

Mhealth and Utilization of Health Care Services in Lagos Southwest Nigeria- A Pilot Study

Gbemisola E. Osanyin (✉ ennybanks@yahoo.com)

College of Medicine, University of Lagos Nigeria

Esther O. Oluwole

College of Medicine, University of Lagos Nigeria

Adesumbo K. Odeseye

University of Lagos

Bosede B. Afolabi

College of Medicine, University of Lagos Nigeria

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Abstract

Background: A third of pregnant women in Nigeria do not attend Antenatal care, hence this quasi-experimental study was carried out within 500 consenting pregnant women within the 5 administrative zones of Lagos to determine the association between Mhealth services and utilization of antenatal and skilled delivery services amongst pregnant women in Lagos, Southwest Nigeria.

Methods: Participants were divided into an intervention (who received voice messages) and a control arm (did not receive voice messages). Ownership of a mobile phone and willingness to participate were the selection criteria. Data was collected using a structured interviewer administered questionnaire. Analysis was by descriptive statistics with 95% CI to identify factors associated with antenatal attendance.

Results: Total respondents were 488 (response rate 97.6%). One hundred and fifty-nine (63.8%) of the intervention group found the messages useful. Using the WHO 2016 ANC model, women in the intervention group had a significantly higher frequency of antenatal care attendance than the control group ($p < 0.0001$). There was a statistically significant difference in antenatal attendance between the intervention and the controls ($p < 0.0001$). There was also a significantly lower likelihood of poorly supervised (unskilled) home deliveries within the intervention arm ($p=0.011$).

Conclusion: Mhealth was associated with an increased antenatal attendance and skilled birth attendance at delivery. This has a significant impact in reducing morbidity and mortality indices.

Introduction

Nigeria accounts for 20% of the global maternal death rates with a maternal mortality ratio of 917 per 100,000 live births as at 2017.¹ In Nigeria, 56.8% of pregnant women are said to attend a minimum of 4 Antenatal care visits at any facility during the course of their pregnancy and 67% receive this Antenatal care service from a skilled birth attendant.² There is increasing evidence that this unremitting high maternal mortality rate is partly due to poor quality antenatal care, lack of access to antenatal care as well as underutilization of quality care amongst other causes.³⁻⁵ Several programs and strategies have been put in place by the government to mitigate against these numerous causes, in spite of this only 39% of births are said to be attended to in a health care facility.² Sufficient evidence has shown that effective communication and engagement with health care providers is commensurate with uptake of health care services and simple text-based interventions can help improve utilization of antenatal care services.^{4,5}

Mobile Health technology (mHealth) includes the use of devices such as the mobile phones, smart phones, handheld and ultraportable devices such as Laptops and Ipad to mention but a few. These devices have become more appealing to health care providers because of their popularity, mobility and technological proficiencies as well as their ability to deliver health information and services to remote locations.⁶⁻⁹

These devices can be used to report health information and deliver health care services through telemedicine in developing countries and as such help improve patient education and adherence to appointments, disease self-management and remote monitoring of patients.⁶ Evidence has also shown that a simple device such as a mobile phone minimizes the time constraints encountered in accessing healthcare and facilitates urgent referrals for emergency obstetric and maternal health services in low and middle-income countries (LMIC).¹⁰ Today, Mobile phones have reached the hands of 90% of the world's population, 80% of whom dwell in the rural areas.⁷ This rapid development of mobile technology has generated new ways to address public health challenges and raised the standard of health care access and delivery.⁸

There have been a few systematic reviews evaluating the role mHealth plays in improving the health care system especially in developing countries. Murthi et al¹¹ concluded that mobile voice messages provided suitable and appropriate information throughout pregnancy and helped improve uptake of maternal services geared towards improving maternal health outcomes. Free et al⁷ too found advantages related with mHealth interventions as it concerns utilization of health services especially in the area of appointment reminders and provision of related clinical support. Finally, Piette et al also established useful benefits in patient self-care and chronic disease management in LMIC through the use of mHealth and Buong et al discovered that short messaging service (SMS) had greater impact than pamphlets in improving the knowledge, attitude and health seeking behaviors of mothers in LMIC.^{12,13} Uptake of post natal care in LMIC especially in rural areas is described as very poor, mhealth strategies used to encourage PNC visits was characterized by an improvement in uptake of PNC services.^{14,15,16}

With emerging interest in this field, numerous large scale research studies are being done in order to generate the evidence needed to encourage investing in major pilot studies. This study aimed to investigate whether providing care and appointment reminders through mobile phones has any relationship with utilization of maternal health care services such as antenatal care, facility delivery and postnatal care for pregnant mothers and their newborn.

Methodology

This quasi experimental study was carried out in Lagos, a state in the southwest geopolitical zone of Nigeria and the economic capital of Nigeria with a projected population of 24.6 million as at 2015 and a land mass of 3,577 sq. km. A major cosmopolitan city with a mixture of all the Nigerian ethnic groups but predominantly the Yoruba ethnic group, it is divided into 5 administrative divisions and 20 Local government areas (LGA).¹⁴ These Local Government Areas provide primary health care (PHC) services to the population, there are 288 primary health care centers with 1 Flagship PHC in each LGA. A PHC is the first point of contact for most Nigerians with the health care system. The flagship PHC provides comprehensive health care and maternity services. The study participants were pregnant women domiciled in the various divisions who registered for antenatal care in the selected Primary Health Care centers (PHC).

A multi-stage simple random sampling technique was adopted for this study to achieve a good representation of the population. All the primary health care centers in Lagos were stratified into the 5 administrative Districts. Two comprehensive PHC per district were selected by simple random sampling from the list of all the 20 flagship primary health care centers in the 5 districts. Using a balloting technique, one of the PHCs was selected for recruitment of the control arm whilst the second PHC was selected for recruitment of the intervention arm as such, there were 5 PHCs as intervention arm and 5 PHCs for the control.

The sample size was calculated using the formula for comparing 2 proportions with a standard deviation at the 95% confidence interval (1.96). The minimum sample size calculated was 227 per group of pregnant women with a non-response rate of 10% this brought the total sample size to 250 consenting pregnant women recruited per group. This study was conducted between April 2019 to September 2019 and all participants were followed up till delivery and two weeks postpartum.

Participant selection criteria included pregnant women at their booking visits in the PHC, ownership of a mobile phone and willingness to participate. The participants were identified by a field worker-based enrollment system and interviewer administered questionnaires were used to gather preliminary data.

Field workers explained the study to all eligible participants by reading the participant information sheets in the preferred language of the participant; a written informed voluntary consent was thereafter obtained and baseline data collection was done.

The participants in the intervention arm received a mobile-phone-based voice message fortnightly consisting of information about the advantage of maternal health care service usage (i.e. ANC, PNC and institutional delivery) as well as appointment reminders. After birth, post natal care visit reminders and information about its advantages were also sent.

Two weeks post-delivery, participants were again requested to fill a questionnaire at their post-partum visit. Information on outcome of pregnancy, place of delivery and client satisfaction of services offered was collected. Clients who defaulted in clinic attendance were followed up via direct phone calls from the field workers.

Results

A total of 488 women participated in this study (249 intervention arm and 239 controls). Table 1 shows the sociodemographic characteristics of the observed population. The mean age of participants was 28.3 ± 5.5 years. Just over half of all the participants (58.2%) had secondary education. More women in the intervention arm had tertiary education and above when compared with the control group. Majority of the participants were of parity 0–4.

Table 1
SOCIODEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

Sociodemographic Variables	Intervention group n = 249 FrEq. (%)	Control group n = 239 FrEq. (%)	Total n = 488 FrEq. (%)	Test Statistics
Age group (years)	1 (25.0)	3 (75.0)	4 (100.0)	$\chi^2=13.175$
<=18	92 (42.8)	123 (57.2)	215(100.0)	$p = 0.010^*$
19–28	143 (58.4)	102 (41.6)	245(100.0)	
29–38	12 (52.2)	11 (47.8)	23 (100.0)	
39–48	1 (100.0)	0 (0.0)	1 (100.0)	
49 and above				
Marital Status	241(50.8)	233 (49.2)	474(100.0)	$\chi^2=1.007$
Married	1 (100.0)	0 (0.0)	1 (100.0)	$p = 0.604$
Separated	7 (53.8)	6 (46.2)	13 (100.0)	
Single				
Level of education	2(50.0)	2(50.0)	4(100.0)	$\chi^2=10.149$
None	37 (44.6)	46 (55.4)	83(100.0)	$p = 0.002^*$
Primary	138 (48.6)	146 (51.4)	284(100.0)	
Secondary	64 (59.3)	44 (40.7)	108(100.0)	
Tertiary	8 (4.6)	1(4.4)	9 (100.0)	
Others				
Religion	176 (55.7)	140 (44.3)	316 (100.0)	$\chi^2=7.830$
Christianity	73 (42.4)	99 (57.6)	172	$p = 0.005$
Islam				
Parity	249 (51.6)	234 (48.4)	484(100.0)	$\chi^2=4.220$
0–4	0 (0.0)	4 (100.0)	4 (100.0)	$p = 0.056^*$
5 and above				

*Fisher's exact

Sociodemographic Variables	Intervention group	Control group	Total	Test Statistics
	n = 249	n = 239	n = 488	
	FrEq. (%)	FrEq. (%)	FrEq. (%)	
GA at Booking	147 (51.0)	141 (49.0)	288(100.0)	$\chi^2=2.193$
0–12 weeks	91 (49.5)	93 (50.5)	184(100.0)	$p = 0.334$
13–24 weeks	11 (68.8)	5 (31.2)	16 (100.0)	
25 weeks and above				
Mobile Messages	187(75.1)	50(20.9)	237(100.0)	$\chi^2=130.230$
Yes	62 (24.9)	189 (79.1)	251 (100.0)	$p = 0.000$
No				
*Fisher's exact				

Sixty-two (24.9%) of the participants who were enrolled in the intervention arm failed to receive voice calls for various reasons. Some had provided phone numbers that belonged to their spouses, some missed their voice calls due to lack of battery power on their phones and some said the timing of the calls was too early (7-8am in the morning. A primary health care center selected as one of the controls was found to have a similar service already being provided for their clients (ie reminder text messages) after the study had already started and as such 50 (20.9%) of the respondents in the control arm were also receiving appointment reminders.

Total number of ANC visits are summarized in Fig. 1. This summary is based on the WHO recommendation of at least 8 visits between a pregnant woman and her care giver in the course of pregnancy. The frequency of ANC visits amongst the intervention group was significantly higher when compared with the control group using this criteria ($p < 0.000$).

Of the fifteen women who delivered under unskilled care at home, fewer were in the intervention arm than in the control arm (26.7% vs 73.3%) and there was a significant difference in the place of delivery in both groups, favoring a higher frequency of institutional delivery in the intervention group ($p = 0.011$) (Table 2).

Table 2
PARTICIPANTS UTILIZATION OF SKILLED BIRTH ATTENDANCE AT DELIVERY
(PLACE OF DELIVERY)

Place of delivery	Group			Test Statistics
	Intervention	Control	Total	
	Freq (%)	Freq (%)	Freq (%)	
Home	4 (26.7)	11(73.3)	15 (100.0)	$\chi^2=11.188$ $p = 0.011$
Private	27 (65.9)	14 (34.1)	41 (100.0)	
Public	214 (50.0)	214 (50.0)	428 (100.0)	
$\chi^2 = \text{chi-square}; p = p \text{ value}$				

Postnatal care (PNC) was described in Table 3. PNC was well attended by 418 (85.7%) participants. Within the intervention group, 44(62.9%) of the participants did not attend the PNC visits whereas only 26 (37.1%) of participants in the control group did not attend. The commonest reason by those who failed to attend was that the visit was too soon after delivery

Table 3
POSTNATAL VISITS AMONG THE INTERVENTION AND CONTROL GROUPS

Attended postnatal clinic	Group			Test Statistics
	Intervention	Control	Total	
	Freq (%)	Freq (%)	Freq (%)	
Yes	205 (49.0)	213 (51.0)	418(100.0)	$\chi^2=4.579$ $p = 0.038$
No	44 (62.9)	26 (37.1)	70 (100.0)	
$\chi^2 = \text{chi-square}; p = p \text{ value}$				

The relationship between age, parity, level of education and antenatal attendance was observed in Table 4. There was no statistically significant difference noted between most sociodemographic data collected and frequency of antenatal visits for both the intervention and control arm. However, ANC attendance within the control arm was observed to be significantly lower in the participants with a lower level of education.

Table 4
RELATIONSHIP BETWEEN SOCIODEMOGRAPHIC CHARACTERISTICS AND NUMBER OF ANC ATTENDANCE

Socio-demographic characteristics	ANC attendance					
	Intervention group			Control group		
	< 8 Freq (%)	8 and above Freq (%)	Total Freq (%)	< 8 Freq (%)	8 and above Freq (%)	Total Freq (%)
Level of education	1(50.0)	1(50.0)	2(100.0)	2(100.0)	0(0.0)	2(100.0)
None	9 (24.3)	28 (75.7)	37 (100.0)	25(54.3)	21(45.7)	46(100.0)
Primary	53 (38.4)	85(61.6)	138(100.0)	123(84.2)	23(15.8)	146(100.0)
Secondary	24(37.5)	40(62.5)	64(100.0)	44(100.0)	0(0.0)	44 (100.0)
Tertiary	1 (12.5)	7 (87.5)	8 (100.0)	1(100.0)	0(0.0)	1(100.0)
Others						
Test statistics	$\chi^2 = 4.677$; $p = 0.322$			$\chi^2 = 34.018$; $p = \mathbf{0.000^*}$		
Parity	88(35.3)	161(64.7)	249(100.0)	191(81.6)	43 (18.4)	234(100.0)
0–4				3 (75.0)	1 (25.0)	4 (100.0)
5 and above						
Test statistics				$\chi^2 = 0.115$; $p = 0.735$		
Age group (yrs)	1(100.0)	0(0.0)	1(100.0)	2(66.7)	1(33.3)	3(100.0)
< 18	31(33.7)	61(66.3)	92 (100.0)	101(82.1)	22(17.9)	123(100.0)
19–28	52(36.4)	91(63.6)	143(100.0)	83(81.4)	19(18.6)	102(100.0)
29–38	4 (33.3)	8 (66.7)	12 (100.0)	9 (81.8)	2 (18.2)	11 (100.0)
39–48	0 (0.0)	1 (100.0)	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
49 and above						
Test statistics	$\chi^2 = 2.572$; $p = 0.759^*$			$\chi^2 = 0.471$; $p = 0.925$		
$\chi^2 = \text{chi-square}; p = p \text{ value}$						
* = Fisher Exact						

Discussion

This study demonstrated that antenatal care reminders through voice messaging improved antenatal attendance and institutional delivery. Frequency of antenatal attendance was statistically significant as well as a reduction in home birth thus strengthening the call for skilled birth attendance in delivery especially in developing countries.

An international survey conducted on 2000 health care professionals, patients and consumers in 4 different countries (USA, China, Brazil and India) on mHealth and healthcare service delivery reported an improvement in health care outcomes with an improvement in quality of care. Patients and consumers interviewed also reported an achievement of their health goals through improved health seeking behaviors and increased compliance with medications and follow up visits. All respondents agreed that uptake of mHealth could be achieved if it was simple, affordable and accessible.^{15,16} This study attempted to fulfill these assumptions and observed an improvement in antenatal attendance.

Many studies and systematic reviews on the role of Mhealth and utilization of maternal antenatal and postnatal studies in developing countries have been carried out with similar and promising findings as observed in this study. A detailed analysis of all the studies reviewed established a significant increase in maternal and neonatal service utilization with increase in both ANC and PNC attendance.¹⁷⁻¹⁹ Shiferaw et al in their study concluded that the educational messages and hospital visit reminders received caused the women to feel more valued by their health care providers and hence made them more responsive to the care and attention they received during pregnancy.²⁰ All these studies were based on a minimum ANC attendance of 4 visits. This study based its findings on a minimum of 8 ANC visits per arm and was still able to demonstrate a significant increase in attendance. WHO currently recommends a minimum of 8 contacts in pregnancy: five in the third trimester (fortnightly from 30 weeks), one in the first trimester (Preferably within the 1st 12 weeks) and two contacts in the second trimester (between 16–20 weeks and 20-26weeks).^{21,22}

In Sondaal et al review, the major mhealth application was via short messaging service (SMS); however irrespective of the pathway involved, uptake of mHealth was more enhanced if the message being conveyed was in lay terms and in local/preferred language of the patients.¹⁷ This study used mobile phone based calls in interacting with the participants in their preferred language of choice for ease of communication irrespective of the literacy level. Murthi et al conducted their study using the “mMitra” voice messaging service in India and encouraged the use of mobile voice messaging service as it provides a positive impact on maternal health care and improves health outcomes especially in low literacy settings.²²

In Nigeria, a similar study was conducted with pregnant women in Ondo state, participants were provided with mobile phones to see if there was an improvement in utilization of primary health care facility utilization, a 43.4% increase in utilization was seen.²³ In Northern Nigeria, women without mobile phones had significantly lower access to ANC services and skilled health care delivery.²⁴ No significant differences were observed in uptake of post natal services in both studies as was also observed in this study.

Another study on mhealth and post natal care utilization in Nigeria had 63% of its study participants not utilizing post natal care. Promoting education of these women, appointment reminders and mobile clinics were suggested strategies to improve these numbers^{27,28} This study attempted to encourage post natal visit by sending appointment reminders 2 weeks postpartum but did not observe any significant difference in PNC attendance. WHO recommends at least three postnatal contacts for all mothers and newborns, on day 3 (48–72 hours), between days 7–14 after birth, and six weeks after birth.²⁹ The participants who did not attend PNC stated that the PNC clinic visit was too soon after birth.

STRENGTH AND LIMITATIONS

Major limitations to the study was the difference in educational status of the two groups. The intervention group were older and more educated than the control group. A randomized trial might have showed a less biased difference. Another limitation was our inability to provide remote monitoring via a two way communication due to cost of software. Calls were made to participants only in cases of defaults to clinic visits to find out the reasons why. Automated voice messaging systems as was used in this study is a veritable tool for providing Mhealth services especially in developing countries but this requires 3G network with its added cost implication.³⁰

Also worthy of mention was a part of the control arm who also got text reminders but the fact that despite that, intervention still appeared to work suggests that mHealth was a truly useful tool.

Mobile phones are becoming more inexpensive by the day and as such integrating it into the primary health care setting in resource poor communities is worth considering. In addition, developing alternate power sourced health applications should also be considered in developing countries as most of these countries lack continuous power supply giving rise to inability to fully charge phone batteries.³⁰ In this study there were cases of study participants not receiving voice calls due to inability to charge their phone batteries following a lack of power supply.

Conclusion

We have found in this study that Mhealth is a useful tool in health promotion and adherence as well as in cultivating a quality health care system however further studies are needed to design an appropriate Mhealth initiative which can be incorporated into the comprehensive health care delivery system. More effort must also be geared towards promoting the importance and uptake of Post natal care.

Declarations

Ethical Approval and Consent to Participate.

The study protocol was approved by the institutional review board (IRB) of the College of Medicine of the University of Lagos Health Research and Ethics Committee (CMUL/HREC/03/19/508) from April 2019 to

April 2020.

Written informed consent was obtained from each participant before data collection.

Availability of Data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Disclosure of interests

The authors have no conflict of interest to declare.

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Contribution to authorship

GE Osanyin contributed to study conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, interpretation of data, writing of original draft, review & editing of final manuscript.

BB Afolabi contributed to the study conception, study design, analysis and interpretation of the data, and reviewed and approved the final manuscript.

EO Oluwole contributed to the study concept and design, statistical analysis and interpretation of the data, and drafting of the manuscript.

AK Odeseye contributed to data curation, project administration, supervision, visualization and validation of field workers and data collection, drafting and editing of manuscript.

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Figures

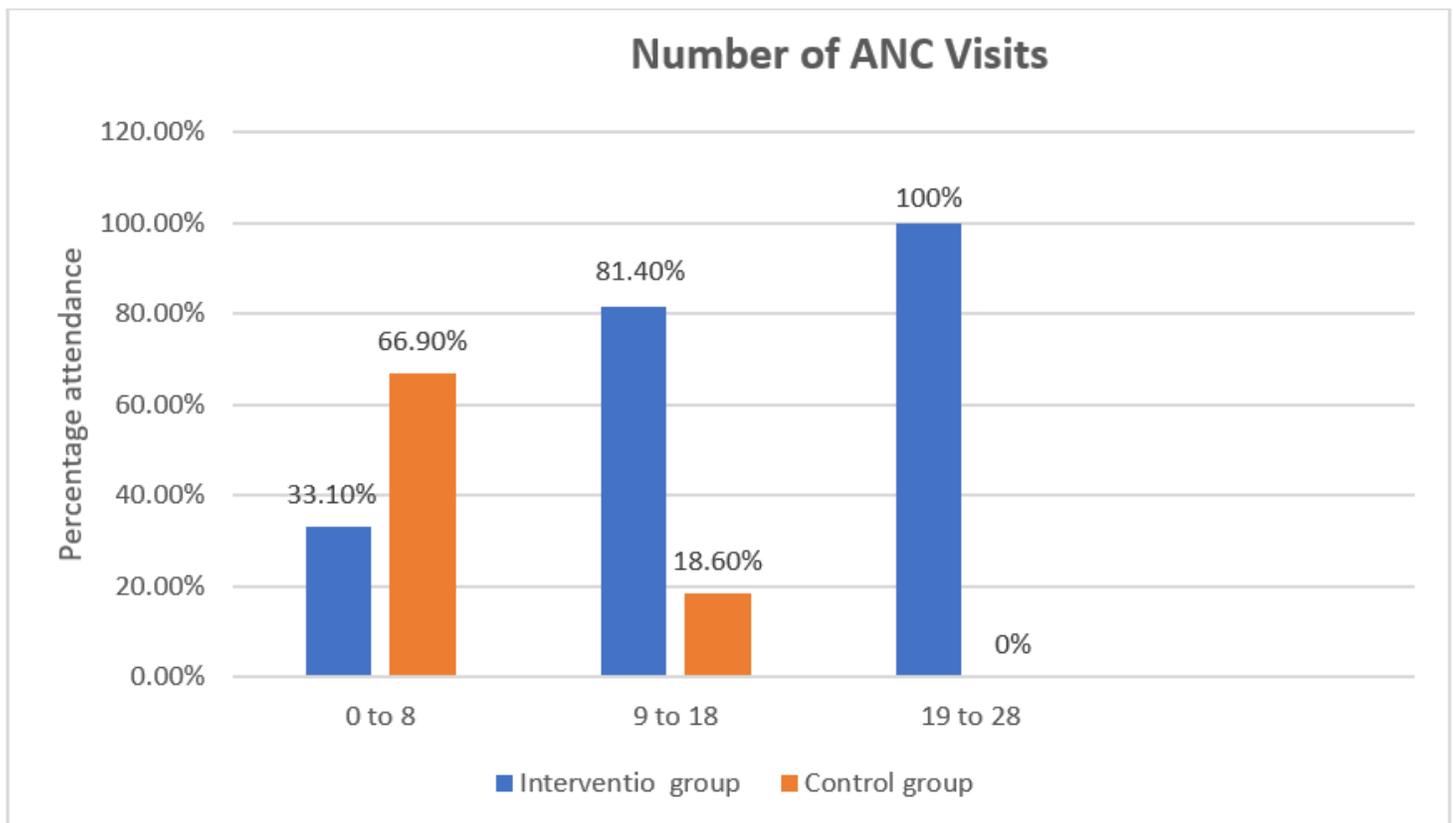


Figure 1

FREQUENCY OF ANTENATAL VISITS AMONGST PARTICIPANTS ($p < 0.000$, $x^2 = 115.19$)