Pokot County reporting 18.2% while Nairobi County reported 73%[15]. Narok County reported 46.0 % fourth ANC attendance[15]. It is worthwhile to note though that this was self-reported survey data and recall bias likely to occur.

The low proportion of attendance of ANC is correlated with poor maternal and neonatal outcomes in Africa with morbidities and mortalities remaining high[20 21]. Those mothers who attend more ANC visits are also more likely to deliver under a skilled healthcare attendant.

These challenges coupled with inadequate services offered in health facilities make the impact of antenatal services much less than would be expected. This is compounded by socio-cultural challenges and lower literacy levels in some parts of Kenya making maternal and child healthcare delivery more complicated and the health outcomes less than favourable.

Study Justification and Objectives

The field of mHealth is proposed as a potential solution to the many challenges facing middle and low-income countries in health care delivery[22]. Text messages have been shown to improve health-seeking behaviour, treatment adherence, data collection and as a communication tool to improve patient follow up and data reporting[23 24 25]. Given that mHealth tools have been promising in behaviour change broadly, the potential exists to improve essential preventive maternal and child health services as well.

The KDHS 2014 reported that in Narok County only 40% of the deliveries were assisted by a skilled health care attendant and only 39% of these deliveries were in a health facility, which was much lower than the national achievements of 62% and 61% respectively[6].

This study aimed to examine the effects of a targeted mobile phone intervention on ANC and PNC attendance in a pastoralist community. It hypothesized that a targeted mobile phone intervention in antenatal care would not be associated with improvement in ANC and PNC attendance in the study population.

Materials and Methods

Study site

The study was conducted in four hospitals in Narok County, Kenya, a majorly pastoralist community-occupied county: the Narok County Referral Hospital, Ololunga Sub-county Hospital, Ntulele and Mulot Health Centres. The study population comprised the women of reproductive age who were expectant and were attending antenatal care at the Maternal and Child Health Clinics in the participating health facilities.

Study design

A Randomized Controlled Trial (RCT) was conducted to determine the effects of a targeted mobile phone intervention on antenatal and postnatal clinic attendance. The study was conducted on pregnant mothers recruited within their first or second trimester, who on providing informed consent, were enrolled and followed up to 42 days after delivery. Recruitment started in June 2018. A targeted mobile phone intervention was administered to the women in the intervention study arm while those in the non-intervention arm were provided with routine antenatal care.

The intervention had two components; firstly a standardized Short-message Service (SMS) designed to include information on the importance of antenatal care and a reminder to attend the ANC clinic regularly was sent fortnightly using an individualized messaging system immediately on recruitment. The second component was a phone call reminder done one week before the date the study mother had been

booked to attend the ANC clinic. Clinic bookings were done monthly.

The message was translated into Swahili to enable it to reach all the ethnic groups within the county. Two research assistants were recruited at each participating facility and trained on the study protocol and the study registers. Recruitment of study participants was done by the research assistants at their work station. The principal researcher would then allocate the newly recruited mother to their specific study arm using a computer-generated list of random numbers, and then relay this information to the research assistants.

After delivery, the primary outcome (clinic attendance) was extracted from the ANC booklets and registers and recorded in the study questionnaire. Those study mothers who neither delivered in any of the participating health facilities nor brought their babies for immunization at 6 weeks were called using the phone numbers provided and the outcomes recorded. Those mothers who delivered at home were advised to take their babies for immunization.

Selection criteria

Study participants were selected based on attending their first ANC within the first or second trimester. They were also required to own a mobile phone or have access to one at the household level and should have been a resident in Narok County for at least 5 years before recruitment. Minors were required to have a caregiver who would give informed consent.

Mothers who did not give consent and those with co-morbidities were excluded. Where the study participant was not the primary owner of the mobile phone, the phone-owner was informed to promptly relay the messages and calls he/she received to the study participant.

Randomization was at the individual level and allocation to study arms used the mobile phone numbers as unique identifiers which had been serialized from 1 to 280 (determined sample size).

Sample size calculation

Type one error was assumed to be 0.05 while the power of the study was estimated at 80%. The proportion of deliveries assisted by a skilled healthcare attendant in Narok was estimated at 0.40 by the KDHS 2014[6]. This study assumed a clinically significant improvement of 0.20. Using the Fleiss' formula, the sample size calculation gave a sample size of 107 mothers in each study arm. A 10% adjustment was made for loss to follow-up and 18% for contamination giving each arm 140 participants[26].

Data collection

Data were collected using a questionnaire, which was divided into different sections (A to E) with each section being filled at different times in the course of the pregnancy and the study. Section A contained socio-demographic data; section B, anthropometric and systemic clinical examination. Section C contained the postnatal outcomes; while section D had information extracted from registers and section E contained an assessment of the acceptability of the intervention. Data Analysis was done using Stata statistical Software v12.

Ethical approval

Ethical approval was obtained from the Kenya Medical Research Institute's Scientific and Ethics Review Unit (SERU) protocol number KEMRI/SERU/CPHR/001/3573.

Results and Discussion

The organization of the randomized controlled trial (RCT):

The flowchart (Figure 1) derived from the CONSORT 2010 guidelines on clinical trials shows the study flow[27]. 262 out of 280 study participants completed the study, giving a

response rate of 93.6%. The baseline characteristics are shown in Table 1.

Study participants' age at enrolment

There were 119 study participants aged between 20 and 24 years forming the majority of the study mothers at 45.42%, followed by the 59 mothers aged between 25 and 29 years at 22.52%. The 50 study mothers aged 19 years and below (teens) were the third highest at 19.08%. The least proportion of study participants were those aged 40 years and above forming 1.13%. This is depicted in the pie chart below (Figure 2).

Baseline Body Mass Index (BMI) of the study participants by age

The mean BMI for the 39 study participants aged 19 years and below was 22.61 (SD 2.59, 95% CI 21.77-23.45) with a median of 22.52 and a range of 14.10 while it was 24.44 (SD 4.03, 95% CI 23.61-25.28) with a median of 23.61 and a range of 19.0 for the 92 study participants aged between 20 and 24 years.

The mean BMI for the 47 study participants aged between 25 and 29 years was 25.61(SD 5.87, 95% CI 23.89-27.34) with a median of 24.83 and a range of 25.29 while it was 26.59 (SD 4.46, 95% CI 24.22-28.97) with a median of 26.49 and a range of 18.81 for the 16 study participants aged between 30 and 34 years.

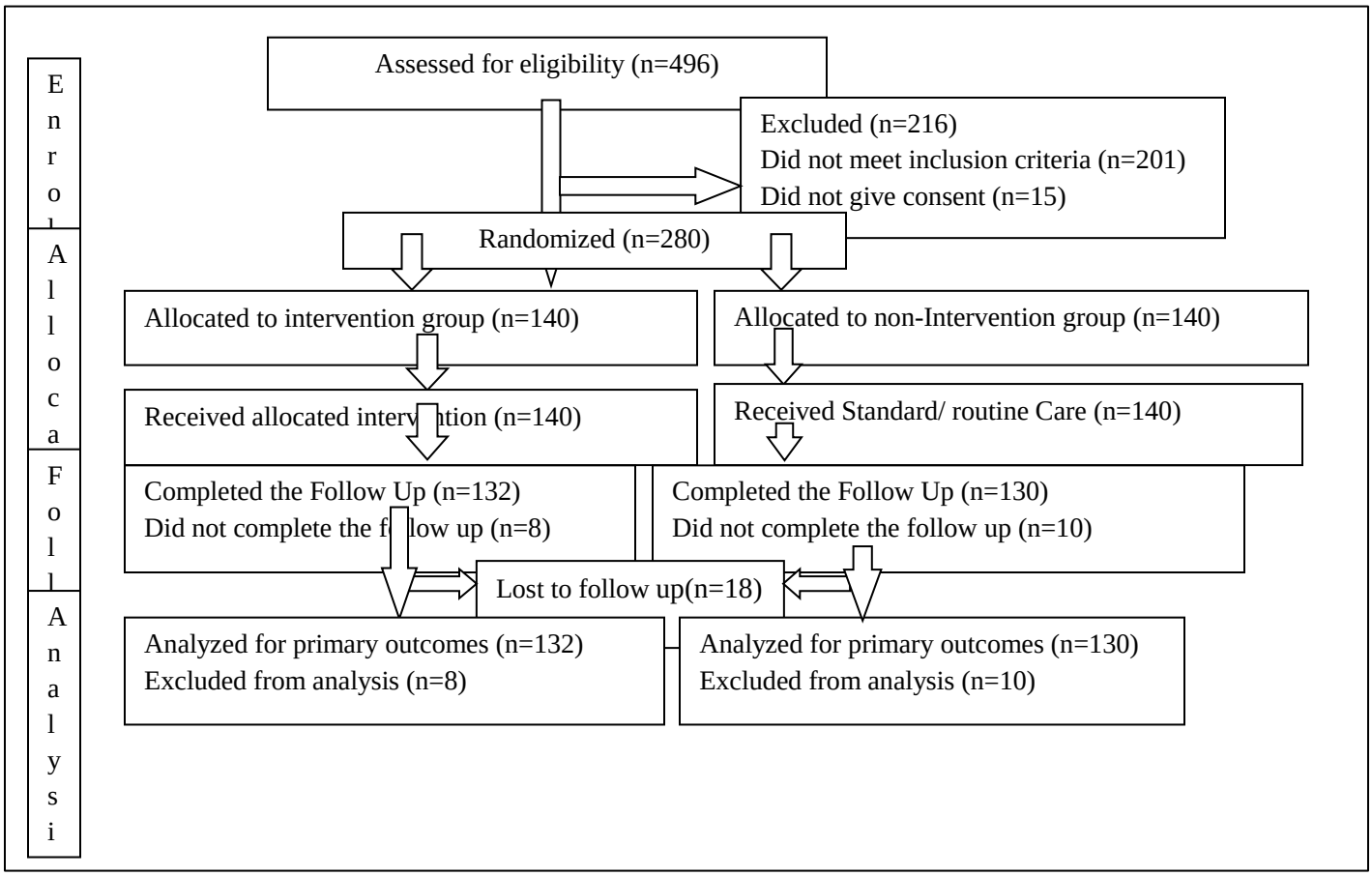

Figure 1: Flowchart of Phases of Parallel Randomized Trial –Modified from CONSORT 2010

Table 1: Table showing the Baseline Characteristics of Study Participants

Variable	Intervention Arm (N=132)[a]	Non-Intervention Arm (N=130)[a]
Age (Years)	24.29 ± 5.29	23.44 ± 5.12
Marital Status: n (%)		
Married	115 (87.12)	111 (85.38)
Single	16 (12.12)	19 (14.62)
Separated	1 (0.38)	
Parity (Number of children)	1 ± 1.03	0.88 ± 1.29
Level of Education: n (%)		
Never Attended		7 (5.38)
Primary	47 (35.61)	47 (36.15)
Secondary	53 (40.15)	47 (36.15)
Tertiary	32 (24.24)	29 (22.31)
Level of Education attained by Spouses: n (%)		
Never Attended	1 (0.76)	4 (3.08)
Primary	30 (22.73)	30 (23.08)
Secondary	47 (35.61)	48 (36.92)
Tertiary	38 (28.79)	29 (22.31)
Distance to a Health Facility: n (%)		
Less than 1 km	24 (18.18)	19 (14.62)
1 to 5 km	74 (56.06)	90 (69.23)
More than 5 km	34 (25.76)	21 (16.15)
Time taken to a Health Facility: n (%)		
Less than 15 minutes	20 (15.15)	12 (9.23)
15 to 30 minutes	38 (28.79)	35 (26.92)
30 to 60 minutes	56 (42.42)	74 (56.92)
More than 60 minutes	18 (13.64)	6 (6.92)
Spouses' Drinking/Smoking status: n (%)		
Didn't Drink or Smoke	95 (83.33)	92 (84.4)
Drank and/or Smoked	19 (16.67)	17 (15.6)
Key Decision Maker at Family Level: n (%)		
Couple together	41 (31.06)	41 (31.54)
Husband	33 (25)	32 (24.62)
Study Participant	53 (40.15)	51 (39.23)
Parent	4 (3.03)	5 (3.85)
Mothers with Previous Scar: n (%)		
With Scar	13 (9.85)	8 (6.15)
Without Scar	119 (90.85)	122 (93.85)
Height (Metres)	1.578 ± 0.066	1.57 ± 0.061
Weight (Kg)	61.35 ± 10.48	60.45 ± 10.79
BMI	24.92 ± 4.52	24.62 ± 4.77
Systolic BP (mmHg)	116.90 ± 13.57	114.90 ± 12.38
Pulse Rate	78.81 ± 6.82	79.73 ± 7.75
Temperature (^{0})	36.63^0±0.37	36.61^0± 0.43
Gestation at Enrolment by Fundal Height (Weeks)	19.43 ± 4.94	20.09 ± 4.39
Gestation at Enrolment by Dates (Weeks)	19.53 ± 6.44	20.13 ± 4.87
Time of Follow (Weeks)	20.59 ± 6.02	19.78 ± 5.04
Hemoglobin (g/dl)	11.75 ± 1.71	11.57 ± 1.46

Values are Means ± SD unless otherwise indicated
[a] Numbers may not add up to 132 or 130 due to missing values

The mean BMI for the 10 study participants aged between 35 and 39 years was 26.80 (SD 4.81, 95% CI 23.36-30.25) with a median of 27.07 and a range of 14.15 while it was 33.18 (SD 5.58, 95% CI 19.33-47.04) with a median of 33.05 and a range of 11.15 for the 3 study participants aged 40 years and above. The mean BMI at baseline increased with the age of the study participant (Figure 3).

The Intervention

The mean number of SMS sent to the 132 study mothers in the intervention arm was 11.93 messages (SD 2.5, 95% CI 11.50-12.36) with a median number of 12 messages; the lowest number of messages sent was 4 and the highest number being 19 messages giving a range of 15 messages.

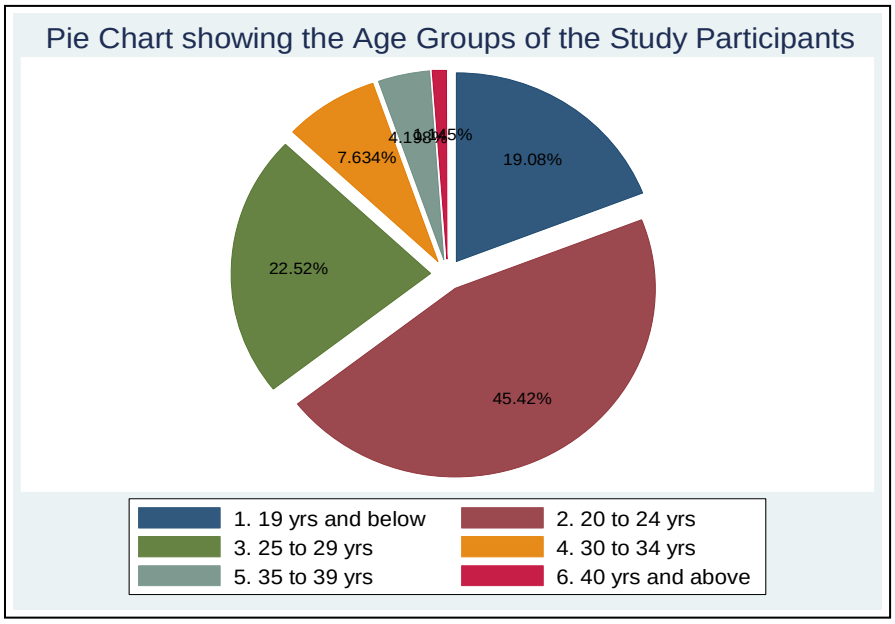

Figure 2: Pie Chart showing the Proportion of mothers by Age Group

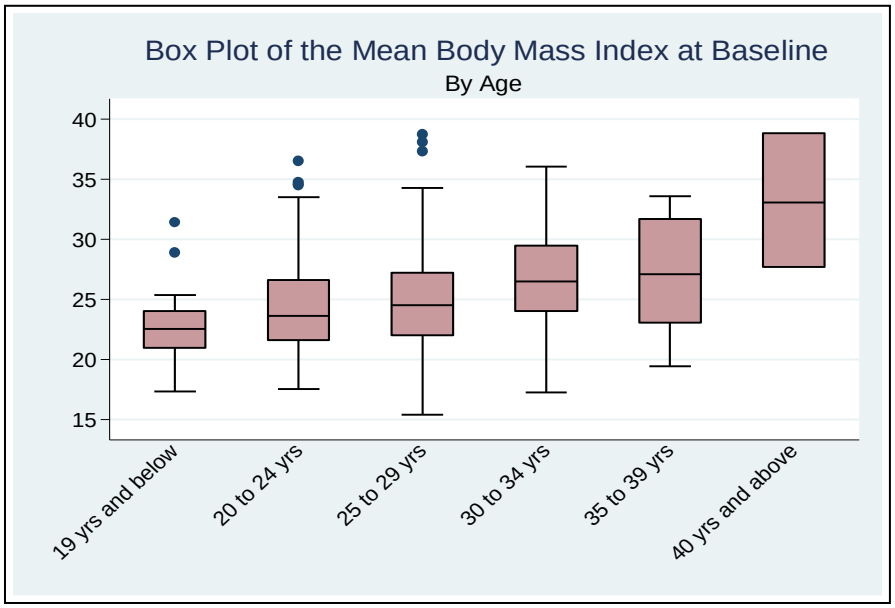

Figure 3: Box Plot showing the Mean Body Mass Index (BMI) of Study Participants by Age

The mean number of calls done to the 132 study mothers was 4.68 calls (SD 1.24, 95% CI 4.47-4.89) with a median number of 4.5 calls, the lowest number done being 2 and the highest number done being 8 calls giving a range of 6 calls.

Number of ANC Visits by Study Group

For the 131 study mothers who were in the intervention arm, the mean number of visits was 4.10 visits (SD 0.76, 95% CI 3.97-4.23) with a median of 4 visits, a minimum of one visit and a maximum of 5 giving a range of 4 visits. For the 128 study mothers who were in the non-intervention arm, the mean number of visits was 2.84 visits (SD 0.95, 95% CI 2.68-3.01) with a median of 3 visits, a minimum being one visit and a maximum of 5 giving a range of 4 visits. (Figure 4).

Number of ANC Visits by Education Level

For the 3 study mothers who had not attended any formal schooling, the mean number of visits was 3 visits (SD 1.15, 95% CI 1.93-4.07) with a median of 3 visits, a minimum of 2 visits and a maximum of 5 giving a range of 3 visits. While for the 93 study mothers who had attained primary schooling, the mean number of visits was 3.49 visits (SD 1.05, 95% CI 3.28-3.71) with a median of 4 visits, a minimum of one visit and a maximum of 5 giving a range of 4 visits.

For the 99 study mothers who had attained secondary schooling, the mean number of visits was 3.44 visits (SD 1.07, 95% CI 3.23-3.66) with a median of 4 visits, a minimum of one visit and a maximum of 5 visits giving a range of 4 visits. Whereas for the 60 study mothers who had attained tertiary education, the mean number of visits was 3.57 visits (SD 1.08, 95% CI 3.29-3.85) with a median of 4 visits, a minimum of one visit and a maximum of 5 visits giving a range of 4 visits. (Figure 5).

Postnatal Clinic (PNC) Attendance

Fifty one point nine one per cent (51.91%) (n=136) of study participants reported on whether or not they attended the postnatal clinic, of which 30.15% (n=41) attended while 69.85% (n=95) did not attend the clinic post-delivery. (Figure 6)

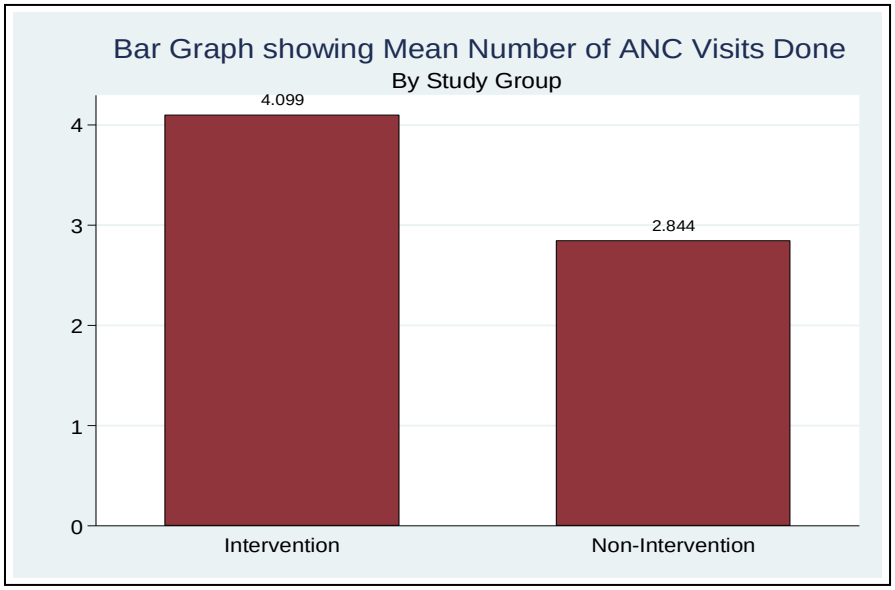

Figure 4: Bar Graph showing the Mean Number of ANC Visits done By Study Group

Postnatal Clinic (PNC) Attendance by Study Group

Sixty (60) study participants who reported on PNC attendance were in the intervention arm, with 41.67% (n=25) of them attending the PNC while 58.33% (n=35) did not attend. 76 study participants were in the non-intervention arm, with 21.05% (n=16) attending the PNC while 78.95% (n=60) did not attend. This indicated that the likelihood of attending the postnatal clinic was twice higher for those study mothers in the intervention arm compared to the mothers in the non-intervention arm. The null hypothesis that there was no difference in the likelihood of a study mother attending postnatal clinic by study group was tested with Chi-Square statistics.

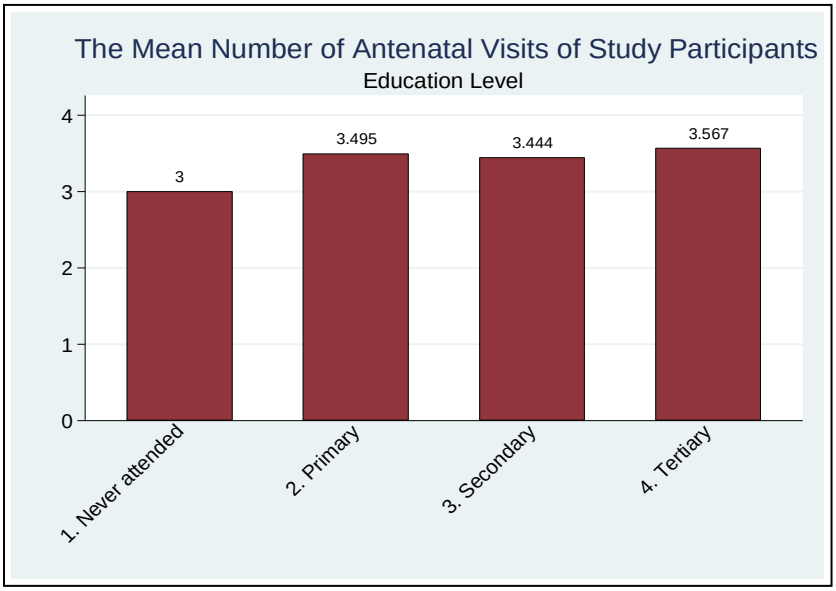

Figure 5: Bar Graph showing the Mean Number of ANC Visits by Education Level

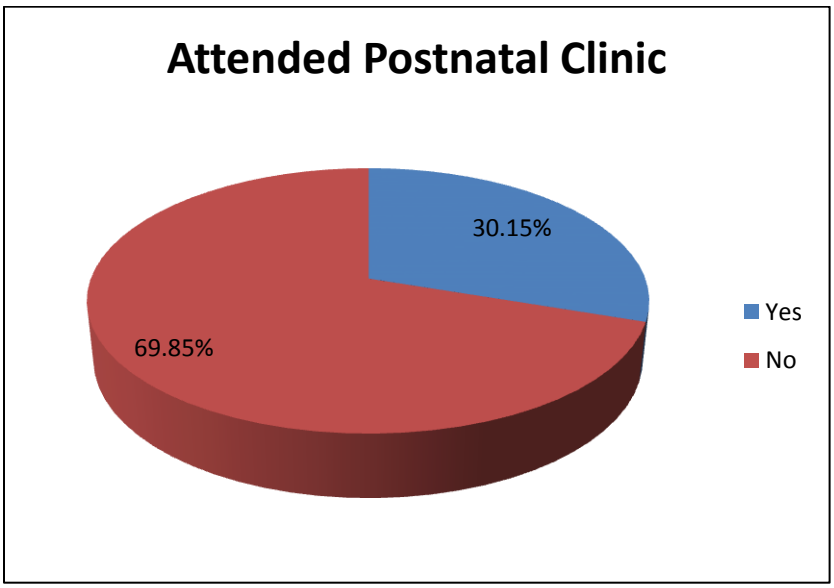

Figure 6: Pie Chart showing the Proportion of Study Participants who attended the Postnatal Clinic

The null hypothesis was rejected (X^2=6.7658, p = 0.009) indicating that the mothers in the intervention arm were more likely to attend the postnatal clinic compared to those in the non-intervention arm. (Figure 7).

Postnatal Clinic (PNC) Attendance by Place of Delivery

For the 37 study participants who delivered at home, only 8.11% (n=3) attended the PNC while 91.89% (n=34) did not attend. For the 97 study participants who delivered in hospital, 39.18% (n=38) attended the PNC while 60.82% (n=59) did not attend. This indicated that the likelihood of attending the postnatal clinic was 4.83 times higher for those study mothers who delivered in hospital compared to the mothers who delivered at home. (Figure 8).

Postnatal Clinic (PNC) Attendance by Education Level

All the three study participants who had not attended any formal schooling did not attend the postnatal clinic. Of the 52 study participants who had attended primary school, 23.08% (n=12) attended the PNC while 76.92% (n=40) did not attend. Of the 51 study participants who had attended secondary school, 37.25% (n=19) attended the PNC while 62.75% (n=32) did not attend. For the 30 study participants who had attended tertiary education, 33.33% (n=10) attended the PNC while 66.67% (n=20) did not attend. This indicated that the likelihood of attending the PNC increased as the level of education increased. (Figure 9).

Difference in Means of Number of Antenatal Visits by Study Group

The distribution of the mean number of antenatal visits was explored using a histogram. It was found to be slightly skewed towards the left. (Figure 10).

The mean number of antenatal visits was 4.099 visits for the 131 study participants in the intervention arm while it was 2.843 visits for the 128 study participants in the non-intervention arm. The difference in means was 1.256 visits (95% CI 1.044-1.256) for the two arms.

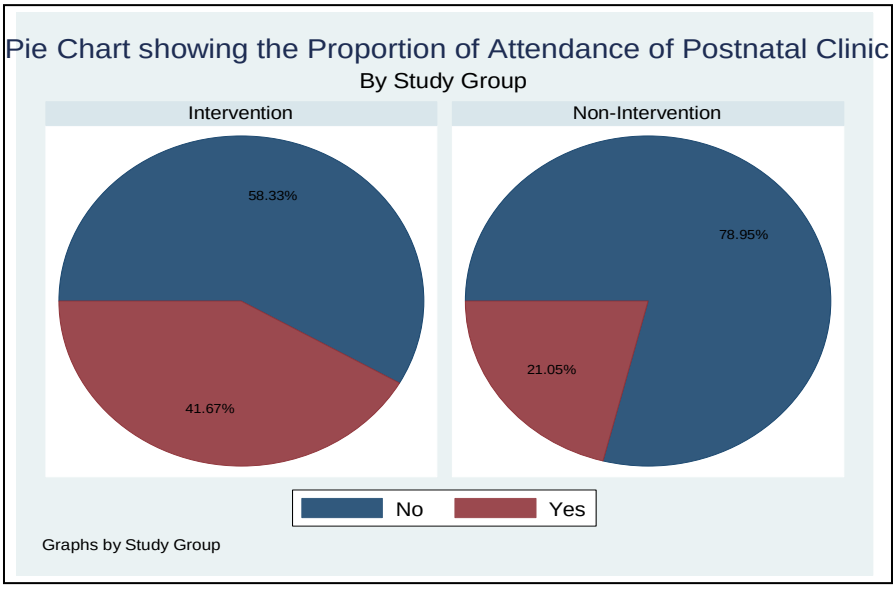

Figure 7: Pie Chart showing the Proportion of Study Participants who attended the Postnatal Clinic by Study Group

Student t-test was used to test for significance for the null hypothesis of there being no difference between the mean number of antenatal visits by a study group at a 95% confidence level. The mean difference in the number of visits between the two groups was statistically significant at a 95% confidence level (p-value<0.0001) indicating that the mothers in the intervention group were likely to attend more antenatal visits. Thus the null hypothesis was rejected.

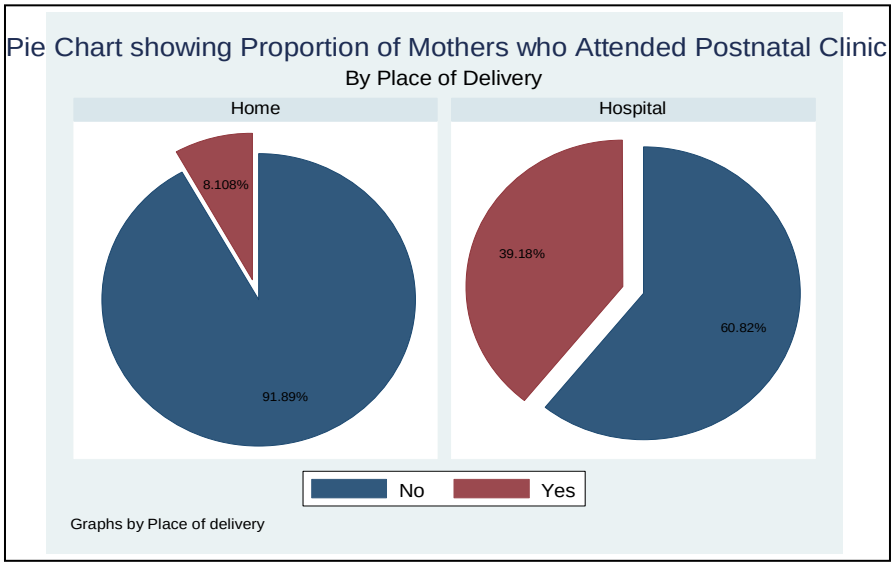

Figure 8: Pie Chart showing the Proportion of Study Participants who attended the Postnatal Clinic by Place of Delivery

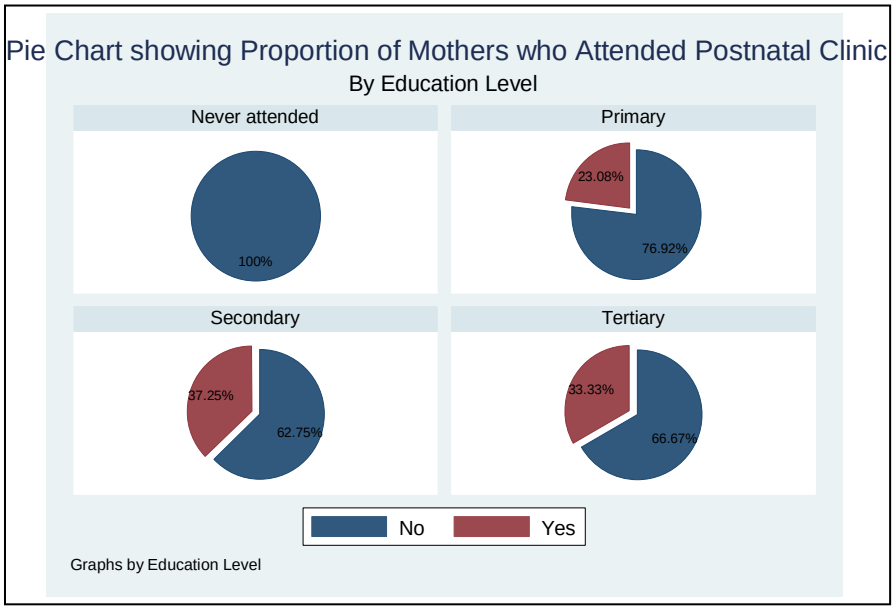

Figure 9: Pie Chart showing the Proportion of Study Participants who attended the Postnatal Clinic by Education Level

Difference in Means of Number of Antenatal Visits by Age

For the 50 study mothers aged 19 years and below the mean number of visits was 3.26 visits, while it was 3.48 visits for the 118 study mothers aged between 20 and 24 years. The mean number of visits was 3.70 visits for the 57 study mothers aged between 25 and 29 years while it was 3.41 visits for the 34 study mothers aged 30 years and above.

One-way Anova was used to test the null hypothesis of there being no difference between the mean numbers of antenatal visits among the four age categories. The mean differences were found not to be statistically significant at a 95% confidence level (p-value = 0.1916, F=1.59). Thus the null hypothesis was not rejected.

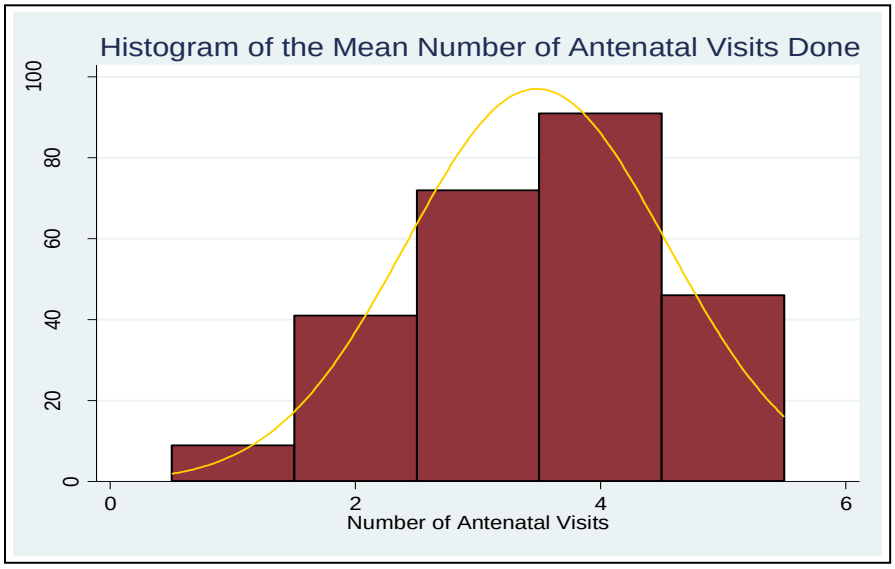

Figure 10: Histogram showing the Distribution of Mean Number of Antenatal Visits

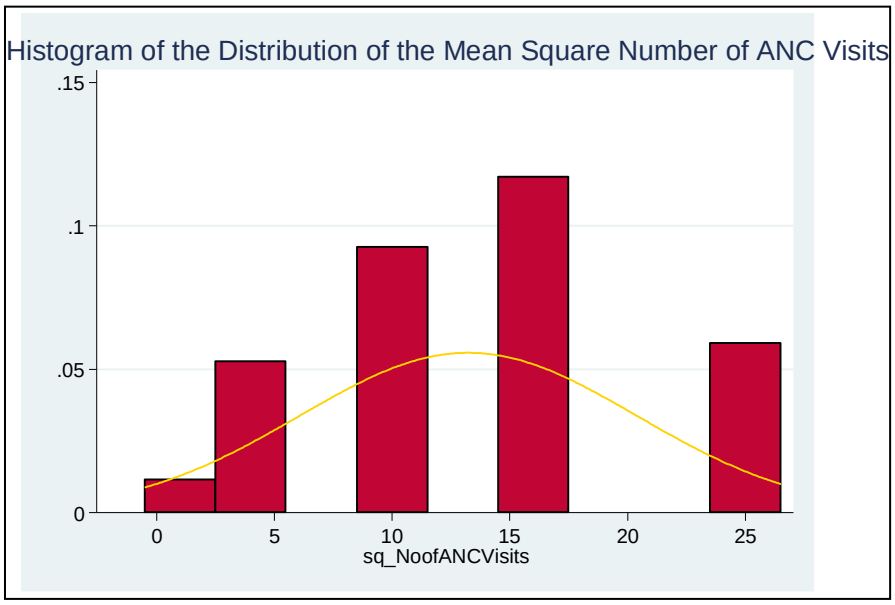

Figure 11: Histogram of the Distribution of the Mean Square Number of ANC Visits

Difference in Means of Number of Antenatal Visits by Time taken to Access a Health Facility

For the 32 study mothers who took less than 15 minutes to access a health facility, the mean number of ANC visits was 3.31 visits while it was 3.54 visits for the 72 study mothers who took between 15 and 30 minutes to access a health facility. For the 128 study mothers who took between 30 and 60 minutes to access a health facility, it was 3.5 visits while for the 27 study mothers who took more than 60 minutes to access a health facility it was 3.41 visits.

One-way Anova was used to test for the null hypothesis of there being no difference between the mean numbers of antenatal visits by the time taken to access a health facility. The differences were found not to be statistically significant (p-value = 0.7544, F=0.40). Thus the null hypothesis was not rejected.

Table 2: Table Showing the Results of Bivariate Regression

Independent Variable	**Coefficient**	**Confidence Interval**	**P-value**	**Constant Term**	**McFadden's R^2**
Age	0.01	0.0039 to 0.0163	0.0016	2.34	0.0046
BMI	0.0028	-0.0054 to 0.0111	0.500	2.503	0.0003
Parity	0.0268	-0.0010 to 0.0547	0.059	2.557	0.0016
SBP	0.0012	-0.0014 to 0.0038	0.374	2.446	0.0004
Gestation by FH	0.0148	-0.022 to -0.0076	<0.0001	2.877	0.0077
Haemoglobin	0.0082	-0.0149 to 0.0314	0.486	2.494	0.0003
No of SMS Sent	0.0153	-0.0013 to 0.0319	0.071	2.671	0.0037
No of Calls done	0.0218	-0.0112 to 0.0549	0.196	2.752	0.0019
Gestation by Dates	0.0019	-0.0027 to -0.0010	<0.0001	2.8439	0.0091
Mean Follow Up Time	0.0014	0.0014 to 0.0033	<0.0001	2.301	0.0146
Study Group					
Non-Inter vs. Intervention	0.660	-0.7308 to -0.5890	<0.0001	2.855	0.1618
Facility Level					
Sub-county Hos vs. Health Centre	0.0340	-0.1321 to 0.0642	0.498	2.6168	0.0010
County Referral vs. Health Centre	0.0560	-0.1316 to 0.0642	0.148		
Marital Status					
Separated vs. Married	0.4030	-1.057 to 0.2513	0.227	2.600	0.0035
Single vs. Married	0.1273	-0.2299 to -0.0246	0.015		
Education Level					
Primary vs. Never Attended	0.2711	0.0319 to 0.5102	0.026	2.317	0.0036
Secondary vs. Never Attended	0.2482	0.0092 to 0.4871	0.042		
Tertiary vs. Never Attended	0.3127	0.0704 to 0.5550	0.011		
Distance to Access a Health Facility	0.0348	-0.1175 to 0.0479	0.410	2.590	0.0003
Time to Access a Health Facility	0.0111	-0.0573 to 0.0794	0.751	2.576	0.000

Regression modeling

The dependent variable – the number of ANC visits done by study participants was transformed to the square of the number of ANC visits to reduce skewness making it normally distributed (Figure 11). To build a regression model to predict the number of ANC visits that a study participant would make in the course of their pregnancy, bivariate regression was done first between the dependent variable and the independent variables using Poisson Regression.

Those variables that were statistically significant formed the basis for multivariate regression. The equation was as: Poisson (p) = $b0+b1$*Independent variable. (Table 2). Bivariate regression modeling showed that the following independent variables were statistically significant; age (Coefficient 0.01, 95% CI, 0.0039 to 0.0163, p=0.0016), gestation by fundal height (Coefficient -0.0148, 95% CI, -0.022 to -0.0076, p<0.0001), gestation by dates (Coefficient -0.0019, 95% CI -0.0027 to -0.0010, p<0.0001), mean follow up time (Coefficient 0.0014, 95% CI 0.0014 to 0.0033, p<0.0001), study group (Coefficient -0.660, 95% CI -0.7308 to -0.5890, p<0.0001) and education level attained (Coefficient 0.2711, 95% CI 0.0319 to 0.5102, p=0.026 for primary school, Coefficient 0.2482, 95% CI 0.0092 to 0.487, p=0.042 for secondary school and Coefficient 0.3127, 95% CI 0.0704 to 0.5550, p=0.011) for tertiary education. These variables were then incorporated into the multivariate regression with the exclusion of study group due to covariance.

On multivariate regression modelling using the truncated negative binomial regression method, the model which had the statistically significant independent variables excluding the gestation at enrolment by dates and also including the body mass index was picked as the best since it had the lowest AIC and BIC and was statistically significant. The p-value for this model was 0.0225 which was statistically significant and a McFadden's R^2 of 0.0124. The AIC and BIC for the model were 1055.4 and 1076.7 respectively. Table 3.

The independent variable, days of follow-up, remained statistically significant, holding the other variables constant, showing that for every one day increase in the days of follow-up of a study participant, the square of number of ANC visits increased by a factor of 1.0042 (95% CI 1.0009 - 1.0074, p = 0.012). The interaction between the independent variables was examined and all the interaction terms were found to be statistically insignificant.

Table 3: Table of the Regression model with Statistically Significant Variables and BMI Excluding Gestation at Enrolment

Dependent variable	Covariate	IRR	p-value	Confidence Interval (95%)	McFadden's R^2	Model p-value	AIC & BIC
Square of the Number of ANC Visits	Age	1.0118	0.212	0.9934 - 1.0305	0.0124	0.0225	1055.4 1076.7
	BMI	1.0022	0.840	0.9806 – 1.0243			
	Gestation by FH	1.0028	0.840	0.9756 – 1.0308			
	Days of Follow up	1.0042	0.012	1.0009 – 1.0074			
	Marital Status	0.8792	0.356	0.6689 – 1.1556			
	Constant	5.0676	0.005	1.6489 – 15.574			

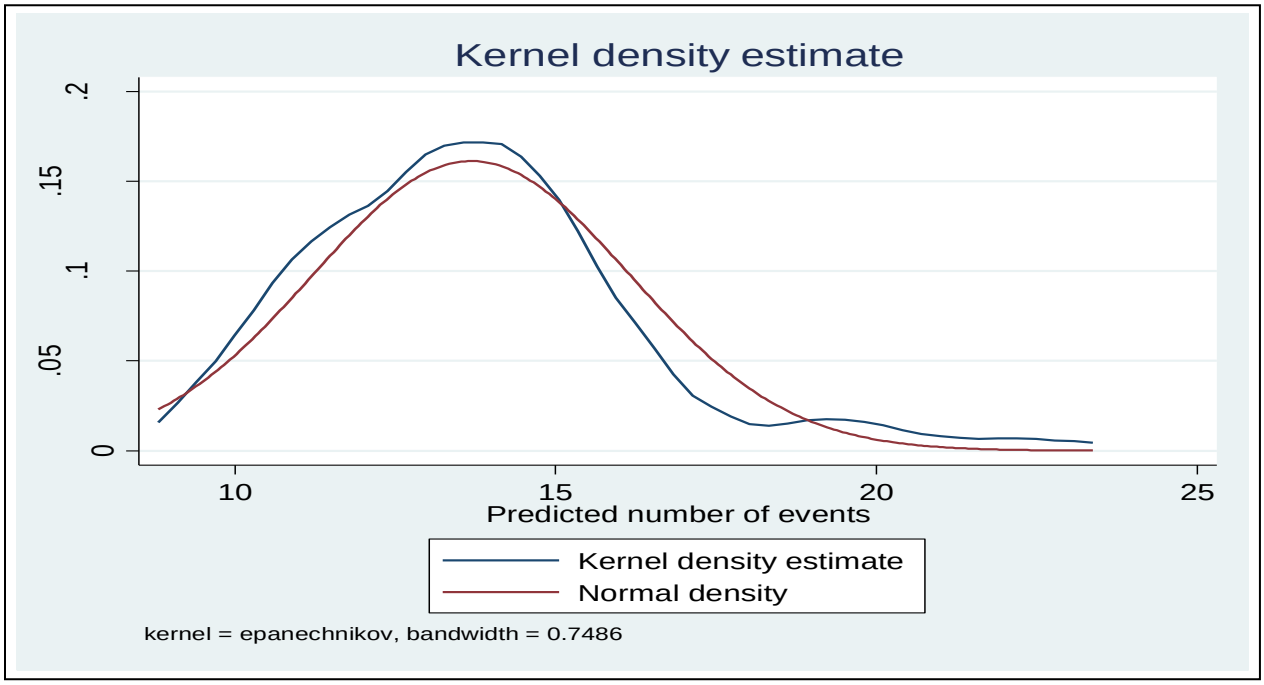

Figure 12: Kernel Density Plot

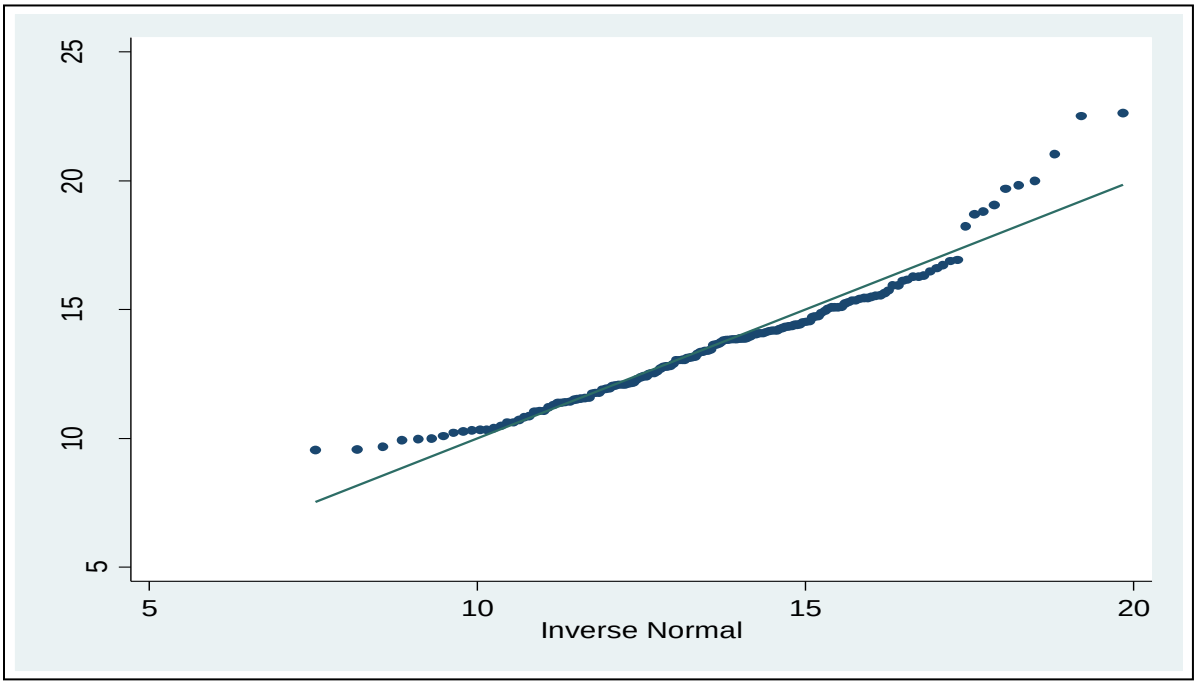

Figure 13: Q Norm Plot (Normal Quintile plot)

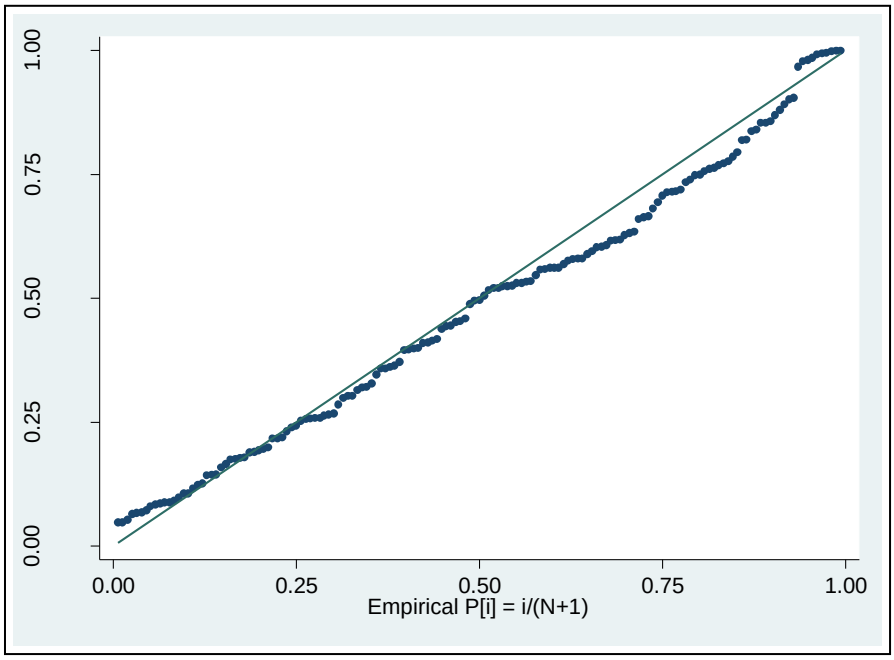

Figure 14: P Norm Plot

Prediction Plots

The residual plots below (Kernel Density Plot, Q-Q Plot and the P Norm Plot) showed that the model was a good predictor of the dependent variable.

Conclusion

A targeted mobile phone intervention was found to be effective in improving both antenatal and postnatal clinic attendance in pregnant mothers in a pastoralist community in Narok County Kenya.

The main limitation of the study was that the study participants were recruited from the maternal and child health clinic and thus these mothers could be different from the general population since they had already come to start their ANC visits early. A community-based recruitment model would improve the study.

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