Journal of Public Health in Africa
Received 11 May 2022 | Revised xx xxx xxxx | Accepted 28 May 2022 | Published Online 12 Sep 2022

DOI: https://doi.org/10.4081/jphia.2022.2222
JPHIA 13 (3), 2222 (2022)

ISSN (O) 2038-9930 IF:0.0

ORIGINAL ARTICLE

Effects of a mHealth voice messaging intervention on antenatal care utilisation at primary care level in Lagos, Nigeria: a cluster randomised trial

Gbemisola E. Osanyin[1*] | Aduragbemi Bankethomas[2,3] | Esther O. Oluwole[4] | Adesumbo K. Odeseye[5] | Bosede B. Afolabi[1,2]

[1]Department of Obstetrics and Gynaecology, College of Medicine, University of Lagos, Nigeria

[2]Maternal and Reproductive Health Collective, Lagos, Nigeria

[3]School of Human Sciences, University of Greenwich, London, United Kingdom

[4]Department of Community Health and Primary Care, College of Medicine, University of Lagos, Nigeria

[5]Kensington Adebukunola Adebutu Foundation (KAAF) Maternity Centre, University of Lagos, Nigeria.

Abstract

Background. Nigeria has one of the lowest antenatal care (ANC) utilization rates compared to other low- and middle-income nations. In order to ensure a *positive pregnant experience*, the World Health Organization recommends at least eight ANC visits during pregnancy. This study intends to examine the impact of a mobile phone-based voice message intervention on ANC use in Lagos, Nigeria.

Methods. In this cluster-randomized experiment, primary healthcare centres were divided into five intervention and five control groups using multistage simple random sampling. The intervention consisted of a weekly voice message transmitted through mobile phone from the time of recruitment in the first trimester until two weeks postpartum. Attending at least eight ANC visits before birth was the primary outcome. STATA v17.0 was used to conduct descriptive and bivariate analyses as well as multivariate linear models to calculate crude risk ratios.

Results. 458 women participated. All intervention group women (269 women, or 58.7% of the sample) received the text message. These ladies were mostly married, Christian, had several children, and had completed high school. Women who received the intervention were more likely to attend eight ANC visits.

Conclusion. A voice message-based intervention can boost ANC utilization, according to the conclusion. This contributes to the existing body of information about the influence of mHealth treatments on maternal health outcomes and serves as a useful tool for ensuring that no woman is left behind.

Keywords: Antenatal care, primary health care, mhealth, utilisation, Nigeria.

INTRODUCTION

One of the Sustainable Development Goals (SDG) of the United Nations (UN) is to reduce the worldwide maternal mortality rate (MMR) to fewer than 70 per 100,000 live births by 2030.[1] According to the most recent estimate, there are 295,000 maternal fatalities worldwide each year, with Nigeria contributing 35,000 of them (12% of global maternal deaths).[2] There is evidence that antenatal care (ANC) can improve pregnancy and birth outcomes for expectant mothers through a variety of ways.[3,4]Components of ANC include the diagnosis of pregnancy-related risks, the prevention and ongoing care of pregnancy-related or concomitant diseases, as well as health education and promotion. Between 2002 and 2016, the World Health Organization (WHO) campaigned for a four-visit ANC model known as focused antenatal care (fANC), which emphasized the implementation of evidence-based therapies at each visit, with a preference for the first appointment in the first trimester.[6] According to the 2018 Nigerian Demographic and Health Survey, approximately 57% of pregnant women in Nigeria received at least four ANC visits during their pregnancies.[7] Nigeria has one of the lowest rates of ANC utilization compared to other low- and middle-income countries (LMICs), with only 65% of women reporting ANC visits, compared to >85% in 10 other LMICs.[8] Nigeria has the lowest percentage of ANC usage among West African nations, particularly among adolescents (56%).[9]

WHO has amended its advice on the minimum number of needed ANC visits to eight: one in the first trimester (ideally within the first 12 weeks), two contacts in the second trimester (between 16-20 weeks and 20-26 weeks), and five in the third trimester (fortnightly from 30 weeks). This move to increase the minimum suggested number of ANC visits is intended to encourage a *positive pregnant experience*.[10] Several individual-level characteristics, including a positive attitude toward ANC utilization, have been proven to increase the likelihood of ANC utilization and commencement in the first trimester.[11]

Mobile devices have been utilized to enhance the utilization of maternal health care in low- and middle-income countries (LMICs), particularly to improve patient education and appointment adherence, disease self-management, and remote patient monitoring.[12,13] In particular, research has demonstrated that successful communication and interaction between skilled health workers (SHP) and pregnant women via simple short message systems (SMS) increased the utilization of maternity services.[14–16] Indeed, studies have demonstrated a correlation between mobile health and the utilization of maternal health services, particularly ANC.[17]Nevertheless, according to a systematic review conducted in 2022, no study has evaluated the efficacy of mHealth interventions on ANC utilization based on the new WHO model for eight ANC visits.[13] This study's purpose was to examine the impact of a mobile phone-based voice message intervention on ANC utilization, as defined by the 2016 WHO recommendation, at the primary health care (PHC) level in Lagos State, Nigeria.

MATERIALS AND METHODS

Ethical considerations

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. All participants had a right to withdraw from the study at any time or refuse to answer any questions.

Study setting

This study was conducted in Lagos, Nigeria - a cosmopolitan state in the South-Western part of the country with 26 million people as of the year 2019.[18]

Supplementary information The online version of this article (Figures/Tables) contains supplementary material, which is available to authorized users.

Corresponding Author: *Gbemisola E. Osanyin, Department of Obstetrics and Gyneacology, College of Medicine, University of Lagos, Nigeria. Tel. +23 48023037850.*
Email: ennybanks@yahoo.com

The state is divided into five administrative districts which are sometimes used as a basis for allocating public facilities. In terms of health service delivery within the public sector, like the rest of the country, this is organised across three levels (primary, secondary, and tertiary). The primary level is the foundation of the health system and the level at which non-emergency and preventative health services are provided. It is also expected that uncomplicated childbirth services and basic emergency obstetric care services are available for pregnant women at this level. There are 329 primary healthcare centres (PHCs) at the primary level with 20 of them designated as comprehensive PHCs since they are designed to have the capacity for providing the full complement of primary level care on a 24-hour basis.[19]

Study design

This is a cluster randomised trial conducted in the Lagos comprehensive PHCs. A multi-stage simple random sampling technique was adopted in selecting the PHCs to be included in our study. First, all comprehensive PHCs in the state were stratified based on the administrative districts where they are situated. Two comprehensive PHCs per district were selected by simple random sampling from each district. Using a balloting technique, one comprehensive PHC was selected for recruitment of the control arm whilst the other was selected for recruitment of the intervention arm. Consequently, there were five PHCs selected as the intervention arm and five PHCs for the control. Study participants were recruited from the selected PHC with inclusion criteria defined as pregnant women who were registered for ANC at the included health facilities and who had provided informed consent a priori. Those who did not own a mobile phone (whether shared or not) were excluded from the study.

The intervention

The intervention consisted of weekly automated voice messages provided via mobile phone from recruitment during pregnancy to two weeks postpartum. During the initial ANC visit, the woman's cell phone number and date of recruitment were collected and used for the automation process. The voice calls functioned as appointment reminders for women, informing them of the appointment's time, location, and necessary preparation. In addition, the message in the voice call included information about the demonstrated benefits of ANC, risky pregnant symptoms, early labor indications, pregnancy-related crises, and nutrition during pregnancy. Voice call information after birth emphasized the benefits of infant nursing and immunization and offered PNC visit reminders.

The voice messages were created using findings from Babycenter, the foremost digital parenting resource for new and pregnant women worldwide.[20] Other mhealth initiatives in Ethiopia and India have utilized Babycenter as a starting point for the development of similar initiatives.[21,22] During design workshops that comprised Lagos-based consultant and resident obstetricians, public health professionals, and midwives, messaging were tailored for the local context. The voice messages were created in English, Yoruba, and Pidgin English, which are the most widely spoken languages in Lagos State. The woman had complete control over the language and time of day (early morning, midday, or evening) during which she received audio messages. The voice message was given using a female's voice, lasted approximately two minutes, and began with a distinguishing 'jingle' to alert the expectant woman and her close family members about the incoming contact. To reinforce learning and knowledge, essential messages were summarized at the conclusion of the conversation. The prepared messages in the three languages of instruction were pre-evaluated for suitability to the local context by experts who also ensured the translation process would achieve cross-cultural equivalency.[23] A company in the field of information technology that develops mHealth applications supported in the transmission of the voice calls. Field staff initiated two-way conversations with all participants who missed two consecutive ANC visits or two consecutive automated voice calls. Similarly to those in the intervention group, women in the control group got conventional prenatal care. They did not, however, receive voicemails.

Sample size

The sample size for each study population was determined by comparing two proportions with a standard

deviation at the 95% confidence interval (1.96). The minimum sample size estimated was 227 per group of pregnant women with a non-response rate of 5%. A total of 488 consenting pregnant women were recruited for this study. This study was conducted between April 2019 and March 2020. All participants were recruited in their first trimester of pregnancy and followed up till delivery and during the postpartum period.

Data collection

Data were collected at two points over the course of the study. The initial collection was at the start of the study when the participants were recruited. This was done at the respective PHC through interviewer-administered questionnaires. Data collection was via interviewer-administered questionnaire. After obtaining informed consent, socio-demographic data and obstetric history data of the participants were collected. Data collectors were five female research assistants assigned to two PHC per district. They made fortnightly visits to each PHC in their jurisdiction to keep a record of ANC attendance of each participant. In addition, the research assistants made follow-up calls to any participant who had missed two consecutive scheduled visits to ascertain the cause for their absence. The research team also held weekly meetings with the principal investigator to review the attendance ledgers for consistency and completeness, address any problems encountered by the assistants and follow up with the software generation company in case of missed voice calls. At the end of the study a second round of data collection was performed to establish the number of ANC visits across the study groups.

Data analysis

Given that the study was cluster randomised at the PHC level, we could only conduct a per-protocol analysis for the risk of the outcomes in both intervention and control groups. The intervention was coded into a binary variable with "1" representing women who received the mobile message and "0" representing women who did not receive the mobile message. The main outcome variable was the number of ANC visits (coded to "1" for women who had eight or more ANC visits and "0" for those who had less than eight visits).

All statistical analyses were done using STATA SE 17.0® (StataCorp, College Station, Texas, United States). Descriptive statistics were used to summarise the socio-demographic characteristics of respondents. Bivariate analysis was conducted to measure the proportion of respondents who had at least eight ANC visits in both intervention and control groups. We computed multivariate generalised linear models to measure the crude risk ratios of attending eight or more ANC visits. These risk ratios were then adjusted for age, educational level, and parity.

RESULTS

A total sample of 458 women were included in this study, of which 269 were in the intervention group (representing 58.7% of the total sample). All women in the intervention group received the mobile voice messages. Amongst those who received the voice messages, the majority were aged 25-34 years (62.2%), married (97.8%), Christian (63.2%), and attained secondary education (70.0%). In terms of their obstetric history, the majority were multiparous (48.3%) (Table 1).

In terms of the ANC service received at ANC, the majority of women (84.4% [intervention group]; 86.2% [control group]) received health talk at ANC. Almost all women (99.3% [intervention group]; 98.4% [control group]) were willing to continue ANC at the PHC. Across the entire pregnancy, 60.7% of respondents who received the intervention had eight or more ANC visits compared to 30.1% of those who did not receive the intervention (Table 2).

Women with secondary or tertiary education attended eight or more ANC visits in the intervention group whiles for the control group, these women had primary and secondary education. In both intervention and control groups, a larger proportion of Christians had eight or more ANC visits compared to Muslims (Table 3). Among the women who received the intervention, 89.5% found it useful.

Women who received the intervention had a 2.01 (95% CI 1.44 – 2.80) higher likelihood of attending eight or more ANC visits compared to women who did not. After adjusting for age, parity and

educational status of women, the risk ratio increased slightly to 2.25 (95% CI 1.59 – 3.18) (Table 4).

DISCUSSION

In this study, we aimed to determine the impact of a mobile phone-based voice message intervention on ANC utilization as defined by the 2016 WHO recommendation at the primary health care (PHC) level in Lagos State, Nigeria. After adjusting for socio-demographic factors including age and educational status of women as well as parity, our findings indicated that women who received the intervention had a nearly three times (95% CI 1.59–3.18) greater likelihood of attending eight or more ANC visits than women who did not receive the intervention. This demonstrates that correctly targeted mobile phone voice messages can increase care-seeking for ANC visits in LMICs in accordance with the most recent WHO guidelines. A prior study of a comparable voice message-based intervention in India did not find any significant difference between the intervention and control groups for the number of ANC visits (three or more).[22] However, our study evaluated based on WHO recommendations for eight visits.[10] The variance in thresholds across our research may explain why our findings varied. Nonetheless, it is encouraging that custom-tailored routine audio messages that doubled as appointment reminders for women significantly increased service utilization. Previous research has demonstrated that SMS-based interventions increase ANC utilization.[24,25] Nonetheless, these studies predate the most recent recommendations for eight visits.[10] Women who received the SMS (intervention) and read the entire SMS had a greater proportion of ANC visits (96.9% vs. 84.4%, p=0.01) than women who did not get the SMS (intervention).[26] However, scholars have questioned the emotional connection of sending SMS messages to women.[22]

A crucial aspect of our study is that it evaluates the efficacy of a mhealth intervention on ANC utilization based on the most recent WHO recommendation and focuses on a voice message-based intervention that has seldom been evaluated.[13] However, a few restrictions must be considered when interpreting our results. First, we took a pragmatic approach by randomizing PHCs instead of pregnant women. This was done to prevent the intervention from having any effect on the control group. In comparable trials, mhealth treatments on ANC utilization were examined using a cluster design.[25,26] The process of cluster randomisation may have contributed to the observed variations. Despite controlling for socio-demographic and obstetric variables, the observed substantial effects remained. In addition, we were only able to publish a per-protocol analysis, as every pregnant woman in the intervention PHCs got the intervention.

Regarding implications for practice, there is a strong justification for utilizing audio messages to modify health-seeking behavior and increase ANC utilization. While the majority of women in our survey have attained a secondary education, 36% of Nigerian women do not have any formal education.[7] It is crucial to create interventions directed at this cohort. Indeed, the rising mobile phone usage in LMICs such as Nigeria presents a unique opportunity.[27] Due to the increasing availability of low-cost mobile devices, the number of smartphone connections in 2015 reached 226 million.[28] A voice message is easier to grasp for illiterate women who are unable to read an SMS. In terms of delivery format, women in our study found six or more audio messages to be especially helpful. In terms of research consequences, the optimal design of communications must be investigated. Best practices, the experience of previous researchers, and sound public health education theory led our research. However, other significant gaps in intervention design persist.[29] For instance, what is the optimal quantity of voicemails? In addition, doubts exist regarding the cost-effectiveness and cost-benefit analysis of this intervention.[30]

CONCLUSIONS

A voice-message-based intervention can be useful for boosting ANC usage. Further study is required to optimize design by establishing cost-effectiveness and institutionalizing it for service delivery. This study contributes to the existing body of knowledge about the impact of mHealth interventions on ANC

utilization. When created, optimized, and contextualized for a specific group of women, it can be a useful tool in the global community's efforts to ensure that no one is left behind.

INFORMATION

Conflict of interest. The authors declare no potential conflict of interest.

Authors' contributions. GEO contributed to the conceptualization of the study, data curation, formal analysis, acquisition of funding, investigation, methodology, project administration, resources, supervision, validation, visualization, interpretation of data, original draft writing, and review and editing of the final manuscript; ABT supervised writing of original draft, contributed to data analysis, review and editing of final manuscript; BBA contributed to the study conception, study design and protocol and approved the final manuscript; EOO contributed to the study concept and design, statistical analysis and interpretation of the data, and drafting of the final manuscript; AKO contributed to data curation, project administration, supervision, visualization and validation of field data.

Acknowledgements. The authors thank the participants, the medical officers of health (MOH) of the 10 local government areas (LGA) where the PHC are located, and the entire research team. In addition, they thank the BRAINS Mentored Research of the College of Medicine at the University of Lagos and the MRH Research Collective for their support.

Funding. This research was supported by the National Institutes of Health's Fogarty International Center under Award Number D43TW010134. The material is the unique responsibility of the authors and does not necessarily represent the National Institutes of Health's official position. The funders played no part in the study's design, data collection and analysis, publication decision, or manuscript writing.

Availability of data and materials. All data generated or analyzed during this study are included in this published article.

REFERENCES

1. United Nations. Sustainable Development Goals: 17 goals to transform our world [Internet]. Sustainable Development Goals. 2016 [cited 2020 Oct 12]. http://www.un.org/sustainabledevelopment/sustainable-development-goals/

2. WHO, UNICEF, UNFPA, World Bank Group, UNDP. Trends in maternal mortality 2000 to 2017: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division [Internet]. Geneva: World Health Organization; 2019. 1–119 p. Available from: https://www.unfpa.org/sites/default/files/pub-pdf/Maternal_mortality_report.pdf

3. McDonagh M. Is antenatal care effective in reducing maternal morbidity and mortality? Health Policy Plan. 1996;11(1):1–15.

4. Carroli G, Rooney C, Villar JÂ. How effective is antenatal care in preventing maternal mortality and serious morbidity? An overview of the evidence. Paediatric and Perinatal Epidemiology. 2001;15(s1):1–42.

5.Villar J, Ba'aqeel H, Piaggio G, Lumbiganon P, Miguel Belizán J, Farnot U, et al. WHO antenatal care randomised trial for the evaluation of a new model of routine antenatal care. The Lancet. 2001;357(9268):1551–64.

6. Lincetto O, Mothebesoane-Anoh S, Gomez P, Munjanja S. Antenatal Care. In: Lawn J, Kerber K, editors. Opportunities for Africa's Newborns: practical data, policy and programmatic support for newborn care in Africa [Internet]. Geneva: World Health Organization; 2006. p. 51–62. https://resourcecentre.savethechildren.net/pdf/3381.pdf

7. National Population Commission, ICF International. Nigeria Demographic and Health Survey 2018 [Internet]. Abuja, Nigeria and Rockville, Maryland, USA; 2019. https://dhsprogram.com/pubs/pdf/FR359/FR359.pdf

8.Benova L, Tunçalp Ö, Moran AC, Campbell OMR. Not just a number: examining coverage and content of antenatal care in low-income and middle-income countries. BMJ Global Health. 2018;3(2):e000779.

9. Owolabi OO, Wong KLM, Dennis ML, Radovich E, Cavallaro FL, Lynch CA, et al. Comparing the use and content of antenatal care in adolescent and older first-time mothers in 13 countries of west Africa: a cross-sectional analysis of Demographic and Health Surveys. The Lancet Child and Adolescent Health. 2017;1(3):203–12.

10. World Health Organization. WHO recommendations on antenatal care for a positive pregnancy experience [Internet]. Geneva: World Health Organization; 2016. 1–172 p. https://apps.who.int/iris/bitstream/handle/10665/250796/9789241549912-eng.pdf?sequence=1

11.Okedo-Alex IN, Akamike IC, Ezeanosike OB, Uneke CJ. Determinants of antenatal care utilisation in sub-Saharan Africa: a systematic review. BMJ Open. 2019;9(10):e031890.

12. Feroz A, Perveen S, Aftab W. Role of mHealth applications for improving antenatal and postnatal care in low and middle income countries: a systematic review. BMC Health Services Research. 2017;17:704.

13.Rahman MO, Yamaji N, Nagamatsu Y, Ota E. Effects of mHealth Interventions on Improving Antenatal Care Visits and Skilled Delivery Care in Low- and Middle-Income Countries: Systematic Review and Meta-analysis. Journal of Medical Internet Research. 2022;24(4):e34061.

14. Feroz AS, Ali NA, Saleem S. Assessing mobile phone access, usage, and willingness among women to receive voice message-based mobile health intervention to improve antenatal care attendance in district Thatta, Sindh, Pakistan. Reproductive Health. 2020;17(1):104.

15. Endehabtu B, Weldeab A, Were M, Lester R, Worku A, Tilahun B. Mobile Phone Access and Willingness Among Mothers to Receive a Text-Based mHealth Intervention to Improve Prenatal Care in Northwest Ethiopia: Cross-Sectional Study. JMIR Pediatrics and Parenting. 2018;1(2):e9.

16. Omole O, Ijadunola MY, Olotu E, Omotoso O, Bello B, Awoniran O, et al. The effect of mobile phone short message service on maternal health in south-west Nigeria. International Journal of Health Planning and Management. 2018;33:155–70.

17. Sondaal SFV, Browne JL, Amoakoh-Coleman M, Borgstein A, Miltenburg AS, Verwijs M, et al. Assessing the Effect of mHealth Interventions in Improving Maternal and Neonatal Care in Low- and Middle-Income Countries: A Systematic Review. PLoS ONE. 2016;11(5):e0154664.

18. LASG. Abstract of local government statistics [Internet]. Ikeja; 2019 [cited 2022 Apr 17]. p. 1–113. http://mepb.lagosstate.gov.ng/storage/sites/29/2020/08/Abstract-of-Local-Government-Statistics-Y2019.pdf

19. Mohammed S. Lagos Govt assesses 329 Primary Health Care Centres, to commission 23 more centres. 2020. Cited 2022 Apr 15]. https://bit.ly/3TWeoJO

20. BabyCenter L.L.C. BabyCenter [Internet]. About. 2022 [cited 2022 Apr 15]. Available from: https://www.babycenter.com/about

21. Gelano TF, Assefa N, Bacha YD, Mahamed AA, Roba KT, Hambisa MT. Effect of Mobile-health on maternal health care service utilization in Eastern Ethiopia: Study protocol for a randomized controlled trial. Trials. 2018;19:102.

22.Murthy N, Chandrasekharan S, Prakash MP, Ganju A, Peter J, Kaonga N, et al. Effects of an mHealth voice message service (mMitra) on maternal health knowledge and practices of low-income women in India: Findings from a pseudo-randomized controlled trial. BMC Public Health. 2020;20:820.

23. Lee CC, Li D, Arai S, Puntillo K. Ensuring cross-cultural equivalence in translation of research consents and clinical documents: a systematic process for translating English to Chinese. Journal of Transcultural Nursing. 2009;20(1):77–82.

24.Fotso JC, Robinson AL, Noordam AC, Crawford J. Fostering the use of quasi-experimental designs for evaluating public health interventions: insights from an mHealth project in Malawi. African Population Studies. 2015;29(1):1607–27.

25. Lund S, Nielsen BB, Hemed M, Boas IM, Said A, Said K, et al. Mobile phones improve antenatal care attendance in Zanzibar: A cluster randomized controlled trial. BMC Pregnancy and Childbirth. 2014;14:29.

26. Oliveira-Ciabati L, Vieira CS, Franzon ACA, Alves D, Zaratini FS, Braga GC, et al. PRENACEL

– a mHealth messaging system to complement antenatal care: a cluster randomized trial. Reproductive Health. 2017;14:146.

27. Fotso JC, Tsui A. Leveraging mobile technology to reduce barriers to maternal, newborn and child health care: a contribution to the evidence base. African Population Studies. 2015;29(1):1597–606.

28. GSMA. The Mobile Economy Africa 2016 [Internet]. London; 2016. Available from: https://www.gsmaintelligence.com/research/?file=3bc21ea879a5b217b64d62fa24c55bdf&download

29. Eboreime EA, Olawepo JO, Banke-Thomas A, Abejirinde IOO, Abimbola S. Appraising and addressing design and implementation failure in global health: A pragmatic framework. Global Public Health. 2020;16(7):1122–30.

30. Banke-Thomas A, Madaj B, Kumar S, Ameh C, van den Broek N. Assessing Value-for-Money in Maternal and Newborn Health. BMJ Global Health. 2017;2:e000310.

How to cite this article: Osanyin G.E., Banke-thomas A., Oluwole E.O., Odeseye A.K., Afolabi B.B. Effects of a mHealth voice messaging intervention on antenatal care utilisation at primary care level in Lagos, Nigeria: a cluster randomised trial. Journal of Public Health in Africa 2022;13:2222. https://doi.org/ 10.4081/jphia.2022.2222

TABLE 1: Socio-demographic characteristics of women in intervention and control groups.

Variable	Total (N=458)	Intervention group (N=269)	Control group (N=189)
Age in groups			
15–24	97 (21.2)	48 (17.8)	49 (25.9)
25–34	285 (62.2)	168 (62.2)	117 (61.9)
35 and above	76 (16.6)	53 (19.7)	23 (12.2)
Marital status			
Single	10 (2.2)	6 (2.2)	4 (2.1)
Married	448 (97.8)	263 (97.8)	185 (97.9)
Religion			
Christian	299 (65.3)	170 (63.2)	129 (68.3)
Islam	159 (34.7)	99 (36.8)	60 (31.7)
Educational level			
None	5 (1.1)	4 (1.5)	1 (0.5)
Primary	70 (15.3)	24 (8.9)	46 (24.3)
Secondary	272 (59.4)	164 (70.0)	108 (57.1)
Tertiary	111 (24.2)	77 (28.6)	34 (18.0)
Parity (N=457)			
Nulliparity	90 (19.7)	58 (21.6)	32 (17.0)
Primiparity	155 (33.9)	81 (30.1)	74 (39.4)
Multiparity	212 (46.4)	130 (48.3)	82 (43.6)

TABLE 2: Characteristics of ANC received by women in intervention and control groups.

Variable	Total (N=458)	Intervention group (N=269)	Control group (N=189)
Received health talk at ANC			
No	68 (14.9)	42 (15.6)	26 (13.8)
Yes	390 (85.1)	227 (84.4)	163 (86.2)
Willingness to continue ANC at PHC			
No	5 (1.1)	2 (0.7)	3 (1.6)
Yes	453 (98.9)	267 (99.3)	186 (98.4)
Number of antenatal care visits (N=413)			
Had <8 visits	207 (50.1)	105 (39.3)	102 (69.9)
Had 8 or more visits	206 (49.9)	162 (60.7)	44 (30.1)

TABLE 3: Bivariate table for proportion of women who attended at least eight ANC visits in both intervention and control groups.

Variable	Intervention group (N=269)			Control group (N=189)		
	Total	Had 8 ANC visits	p-value	Total	Had 8 ANC visits	p-value
Age in groups			0.542			0.732
15–24	48	27 (56.3)		31	11 (35.5)	
25–34	166	105 (63.3)		96	27 (28.1)	
35 and above	53	30 (56.6)		19	6 (31.6)	
Educational level			0.045			<0.001
None	4	2 (50.0)		1	0 (0.0)	
Primary	24	19 (79.2)		41	22 (53.7)	
Secondary	163	89 (54.6)		83	21 (25.3)	
Tertiary	76	52 (68.4)		21	1 (4.8)	
Parity			0.286			0.732
Nulliparity	58	30 (51.7)		29	7 (24.1)	
Primiparity	80	51 (63.8)		48	15 (31.3)	
Multiparity	129	81 (62.8)		69	22 (31.9)	
Marital status			0.250			0.164
Single	6	5 (83.3)		3	2 (66.7)	
Married	261	157 (60.2)		143	42 (29.4)	
Religion			0.005			0.005
Christian	170	114 (67.1)		91	35 (38.5)	
Islam	97	48 (49.5)		55	9 (16.4)	
Received health talk at ANC			0.120			0.339
No	42	30 (71.4)		23	5 (21.7)	
Yes	225	132 (58.7)		123	39 (31.7)	
Willingness to continue ANC at PHC			0.756			
No	2	1 (50.0)		0	0 (0.0)	
Yes	265	161 (60.8)		146	44 (30.1)	

TABLE 4: Generalised linear models for risk of ANC>8 and delivery in a health facility as outcomes (N=458).

Variable	Outcome of more than 8 ANC visits	
	Crude RR (95% CI)	Adjusted RR (95% CI)
Intervention		
No	1.00	1.00
Yes	2.01 (1.44 – 2.80) ***	2.25 (1.59 – 3.18) ***
Age in groups		
15–24	1.00	1.00
25–34	1.05 (0.73 – 1.50)	0.93 (0.64 – 1.34)
35 and above	1.04 (0.66 – 1.64)	0.90 (0.56 – 1.44)
Educational level		
None	1.00	1.00
Primary	1.58 (0.38 – 6.52)	2.08 (0.50 – 8.69)
Secondary	1.12 (0.28 – 4.52)	1.20 (0.30 – 4.87)
Tertiary	1.37 (0.33 – 5.60)	1.38 (0.34 – 5.65)
Parity		
Nulliparity	1.00	1.00
Primiparity	1.21 (0.81 – 1.81)	1.15 (0.76 – 1.74)
Multiparity	1.22 (0.84 – 1.78)	1.17 (0.79 – 1.73)

Note: ***p<0.001; **p<0.010; *p<0.050; OR Odds Ratio, CI Confidence Interval.