Bayero Journal of Pure and Applied Sciences, 16(1): 46 - 54
Received: March, 2023
Accepted: May, 2023
ISSN 2006 – 6996

UTILIZATION OF MOBILE PHONE REMINDER IN IMPROVING THE COMPLETENESS AND TIMELINESS OF ROUTINE CHILDHOOD IMMUNIZATION AMONG MOTHERS IN KANO METROPOLIS: A BASELINE STUDY

Yunusa, U.,[ab*] Garba, S. N.,[ab] Bello, U. L.,[ab] Ibrahim, A. H.,[ab] Ladan, M. A.,[ab] Abdulrashid, I.[ab] and Dalhatu, A.[ab]
a. Department of Nursing Sciences, Bayero University Kano, Nigeria.
b. Africa Center of Excellence for Population Health and Policy (ACEPHAP), Bayero University Kano, Nigeria.
Address: Department of Nursing Sciences, Bayero University Kano, P.M.B. 3011, Kano State, Nigeria.
Email address: uyunusa.nur@buk.edu.ng:+2348038199802
ORCID: 0000-0002-3079-7730

ABSTRACT
Mobile phone technology has shown great potentials in health interventions. With the large number of children in Northern Nigeria not being vaccinated with all age appropriate vaccines, mobile phone technology can be leveraged upon to improve routine childhood immunization outcomes in the region. Purpose: This baseline study was conducted to assess the feasibility and recruit appropriate participants for a clustered randomized controlled trial on the effect of utilization of mobile phone reminder in improving the completeness and timeliness of routine childhood immunization among mothers in Kano Metropolis. Methods: Mothers who recently gave birth, have access to mobile phone and willing to receive mobile phone reminder (text messages/calls) were continuously screened until a total of 554 of them were recruited from four (4) health care facilities within Kano Metropolis. Two of the selected facilities were randomly allocated to the intervention and control groups each. All statistical data were analyzed using descriptive and inferential statistics. Findings from the study showed that more than half of the study participants in both the intervention (54.2%) and control (64.0%) group prefer to receive the reminders on immunization of their children in English Language. While majority of participants in the intervention group prefer to be reminded through SMS and phone calls (57.5%), more than half of participants in the control group (55.9%) prefer to be reminded through SMS only. All participants in the intervention group agree to be called and asked about the immunization status of their children.
Conclusion. The study concludes that the study is feasible as all the study participants have access to mobile phones and are willing to receive reminders. There is however a participant's preference of English Language and combination of SMS and phone call to be used in sending the reminders. It is recommended that future studies be conducted in rural areas to compare feasibility with that of the urban setting.
Key words: Utilization, mobile phone reminder, completeness, timeliness, vaccines, immunization

INTRODUCTION

Being the most efficient public health intervention, immunization proffer complete or partial protection from infectious diseases through the administration of vaccines (Galiza & Heath, 2017). Despite this, vaccine preventable diseases remains the commonest cause of childhood mortality worldwide (World Health Organization, 2018) as a child dies every 20 seconds from a disease that could have been prevented by a vaccine (Center for Disease Control and Prevention, 2019). Sub-Saharan Africa remains the region with the highest under-five mortality rate in the world as the region had an average under-five mortality rate of 78 deaths per 1,000 live births. This translates to one in thirteen children dying before his or her fifth birthday – 16 times higher than the average ratio of 1 in 199 in high-income countries (UN IGME, 2019).

The high mortality rate among children under the age of 5 may not be unconnected with the low immunization completion rate in the region. Mutua et al (2016) and Tsega et al (2016) reported similar findings this in their study which revealed that many children especially those in low and midlle-income countries (LMIC) do not get immunized with the routine vaccines at all or are immunized very late thereby reducing the efficacy of the vaccines. One of the major reasons for this has been suggested to be because their parents forgot to get them immunized with basic vaccines on time (Yunusa, et al, 2017).

The 2018 Nigerian Demographic and Health Survey showed that only 34.3% of children between 12 to 23 months were completely immunized in Kano State. This is very low when compared with that of Lagos (62.8%), which has similar population size (NPC, 2019). Same data shows that children in North Western Nigeria are less likely to receive all basic vaccinations compared to children in the South East (20% versus 57%). In addition, less than 10% of children in Zamfara (7%), Kebbi (6%), and Sokoto (5%) received all basic vaccinations (NPC, 2019). Evidently, there is a wide gap in the immunization completion rate in Nigeria (31%) especially the North Western region (20%) compared to the target stipulated by the Global Immunization Vision and Strategy (GIVS) where all countries are expected to achieve a completion rate of 90% (WHO/UNICEF, 2011). As such, for vaccines to reach every Nigerian child, the International Vaccine Access Center (IVAC) recommends among other things the use of text message reminders to parents. This is necessary to increase uptake, completeness and timeliness of routine childhood immunization (Global Alliance on Vaccines and Immunization GAVI, 2020).

The wide availability and use of mobile phones offers great opportunity that can be leveraged for SMS based interventions to remind parents about the immunization schedule of their children (Haji, Lowther & Ngan'ga, 2016). Some studies on the use of mobile phone-based interventions have shown promising results and can serve as a great potential to connect parents and caregivers with routine childhood immunization service providers, particularly for resource constrained settings (Haji, et al 2016: Kazi, 2017: Gibson et al., 2017; Yunusa, et al, 2021). Hence, this baseline study will be conducted to examine the feasibility and recruit eligible participants for a clustered randomized controlled trial on the effect of utilization of mobile phone technology in improving the completeness and timeliness of routine childhood immunization in Kano metropolis.

METHODOLOGY

Study Design and Setting

This baseline study was conducted to assess the feasibility and recruit eligible participants for a clustered randomized control trial on the utilization of mobile phone reminders in the completeness and timeliness of routine childhood immunization in Kano Metropolis. Kano metropolis has a total of eight local government areas. The state has more than a thousand health facilities operating at primary level of care and distributed across the 44 local government areas in the state. In terms of mobile phone access, Kano state is the second state with the highest number of mobile phone active voice subscription (10,987,035) in Nigeria as at the 1st quarter of 2021 (NBS, 2021). Ethical Approval to conduct the study was obtained from Health Research Ethics Committee of the Kano State Ministry of Health (NHREC/17/03/2018). The prospective clustered randomized controlled trial has been registered with the Pan African Clinical Trial Registry. (PACTR202303802849181).

Sample size and Sampling Technique

Sample size of 554 participants calculated using Charan & Biswas (2013) formula for calculating sample size when testing the effect of an intervention between two groups was used for the study. Four out of the eight metropolitan local governments were randomly selected as follows Kano Municipal, Dala, Nasarawa and Gwale. Participants were randomly selected from high volume primary health care facilities randomly selected in each of the four selected LGAs. The selected health facilities are PHC Gwagwarwa (Nasarawa LGA), PHC Gwammaja (Dala LGA), PHC Ja'en (Gwale LGA) and Nuhu Bamali Health center (Kano Municipal LGA). The selected participants were then allocated randomly to intervention and control groups. PHC Gwammaja and Ja'en were randomly assigned to intervention group while PHC Gwagwarwa and Nuhu Bamali Health Center were assigned to the control group.

Method of data collection

Research assistants were trained on data collection, importance of ethics and informed consent prior to commencement of screening and recruitment of participants. Eligibility criteria considered for women to be recruited in the study are mothers who recently gave birth, have access to mobile phone and are willing to receive mobile phone reminder (text messages/calls).

Instrument for this study is a structured and validated baseline questionnaire comprising of questions on socio-demographic characteristics of mothers and index children, willingness to participate in the study, phone ownership, language preference and type of reminder.

Women who attended health care facilities to get their children immunized with Bacillus Calmette-Guérin (BCG) were screened for eligibility to participate in the study. This screening, recruitment of participants and baseline study was conducted within six weeks between 2nd March and 17th April 2023. The women were screened continuously until the required sample of 554 was reached (277 for intervention and 277 for control groups). However only 536 questionnaires (275) were found to be complete and included in the analysis.

Data analysis and presentation: All statistical data were analyzed using descriptive and inferential statistics utilizing the Statistical Package for Social Sciences (SPSS) version 23.0. Findings were presented using frequency distribution tables with simple frequencies and percentages. Intervention and control groups were compered using Chi-Square test and Fisher's exact was used in situations where cells with count of less of than five are more than 20%.

RESULTS

Findings from this baseline study showed that a total of 706 mothers of new born who attended immunization clinics to get their children immunized with BCG were screened for eligibility to participate in the prospective clustered randomized controlled trial. Out of this number, 554 were eligible and recruited to participate in the study. However, response of 18 out of the recruited mothers (2 from the intervention and 16 from control group) were incomplete leaving 536 for analysis and inclusion in the trial. This comprise of 275 and 261 in the intervention and control groups respectively.

Socio-demographic characteristics of respondents as presented in Table 1 revealed that close to half of the mothers in both the intervention (48.7%) and control group (46.0%) are between 25 and 34 years. There is no significant difference (P=0.620) between the mean age of mothers in both the intervention (26.7 $\pm$ 8.1) and control group (27 $\pm$ 6.3). The Table also showed that almost all the mothers in both intervention (96.7%) and control groups (100%) are married. About two third of the mothers in both the intervention (60.3%) and control (64.8%) groups have between 1 and 3 children. Close to three quarter of mothers in both the intervention (71.3%) and control (69.3%) groups have completed secondary schools. While the proportion of participants spouses who completed secondary schools in the intervention group (64.0%) is about twice that of than their counterparts in the control group (36.0), participants who completed tertiary education are significantly higher in the control group (44.1%) than those in the intervention group. Majority of study participants in both the intervention (56.0%) and control group (41.8%) are engaged in trades/business as their source of livelihood. Similarly, trade/business is the major occupation for participants' spouses in both the intervention (80.4%) and control (62.1%) groups. While the proportion of participants who earn between 30,000 and 50,000 naira a month in the intervention group (58.5%) is almost twice that of participants in the control group (30.7%), very few participants in both intervention (1.1%) and control (2.7%) groups earn more than 1000,000 naira per month.

Table 2 revealed that though all the participants children were between 1 to 21 days old at the point of recruitment, the average age of the children in the control group (13 $\pm$ 6.1) is higher than those in the intervention group (10 $\pm$ 6.0). The Table also indicates that there is no significant difference (P=0.142) in the sex of children in both study groups. The Table further indicates that majority of children participating in both the intervention (65.1%) and control (69.3%) groups of the study were delivered in a health facility.

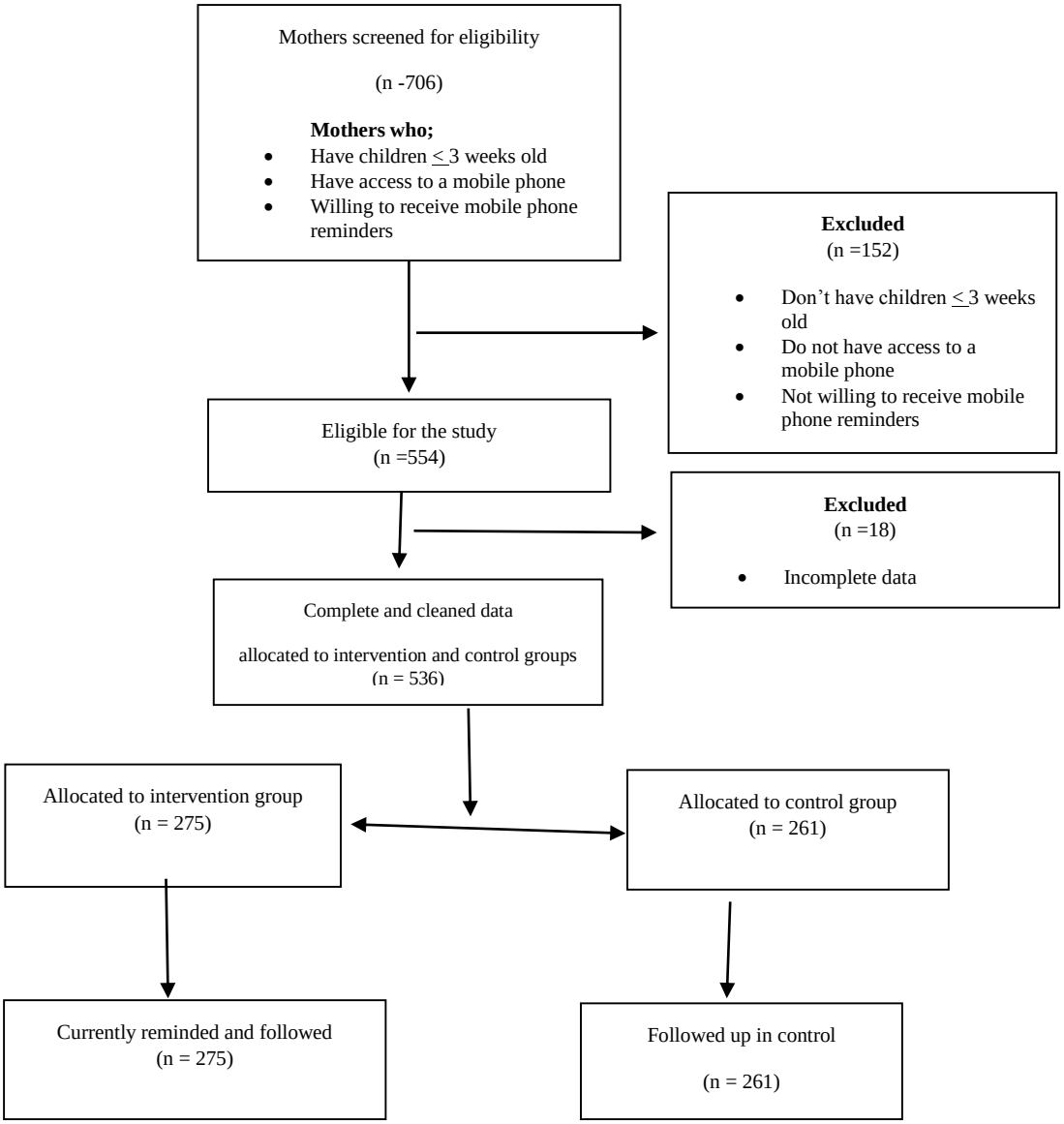

Figure 1: Flow chart of screening and recruitment of study participants

Table 1. Baseline and Socio-demographic Characteristics of Study and Control Group

Variable	Intervention (N=275)		Control (N=261)		Chi-square	*p*-value
	F	%	F	%		
Age in Years						
15 – 24	110	40.0	99	37.9	37.4	0.620
25 – 34	134	48.7	120	46.0		
35 -44	31	11.3	42	16.1		
Mean age	26.7 ± 8.1			27 ± 6.3		
Marital Status						
Married	266	96.7	261	100	8.7	0.013
Single	5	1.8	0	0		
Widow/widower	4	1.5	0	0		
Number of Children alive						
1-3	166	60.3	169	64.8	8.4	1.161
4-6	86	31.3	77	29.5		
>6	23	8.4	15	5.7		
Mean number of children alive	3.2 ± 2.2			3.02 + 2.09		
Ethnic Group						
Hausa	252	91.6	235	90.0	2.8	0.598
Fulani	15	5.5	18	6.9		
Yoruba	5	1.8	2	.8		
Others	3	1.1	6	2.3		
Educational Status						
No formal education	13	4.7	12	4.6	1.7	0.627
Primary	35	12.7	29	11.1		
Secondary	196	71.3	181	69.3		
Tertiary	31	11.3	39	14.9		
Educational status of spouse						
No formal education	5	1.8	19	7.3	46.2	0.043
Primary	15	5.5	33	12.6		
Secondary	176	64.0	94	36.0		
Tertiary	79	28.7	115	44.1		
Occupational status						
Civil servant	13	4.7	14	5.4	13.5	0.964
Vocation/artisanship/handicraft	13	4.7	27	10.3		
Trade/business	154	56.0	109	41.8		
Unemployed	95	34.5	111	42.5		
Occupational status of spouse						
Civil servant	39	14.2	65	24.9	22.9	<0.05
Farming	1	0.4	1	0.4		
Vocation/artisanship/handicraft	14	5.1	33	12.6		
Trade/business	221	80.4	162	62.1		
Average Monthly income (N)						
<30,000	8	2.9	118	45.2	138.5	<0.05
30,000 – 50,000	161	58.5	80	30.7		
51,000 – 100,000	103	37.5	56	21.5		
>100,000	3	1.1	7	2.7		

Table 2 Baseline and Socio-demographic Characteristics of Children in Intervention and Control Group

Variable	Intervention group (N=275)		Control group (N=261)		Chi-square	*p*-value
	F	%	F	%		
Age in Days						
1 – 3	49	17.8	15	5.7	69.0	<0.05
4 – 6	52	18.9	26	10.0		
7 – 9	46	16.7	40	15.3		
10 – 12	43	15.6	42	16.1		
13 – 15	35	12.7	28	10.7		
16 – 18	18	6.5	30	11.5		
19 – 21	32	11.6	80	30.7		
Mean age in days	10 $\pm$ 6.0		13 $\pm$ 6.1			
Sex						
Male	151	54.9	126	48.3	2.4	0.142
Female	124	45.1	135	51.7		
Place of Delivery						
Health Facility	179	65.1	181	69.3	8.9	0.049
Home	72	26.2	73	28.0		
Others	24	8.7	7	2.7		

Table 3 showed that almost all the participants in both the intervention (98.5%) and control (94.6%) group own a mobile phone. The Table further revealed that all the study participants (100%) are willing to receive mobile phone reminder on the immunization of children. More than half of the participants in both the intervention (54.2%) and control (64.0%) group preferred to receive the reminder on immunization of their children in English Language. While majority of participants in the intervention group prefer to reminded through SMS and phone calls (57.5%), majority of participants in the control group (55.9%) prefer to be reminded through SMS only. Contrary to participants in the intervention group who all agree to be called and asked about the immunization status of their children (100%), just above three quarters of participants in the control group (77.4%) were willing to accept follow-up phone calls.

Table 3 Distribution of the studied groups according to phone ownership, preferred Language of Reminder and Follow up calls.

Variable	Intervention group (N=275)		Control group (N=261)		*Chi-square*	*P* value*
	F	%	F	%		
Phone Ownership						
Own a mobile phone	271	98.5	247	94.6	6.3	0.15
Access to a relative's phone	4	1.5	14	5.4		
Willing to receive mobile phone reminder						
Yes	275	100.0	261	100.0		
Preferred Language of Reminder						
English	149	54.2	93	35.6	17.9	0.105
Hausa	125	45.5	52	19.9		
Other	1	0.4	0	0		
Preference on type of reminder						
SMS only	50	18.2	146	55.9	182.6	<0.05
Phone calls	67	24.4	104	39.8		
SMS and Phone Calls	158	57.5	11	4.2		
Agree to follow up calls on child's immunization status						
Yes	275	100.0	202	77.4	-	-
No	0	0	59	22.6	-	-

DISCUSSION

The overall aim of this baseline study was to assess the feasibility of utilizing mobile phone SMS and calls to remind parents about the immunization of their children in Kano metropolis state. Mothers of new born babies between 15 and 49 years were simultaneously recruited from four selected focal health facilities in Kano metropolis. It was observed that about half of the women in both the intervention and control groups are young adults between the ages of 25 and 34 years. Women in this age category were more likely to have participated in the study based on the inclusion criteria of having at least a child. This is the age at which women are expected to have married and started giving birth to children in the region. This finding is similar to that of study conducted on enhancing routine immunization performance using innovative technology in an urban area of Nigeria by Eze and Adeleye (2015) which revealed that 66% of respondents are between the same age range of 25 and 34 years.

As culturally expected of the women in Kano state, the socio-demographic data of the study showed that all the participants in both the intervention and control groups are married. This corroborates the results of study conducted by Eze and Adeleye (2015) where 96.1% of the of the survey respondents are married. The study found that on the average, each of the study participants in both the intervention and control groups has about three children. This is similar to findings of the 2018 Performance Monitoring for Action PMA survey conducted in Kano state (Center for Research Evaluation and Resource Development CRERD) which revealed that the women who participated in the survey had an average of four children at the time of their first contraceptive use (26.8 years for Urban women and 29.2 years for rural women).

Based on the educational status of the participants, findings of the study revealed that close to three quarter of the entire study participants have completed secondary schools. This is similar to results of study conducted in Ondo state by Ekhaguere et al., (2018) which revealed that 61% of participants in the intervention group have completed tertiary education. On the other hand, findings from this study validates the results of the 2018 NDHS (NPC, 2019) which showed that only 8.1% of women (15 – 49 years) in Kano state have tertiary education. Even though the proportion of participants with tertiary education in the entire study was low. It was however observed that they were slightly higher in the control group compared to the intervention group. Study participants who have no formal education in the entire study is significantly lower than that of the same category of women who participated in 2018 NDHS (NPC, 2019) which reported that 56.3% of women in Kano state have no formal education. Findings from the study further revealed that a significantly higher proportion of the participants spouses who are mostly men have tertiary education compared to the participants. This may be related to the higher value placed on the education of boy child compared to the girls especially post-secondary where some parents place more importance on ensuring that their daughters marry into good homes rather than striving towards furthering their education.

In terms of occupation, it was observed that more than half of participants in the intervention group and about two fifth of participants in the control group are engaged in trade or businesses. The study reported that few of the entire study participants are civil servants. This corresponds to the low proportion of participants with tertiary education. In Nigeria, it is expected that civil service positions are mainly occupied by those who have tertiary educational qualification. This result is similar with with that of study conducted by Brown and Oluwatosin (2017) where 44.1% of intervention group participants are engaged in petty trading. However, the result of the current study revealed that the proportion of civil servants in this study is significantly less than that of study conducted by Brown and Oluwatosin (2017) which reported that 13.2% of women in the intervention group and 11% of women in the control group are civil servants. The proportion of participants in this study who are unemployed is significantly higher than the proportion of unemployed participants in the study conducted by Ekhaguere, et al., (2018) where only 18.9% and 18% of the study participants are unemployed the intervention and control group respectively. Findings from this study showed that majority of the study participants stated that they earn less than 100,000 naira per month and close to half of the participants in the control group reported that they earn less than 30,000 a month. This low monthly income may be related to the existing cultural and social norm of the people of Kano state where men are the ones expected to earn and take care of the family. With majority of the study participants being women, it is expected that they rely more on their spouses' income. Hence the possible reason for majority of them reporting to low monthly income.

Findings from this study showed that only children who are between 1 and 21 days of birth where included. There was no significant difference in the gender of children included in both the intervention and control group. While male children were slightly higher in the intervention group, the control group on the other hand has slightly more female children. This is contrary to gender of children who participated in similar studies conducted in Nigeria (Brown & Oluwatosin, 2017; Brown, Oluwatosin, Akinyemi & Adeyemo, 2015; Ekhaguere et al., 2018) which reported that female children who participated in the study (50% +) are more than their male counterparts. However, similar study conducted in Pakistan by Kazi et al., (2018) showed that the male children are more than the females in both the intervention (56%) and control group (50.7%). Nonetheless the difference in gender of children is not expected to affected the participation of mothers in the study or affecting the study outcome. In terms of place of birth, it was observed that about two third of participants in the entire study were delivered in a health facility. This is similar to the findings of a similar study conducted by Brown, et al, (2015) which showed that 62.7% of the children involved in the survey were given birth in a health facility (40.0% in private and 22.7% in public health facilities) while 37.8% were delivered either at home or TBAs/mission homes.

It was observed that all the women who participated in this study have access to mobile phone either by direct ownership or relying on a relatives' phone. Though majority of the participates own their personal phone, a small fraction of the participants would rely on access to a relatives' phone. This is in line with the Anammah (2018) which identified Nigeria as Africa's largest mobile market, having more than 162 million. With participants drawn from the Kano metropolis which comprise of urban local government areas in the state, the implementation of mobile phone technology in reminding parents about the immunization of their children is feasible and achievable in the study area. Contrary to expectations, more than half of the study participants stated that they will prefer their reminders to be sent in English Language. With majority of the participants from Hausa extraction, one would have expected their reminders to be sent in Hausa Language, but they preferred to be reminded in English. This may be related to their level of education where majority of the study participants have attained secondary education. The study revealed a preference of a combination of SMS and phone call reminder by the participants in the intervention group compared to their counterparts in the control group who prefer the use of only SMS. However, all the study participants agreed to be called and followed up about the immunization of their children.

CONCLUSION

The study concludes that majority of the study participants own personal mobile phone and willing to receive reminders on the immunization of their children. While majority of the participants in the intervention group prefers to be reminded through phone calls and SMS, their counterparts in the control group prefer SMS reminders only. Finally the study participants unanimously accepted to be followed up and tracked on the immunization status of their children via phone calls. With the study conducted mainly in urban settings, it is therefore recommended that the study is scaled up to rural settings of the state.

Declaration of Competing Interest

Authors declare no competing interests.

Acknowledgment

This study is sponsored by the Tertiary Education Fund (TETFund) Institutional Based Research (IBR) grant (TETF/DR&D/UNI/KANO/IBR/2021/VOL.I) under Bayero University Kano, Nigeria.

REFERENCES

Anammah, J. (2018). Mobile Report Nigeria 2018, Introduction to the 4th Edition of the Nigerian Mobile Report, JumiaMobileWeek,

Brown, V.B., Oluwatosin, A., Ogundeji, M.O. (2015). Experiences, perceptions and preferences of mothers towards childhood immunization reminder/recall in Ibadan, Nigeria: a cross-sectional study. *The Pan African medical journal*. 20:243.

Brown, V.B., Oluwatosin, O.A. (2017). Feasibility of implementing a cell phone-based reminder/recall

strategy to improve childhood routine immunization in a low-resource setting: a descriptive report. *BMC health services research*.17(Suppl 2):703.

Centre for Disease Control and Prevention (2019) 1600 Clifton Road NE, Atlanta, GA 30329-4018 www.cdc.gov/global Email: cdcglobal@cdc.gov

Centre for Research Evaluation and Resource Development CRERD (2018). Performance Monitoring and Accountability, PMA 2020, CRERD, Ile-ife, Osun State, Nigeria

Charan, J. & Biswas, T. (2013). How to Calculate Sample Size for Different Study Designs in Medical Research, *Indian Journal Psychological Medicine*. 35(2): 121–126. doi:10.4103/02537176.116232

Ekhaguere, O.A., Oluwafemi, R.O., Badejoko, B., Oyeneyin, L.O., Butali, A., Lowenthal, E.D., et al. (2019) Automated phone call and text reminders for childhood immunisations (PRIMM): a randomised controlled trial in Nigeria. *BMJ global health*. *4(2*):e001232.

Eze, G. U., Adeleye, O.O. (2015). Enhancing Routine Immunization Performance using Innovative Technology in an Urban Area of Nigeria. *West African journal of medicine*. 34(1):3-10.

Galiza, E. & Heath, P. (2017). Immunization, *Journal of public medicine* retrieved on 21st December 2017 from http://dx.doi.org/10.1016/.2017.07.001

Gibson, D.G., Ochieng, B., Kagucia, E.W., Were, J., Hayford, K., Moulton, L.H. & Feikin, D.R. (2017) Mobile phone delivered reminders and incentives to improve childhood immunisation coverage and timeliness in Kenya (M-SIMU): a cluster randomised controlled trial. *Lancet Global Health,* 5: e428–38.

Global Alliance on Vaccines and Immunizations GAVI (2020) IVAC identifies solutions to Nigeria childhood mortality crisis, Accessed on 24th April, 2020 from https://www.gavi .org/news/media-room/ivac-identifies- solutions-nigeria - childhood-mortality-crisis

Haji, A., Lowther, S., & Ngan'ga, Z. (2016). Reducing routine vaccination dropout rates: Evaluating two interventions in three Kenyan districts 2014, *BMC Public Health*, 16:152.

Kazi, A.M., Ali, M., Zubair, K., Kalimuddin, H., Kazi, A.N., Iqbal, S.P., et al (2018). Effect of mobile phone text message reminders on routine immunization uptake in Pakistan: randomized controlled trial. *JMIR public health and surveillance*.4(1): e20.

Kazi, A.M., Carmichael, J.L, Hapanna, G.W. (2017). Assessing mobile phone access and perceptions for texting-based mHealth interventions among expectant mothers and child caregivers in remote regions of northern Kenya: a survey-based descriptive study. *JMIR Public Health Surveillance*, 3: e5.

Mutua, K.V., Kimani-Murage, E., Ngomi, N., Ravn, H., Mwaniki, P., & Echoka, E. (2016).Fully immunized child: coverage, timing and sequencing of routine immunization in an urban poor settlement in Nairobi, Kenya. *Tropical medicine and health*. 44(1): 13. DOI: 10.1186/s41182-016-0013-x

National Population Commission NPC (2019) Nigerian Demographic and Health Survey 2018, Rockville, Maryland, USA ICF International National Primary Health Care

National Bureau of Statistics NBS (2018). Telecoms Data: Active Voice and Internet per State, Porting and Tariff Information (Q4:2017).

Tsega, A., Hausi, H., Chriwa, G., Steinglass, R., Smith, D., & Valle, M. (2016). Vaccination coverage and timely vaccination with valid doses in Malawi, Vaccine Reports 6, 8-12

United Nations Inter-Agency Group for Child Mortality Estimation (UN IGME) (2019) Levels & Trends in Child Mortality: Report 2019, United Nations Children's Fund, New York.

World Health Organization (2018) Immunization vaccine and biologicals, retrieved on 31st January 2018 from http://www.who.int/entity/immunization/en/

World Health Organization/ united Nations Children Fund WHO/UNICEF. (2011). immunization summary - a statistical reference containing data through 2011. Retrieved June 27th 2013, from http://www.whoint/entity/immunizationmonitoring/data/coverageestimatesseries.xls

Yunusa, U., Irinoye, O. O. Lawal, U. B, Timothy, G. (2017) Determinants of Parental Compliance with Routine Childhood Immunization Schedule in Nassarawa State, Nigeria. *International Journal of Nursing and Care,* 1(3) 001: 1-7.

Yunusa, U., Garba, S.N., Umar, A.B. Idris, H.S., Lawal, U.B., Idris, A. et al, (2021). Mobile phone reminders for enhancing uptake, completeness and timeliness of routine childhood immunization in low and middle income countries: A systematic review and meta-analysis. *Vaccine,* 39 (2021) 209-221 DOI:https://doi.org/10.1016/j.vaccine.2020.11.043