



Determinants of Immunization Completeness among Children Aged 12-23 Months in South-West Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author AO research idea, introduction and review. Author ODE introduction, methods, analysis, results and discussion. Author BOE research idea and review. Author YAO research idea and result. Author BCN research idea and review. Author AAE research idea and review. Author AUO research idea and review. Author DWA research idea and review. Author BK research idea and review. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Vaccine preventable disease remained issue of major concern to the global health system. Low coverage of immunization necessitated the need to explore the determinants of immunization uptake. Factors influencing immunization coverage in South-West Nigeria were investigated in this study.

Methods: Data from the Nigeria demographic and health survey (NDHS) was used for this study. Our focus was on children between 12 to 23 months whose parents were residents of South-West Nigeria. A total of 655 records were used for the analysis of this study. The outcome variable (child's immunization status) was categorized as "non-or- under immunized and fully immunized". Considered explanatory variables were children and parents' characteristics.

Data were analyzed using Statistical package for social sciences (SPSS) version 25. Descriptive statistics were presented and generalized linear model was used to explore the determinants of immunization completeness.

Results: Of the 665 children whose mean age was 16.7 ± 3.4 SD months, 62.3% were non-or-under immunized, while only 79.8% were birthed in the health facility. Majority of them (65.1%) were not presented for postnatal check within two months of birth while 51% do not have health card. About 79% of the mothers said distance to the health facility was not a problem. In this study, postnatal check within 2 months of birth, type of residence and ownership of health card were identified factors influencing the uptake of immunization. For instance, Those who said distance is a problem were 3 times less likely to fully immunize their children (AOR=0.28, $p=0.000$, 95% CI: 0.16-0.47). Obviously, ownership of health card (AOR=15.34, $p=0.000$, 95% CI: 9.86-23.88) and postnatal check within 2 months of birth (AOR=1.78, 95% CI: 0.37-0.86) were associated with the likelihood of complete immunization.

Conclusion: Immunization uptake was very low in South-West Nigeria. Factors that were positively associated with completeness of immunization include observance of postnatal check and ownership of healthcare card while problem of distance to health facility was negatively associated. Increasing vaccination coverage/ completeness would ameliorate, if policy geared towards the improvement of postnatal check-ups, distribution of healthcare facilities within residential areas and strict adherence to the use of health care are considered in the South-West Nigeria.

Keywords: Vaccination; preventable diseases; global health system; immunization.

1. INTRODUCTION

Vaccine preventable diseases remained issue of major concern to the global health system. The global burden of preventable disease such as diphtheria, tetanus, pertussis (whooping cough), poliomyelitis (polio), measles, mumps, rubella and haemophilus influenzae type b infections is skyrocketing and the mortality rate is not encouraging, for instance, in 2019 World Health Organization (WHO) reported a global estimate of 5.2 million death of under-five children that resulted from preventable disease and the following were recorded for Nigeria, 2,289 Diphtheria death, 28,094 measles death, 18 polio death, 1644 rubella death, 138 tetanus death, 154 yellow fever death [1,2].

Immunization still remain a major and cost effective health intervention among under-five children contributing a crucial reduction in under-five morbidity and mortality [3].

1.1 Nigerian Health Systems

Health system in Nigeria is deteriorating as a result of poor development. Meanwhile Nigeria was labeled as the "giant of Africa" but obviously, her health system is Lilliputian. Southwest Nigeria is not left out in the obnoxious health system. Inadequate structural facilities and equipment were thorns in the flesh of the health

system in this part of the world. Also, poor medical attention as a result of shortage of health staff is skyrocketing. Inadequate and lack of evaluate-ablesurveillance systems were aches in the head of South-west Nigerians [4,5].

1.2 Vaccination

WHO defined Vaccination as "a simple, safe, and effective way of protecting people against harmful diseases, before coming into contact with them by using the body's natural defense system to build resistance to specific infections and makes the immune system stronger. Vaccines train the immune system to create antibodies, just as it does when it's exposed to a disease. However, because vaccines contain only killed or weakened forms of germs like viruses or bacteria, they do not cause the disease or put you at risk of its complications'. Vaccines are administered by an injection and some of them are given orally (by mouth) or sprayed into the nose. Full vaccination is defined as the proportion of infants exactly 12 months who have received all of the following antigens/vaccines: BCG at birth, HPBx3 DPTx3 OPVx3 MSL at 9 months.

1.3 Global Vaccine Preventable Disease and their Distribution

As at 2019, about 85% of infants' worldwide (total of 116 million infants) received 3 doses of diphtheria-tetanus-pertussis(DTP3) vaccine,

which protected them against infectious diseases that can lead to weighty illness and disability [2]. Also, 72% vaccine coverage was reported for Haemophilus influenzae type b(Hib) that can cause meningitis and pneumonia, and vaccine for the liver attacking viral infection know as Hepatitis B covered about 85% infants. Low coverage (15%) was reported for vaccine against the common reproductive tract infection Human papillomavirus (HPV) causing the deadly diseases (cervical cancer and other types of cancer) in women and genital warts in both men and women. Meningitis A is an infection that is often deadly and leaves 20% affected individuals with long-term devastating sequelae, about 350 million in 24 to 26 countries were vaccinated against it at 2019. A large proportion (85%) was vaccinated against measles, a highly infectious disease caused by a virus that leads to high fever, rashes and can lead to blindness, encephalitis or death [2]. Also, 48% were vaccinated against Pneumococcal diseases, 86% against Polio, 39% against Rotaviruses, 71% against Rubella and 46% against Yellow fever [6,2].

1.4 Immunization Agenda 2030

Calls to address health impartiality and improve health coverage universally have been placed. Innovative approaches to improve the quality of health care among children and unification of community and facility-based care were suggestion made by World Health Organization to curb the preventable disease among under-five children. Thousands of contributions from nations and organizations around the continent was made to create the Immunization Agenda 2030 (IA2030) with the vision of running a decade program (2021-2030) to address the challenges modeled by infectious diseases such as Ebola, COVID-19 etc. by extending vaccine to everyone, everywhere and every age [7].

1.5 Immunization Uptake

The global prevalence of complete immunization was 85%, but Sub-Saharan African countries reported low prevalence ranging from 1.3% to 81.3% [8]. Nigeria been the most densely populated country in Africa with an estimated population growth rate of 2.8% [9] was rated second largest contributor to under-five mortality in the global world [10]. Too low (31%) prevalence of full immunization coverage was reported for children age 12-23 months in Nigeria [11]. Low proportion (28%) received basic

immunization and a lot (19%) were staying at risk of infections by hesitating from receiving vaccinations at all [12]. It was uninteresting to find out that there was a dropout rate of 30% [12]. Going by specific vaccine coverage in Nigeria, 33%, 35% and 50% did not receive BCG vaccine, DPT-HepB-Hib and third dose of DPT-HepB-Hib respectively [12]. In view of several awareness put in place, vaccines against diseases like measles and polio are expected to experience an encouraging coverage, but unfortunately 46% did not receive measles vaccine and 45%, 36% and 43% did not receive the recommended polio 0 dose at birth, the first dose of polio, and the second dose of polio respectively [12].

1.6 Factors Reported to Influence Full Immunization

Studies conducted in Nigeria and abroad showed that demographic, socio-economic and birth characteristics of children were associated factors of complete immunization. For instance, A study revealed the importance of reminder of next due date for immunization in completing immunization for children [13], other factors were availability of funds, human resource factors, health worker shortages, training deficiencies, poor attitude of health workers and vaccination teams [14]. Also, other studies revealed that urban residence, adequate antenatal care visit, vaccination site at health institutions, mothers who knows vaccination schedule of a catchment area, and mothers taking a child for vaccination even if the child is sick were associated factors of complete immunization.

1.7 Problem Statement

Vaccination coverage in Nigeria was low (30%). The proportion of those who took up immunization is really discouraging in three geopolitical zones in Nigeria, 9.6% in the North-West, 14.2% in the North-East, 26.9% in the North-Central in relative to South-West (40.9%), South-East (51.7%) and South-South (52.0%) [15]. Disappointedly, efforts put in place to address the low immunization uptake among children such as Reaching Every Children (RED), Expanded programme on Immunization (EPI), National Immunization Days (fNIDSg), Immunization Plus Days (fIPDsg) and public Enlightenment yielded low or no result [16,14,11,17]. In spite of all the novel approach, limited or no result (1% changes) was reported by scholars [6]. To buttress the point further,

2018 Nigeria Demographic Health survey revealed 31% immunization uptake [11,12].

Although, Immunization coverage in South-West is high compared to the northern regions but its far below the expectation and WHO plan [12].

Literatures have revealed that people's attitude towards uptake of health program such as immunization is driven by cultures, civil conflict and public goods provision, hence suggesting the need to explore the influencing factors of poor immunization coverage across different cultures [18].

There is paucity of information on factors influencing immunization coverage among the South-West region in Nigeria. People from this region have a unique culture and behavioral pattern, of which culture and behavior has been established to contribute hugely to the uptake of immunization [19,18]. This study aimed at exploring influencing factors of full immunization in South-West Nigeria.

2. METHODS

2.1 Study Area

This study was carried out among the southwest region of Nigeria consisting of six states namely Ekiti, Lagos, Ogun, Ondo, Osun and Oyo. It is majorly a Yoruba speaking area with diverse dialects even within the same state. The weather conditions vary between the two distinct seasons in Nigeria; the rainy season (March - November) and the dry season (November - February).

2.2 Study Design

A cross sectional study using secondary data obtained from Nigeria Demographic and Health Survey (NDHS) which was funded by United States Agency for International Development (USAID). The recent NDHS study was conducted in Nigeria in 2018. The NDHS is a nationwide survey with a nationally representative sample of about 42,000 selected households. Eligible respondents were people of age 15-49 who are usual members of the selected households or who spent the night before the survey. Also, the survey involved male at the same time in every third household selected for the female survey. In these households, all men age 15-49 who are usual members of the selected households or spent the night before the survey in the selected households were eligible for individual to be

interviewed. Further information on sampling techniques and others was provided in the NDHS report [20].

2.3 Sample Size

Of the 42,000 selected households, 33924 children between the ages of 0 to 59 months were sampled (NDHS child recode data). Information about the children was provided by their parents or guardian. Since the analysis for this study (immunization coverage) is concentrating on the southwest region, records of children aged 12 to 24 months were sorted for children's immunization status in the southwest which resulted into a total of 655 records. Hence a total of 655 records were used for the analysis of this study.

2.4 Study Variables

2.4.1 Outcome variable

Immunization completeness means any child who received the six vaccines for preventable disease, vaccines of Bacille-Calmette Guerin (BCG), third dose of diphtheria, pertussis and tetanus (DPT3), third dose of oral polio vaccine (OPV3) and measles by 24 months. Children who received fewer vaccines (less than three OPVs, less than 3 DPT, no BCG and/or measles) were grouped as "under immunized". Any child who received all the mentioned vaccines was grouped as "fully immunized" and protected (OPV0 not regarded). Anyone without any of the vaccines was classified as "not immunized", irrespective of whether the child had OPV or measles vaccination from national campaign programs [21].

Completed immunization means any child who has received the six vaccines for preventable disease, vaccines of BCG, third dose of DPT, third dose of OPV3, and MSL by 24 months. Children who received fewer vaccines (less than three OPVs excluding the OPV0, less than 3 DPT, no BCG and/or MSL) were grouped as "under immunized". Children who received all except first OPV were also grouped as "fully immunized". Anybody without DPT1 and OPV1 were classified as "not immunized", irrespective of whether the child had OPV or measles vaccination from national campaign programs.

Explanatory variables considered in this study were literature-informed. Variable on children such as age of child, sex of child, place of birth,

postnatal check in two months, problem of distance to health facility, birth order, having health card as well as information about their parents like mother's age, marital status, mother's educational status, wealth index, type of residence, ethnicity, religion and employment status. More information regarding the data collection is available on the NDHS report [20].

2.5 Data Analysis

The data was sorted by the outcome variable (Immunization status). Records of respondents who have no information about their child's immunization were excluded from the analysis. Descriptive statistics such as mean, frequency and percentage were computed to unveil the prevalence of immunization coverage and describe the children characteristics and parents' characteristics. The bivariate analysis was carried out using independent t-test (for quantitative explanatory variable(s)) and chi-square test of independence for the categorical explanatory variables. To explore factors independently associated with the likelihood of complete immunization. We further categorized the outcome variable into "Non-or under-immunized" and "fully immunized for the purpose of fitting a binary logistic regression model. The binary logistic regression model was fitted for the data using Immunization status that has two categories (fully immunized=1 and non-or- under immunized =0). All analysis was carried out at 5% level of significance.

3. RESULTS

3.1 Immunization Coverage and Children in South-west Nigeria

Immunization status and children characteristics were presented in Table 1. The children mean age was 16.7 ± 3.4 months, 45.1% of the children were of second or third order birth and the study consisted 53.7% of male children. About 47.7% of the children were under immunized while 14.6% were not immunized at all and it's excruciating to find out that only 37.7% were fully immunized in south-west Nigeria.

The proportion of children given birth to in the hospital/ health facilities was 79.8%. Disappointedly, majority (65.1%) of children were not presented for postnatal check within two months of birth, despite the fact that most (79.4%) of them said distance to health facility was not a problem. It was devastating to find out

that 51.4% of the children's caregivers do not have health care card (Table 1).

3.2 Parents Characteristics in South-West Nigeria

Parents' background was presented in Table 2. Women in the age group ≥ 30 years constitute the highest proportion 338 (50.8%). About 615 (92.5%) of women were currently married and few 34 (5.1%) of them were formally married. Also, majority 490 (73.7%) of the respondents had secondary/ higher education while 59 (8.9%) were uneducated. More than two-third 470 (70.7%) of the women lived in urban area. The distribution of women in terms of wealth index revealed that 473 (71.1%) of the women were rich and 85 (12.8%) poor. Yoruba women formed the largest 517 (77.7%) part of the study and other ethnic group was 148 (22.3%). Almost all 554 (92.6%) of the women were employed all year while 394 (59.2%) were Christians (others Christians), 21 (3.2%) catholic and 250 (37.6%) Islam.

3.3 Bivariate Result of Immunization Status among the Children

The results of the bivariate analysis between the outcome variable "immunization status" and other explanatory variables were presented in Table 3.

There wasn't a statistically significant difference ($t(1) = 0.78, p=0.435$) in the mean age of children who were fully immunized ($M=16.6, SD=3.4$) and those who were non-or-under immunized ($M=16.8, SD=3.4$). Of the children who had postnatal check in 2 months after birth, proportion of fully immunized children (47.0%) was significantly lower to those non-or-under immunized ($X^2=12.9, p=0.000$), distance to health facility was also significantly different among the two groups ($\chi=15.2, p=0.000$). Proportion of fully immunized children who have health card was higher (64.7%) compared with the non-or-under immunized ($X^2=194, p=0.000$), Children birthed by uneducated women have lower proportion (13.6%) of fully immunized compared 86.4% who were non-or-under immunized ($X^2=30.0, p=0.000$) The same pattern lower proportion of fully immunized (10.6%) in relative to non-or-under immunized children (89.4%) occurred among poor women ($X^2=37.2, p=0.000$). Place of residence was also found to lower proportion (24.6%) of fully immunized children and more.

3.4 Factors Influencing Immunization Coverage in South-West Nigeria

Factors influencing immunization coverage in south-west Nigeria was explored and results presented in Table 4. Multivariate logistic regression was carried out to explore the factors influencing immunization coverage.

The result revealed that Postnatal check in 2 months was positively associated with the likelihood of receiving full immunization compared to children that were not presented for postnatal check in 2 months of birth (AOR=1.78, $p=0.009$, 95%CI: 0.37-0.86). Those who said distance is a problem were 3 times less likely to fully immunize their children (AOR=0.28,

$p=0.000$, 95%CI: 0.16-0.47). We as well found that children who have health card were more likely to complete their immunization (AOR=15.34, $p=0.000$, 95%CI: 9.86-23.88). All were statistically significant 5% level of significance. Although, some factors such as mother's level of education and type of residence significantly predict the likelihood of full immunization among children at 10% level of education. For instance, Mother's with secondary/higher education were more likely to complete immunization for their children compared to uneducated women (AOR=2.1, $p=0.129$, 95%CI: 0.81 – 5.23) and those who live in rural area were less likely to complete immunization compared to urban dwellers (AOR=0.66, $p=0.104$, 95%CI: 0.40 – 1.09).

Table 1. A table showing the frequencies and percentage distribution of immunization coverage in South-West Nigeria (n=665)

Variables	Frequency (n)	Percentage (%)
Immunization status		
non- or under-immunized	414	62.3
fully immunized	251	37.7
Total	665	100.0
Age of child Mean (SD)	16.7(3.4)	
Sex of child		
Male	357	53.7
Female	308	46.3
Total	665	100.0
Place of birth		
Home	134	20.2
Hospital/Health Facilities	528	79.8
Total	662	100.0
Baby postnatal check within 2 months		
Yes	232	34.9
No	433	65.1
Total	665	100.0
Is distance a problem?		
No	528	79.4
Yes	137	20.6
Total	665	100.0
Birth order		
1	172	25.9
2/3	300	45.1
>=4	193	29.0
Total	665	100.0
Health card		
without health card	342	51.4
with health card	323	48.6
Total	665	100.0

Table 2. A table showing the frequencies and percentage distribution of parent characteristics in South-West Nigeria (n=665)

Variables	Frequency (n)	Percentage (%)
Mother's age		
<=24	134	20.2
25-29	193	29.0
>=30	338	50.8
Total	665	100.0
Mother's marital status		
Never married	34	5.1
Currently married	615	92.5
Formerly married	16	2.4
Total	665	100.0
Mother's education		
No education	59	8.9
Primary	116	17.4
Secondary/Higher	490	73.7
Total	665	100.0
Wealth index		
Poor	85	12.8
Middle	107	16.1
Rich	473	71.1
Total	665	100.0
Residence		
Urban	470	70.7
Rural	195	29.3
Total	665	100.0
Ethnicity		
Yoruba	517	77.7
Others	148	22.3
Total	665	100.0
Employed all year/ seasonal		
employed all year	554	92.6
seasonal/ occasional	44	7.4
Total	598	100.0
Religion		
Catholic	21	3.2
Other Christian	394	59.2
Islam	250	37.6
Total	665	100.0
State		
Oyo	116	17.4
Osun	92	13.8
Ekiti	101	15.2
Ondo	94	14.1
Lagos	152	22.9
Ogun	110	16.5

Table 3. Bivariate analysis of immunization status among the children aged 12-23 months in South-West Nigeria (n=665)

Children's information				Mothers' information			
Variables	fully immunized	Test statistics	P value	Variables	fully immunized	Test statistics	P value
Age Mean (SD)	16.6 (3.4)	0.78	0.435	Wealth Index			
Sex of child				Poor	9(10.6)	37.2	0.000**
Male	134(37.5)	0.01	0.905	Middle	33(30.8)		
Female	117(38.0)			Rich	209(44.2)		
Place of birth				Religion			
Home	43(32.1)	2.19	0.139*	Catholic	9(42.9)	0.92	0.631
Hospital/Health Facilities	206(39.0)			Other	153(38.8)		
Postnatal check in 2months				Christian			
Yes	109(47.0)	12.94	0.000*	Islam	89(35.6)		
No	142(32.8)			Employed all year/seasonal			
Is distance a problem?				employed all year	209(37.7)	0.61	0.435
Yes	32(23.4)	15.2	0.000*	employed seasonal	14(31.8)		
No	219(41.5)			/ occasional			
Birth order				State			
1	70(40.7)	1.16	0.561	Oyo	11(9.5)	93.57	0
2-3	113(37.7)			Osun	31(45.5)		
>=4	68(35.2)			Ekiti	46(45.5)		
Health card				Ondo	42(44.7)		
without healthcard	42(12.3)	194	0.000*	Lagos	95(62.5)		
with health card	209(64.7)			Ogun	26(23.6)		
Type of Residence				Mother's age			
Urban	203(43.2)	20.24	0.000*	<=24	42(31.3)	5.71	0.058*
Rural	48(24.6)			25-29	67(34.7)		
Ethnicity				>=30	142(42.0)		
Yoruba	195(37.7)	0.001	0.979	Marital status			
Others	56(37.8)			Never married	12(35.3)	0.4	0.819
				Currently married	234(38.0)		
				Formerly married	5(31.3)		

Table 4. A table showing the factors influencing full immunization of children aged 12-23 months in South-West Nigeria (n=665)

Variables	AOR	p-value	95%CI	
			Lower	Upper
Age	1.00	0.900	0.94	1.06
place birth				
Home				
Hospital/ Health facility	1.48	0.147	0.87	2.53
Postnatal check in 2months				
Yes	1.78	0.009**	0.37	0.86
No	ref			
Is distance a problem?				
No	ref			
Yes	0.28	0.000**	0.16	0.47
health card				
without health card	ref			
With health card	15.34	0.000**	9.86	23.88
Mother's age				
<=24	ref			
25-29	0.69	0.230	0.38	1.26
>=30	1.01	0.964	0.59	1.75
Mother's educational level				
No education	ref			
Primary	1.15	0.792	0.41	3.18
Secondary/Higher	2.06	0.129	0.81	5.23
Wealth Index				
Poor	ref			
Middle	1.46	0.437	0.56	3.80
Rich	1.66	0.263	0.68	4.01
Type of Residence				
Urban	ref			
Rural	0.66	0.104	0.40	1.09

4. DISCUSSION

Among the six states in Southwest Nigeria, higher proportion of the children from Oyo state was not –or- under immunized. Full immunization rate was encouraging in Lagos state and majority of those who were non-or- under immunized complained that distance from health facility was a problem. Children of higher birth order (4 or higher) are not-or-under immunized and it's evident that majority of children given birth to by uneducated women were non-or-under immunized and majority of them were not having health card. We identified the determinants of immunization status in this study and described parental role/ influence on the completeness of children's immunization. Haven controlled for confounder, postnatal care in two months after birth, having health card and distance to health facility played crucial role in the completion of immunization among children, this findings is not isolated as long distance to health facility, postnatal follow up and has been linked to

incompleteness of immunization in previous studies[22,23].

Socio economic factors such as mother's level of education and type of residence elicited in this study showed a clear likelihood towards full immunization. For instance, rural residency contributed to the likelihood of no-or-incomplete immunization for. This findings is not out of the way as other studies conducted in both local and abroad have looped mothers' low level of education and rural residency to incompleteness of immunization [24,25,26]. A novel finding in this study was that having health card increases the chances of completing child's immunization. Some women miss immunization because of forgetfulness, although verbal remind is common but health card containing the date of next immunization date would enhance or enable women to remember their child's next immunization date which will increase their chances of completing immunization. Scholars have explored various ways of reminding

mother's of the next immunization due date and other means such as SMS etc have been linked to improved immunization completeness [27,13]. This study involved the display of expertise in the use of indicators to derive immunization status. However, the use of secondary data did not permit us to explore some other potential variables as only available information on NDHS was used.

5. CONCLUSION

Immunization uptake is very low in south-west Nigeria, factors associated with completeness of immunization includes postnatal check, distance to health facility, healthcare cards, type of residence and state of residence. Efforts to increase vaccination coverage/ completeness would yield better results if intense attempt were made to improve mother's attitude towards postnatal check and encouraging them to get and make adequate use of health card.

DISCLAIMER

What is Already Know on this Topic

Prevalence of immunization coverage.

Factors associated with immunization coverage in the Nigeria as a whole.

What this Study Adds

This study added information about immunization coverage among the unique ethnic group (Yoruba) in Nigeria. Determinant of immunization coverage among south-west dwellers (Yoruba ethnic group) was unveiled in this study.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Secondary data was used for this study and ethical approval was obtained for the primary data collection by NDHS. Every confidential variables and personal identifier have been excluded from the NDHS dataset before it was made available for this study. The confidentiality and anonymity of the respondents are guaranteed as it was kept under lock and key in a computer that has a password which is available only to the researchers with the

knowledge of the research team lead. Also, permission to use the dataset was requested and granted by the NDHS team.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. WHO. Children: Reducing mortality [Internet]. Geneva: World Health Organization; 2018.
2. WHO. Immunizations. Vaccines and Biologicals; 2020.
3. Ehreth J. The global value of vaccination. *Vaccine*.2003;21(7-8):596-600.
4. Makinde OA, Sule A, Ayankogbe O, Boone D. Distribution of health facilities in Nigeria: Implications and options for universal health coverage. *The International journal of health planning and management*.2018;33(4):e1179-e1192.
5. Menizibeya O. The Nigerian health care system: Need for integrating adequate medical intelligence and surveillance systems. *Journal of pharmacy & bioallied sciences*.2011;3(4):470.
6. WHO. State of the world's vaccines and immunization: World Health Organization; 2009.
7. WHO. Immunization agenda 2030: A global strategy to leave no one behind. In W. H. Organization (Ed.): WHO; 2019.
8. Costa JC, Weber AM, Darmstadt GL, Abdalla S, Victora CG. Religious affiliation and immunization coverage in 15 countries in Sub-Saharan Africa. *Vaccine*.2020;38(5):1160-1169. DOI:<https://doi.org/10.1016/j.vaccine.2019.11.024>
9. National Population Commission. National results: Population by state and sex;2014. (Accessed March 10, 2014).
10. UNICEF N. The children-maternal and child health;2019. Available:https://www.unicef.org/Nigeria/children_1926.html
11. Ataguba JE, Ojo KO, Ichoku HE. Explaining socio-economic inequalities in immunization coverage in Nigeria. *Health policy and planning*.2016;31(9):1212-1224.
12. National Population Commission. Nigeria demographic and health survey 2018: Key indicators report.Abuja, Nigeria;2019.

13. Oladepo O, Dipeolu IO, Oladunni O. Outcome of reminder text messages intervention on completion of routine immunization in rural areas, Nigeria. *Health Promotion International*;2020.
14. Adedokun ST, Uthman OA, Adekanmbi VT, Wiysonge CS. Incomplete childhood immunization in Nigeria: A multilevel analysis of individual and contextual factors. *BMC public health*.2017;17(1):236.
15. NDHS. Nigeria and ICF International.(2014). *Nigeria Demographic and Health Survey 2013*. Rockville, Maryland, USA: National Population Commission and ICF International;2014.
16. Abdulraheem I, Onajole A, Jimoh A, Oladipo A. Reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children. *Journal of Public Health and Epidemiology*.2011;3(4):194-203.
17. Vandelaer J, Bilous J, Nshimirimana D. Reaching every district (RED) approach: A way to improve immunization performance. *Bulletin of the World Health Organization*.86, A-B;2008.
18. Desmet K, Ortuño-Ortín I, Wacziarg R. Culture, ethnicity, and diversity. *American Economic Review*.2017;107(9):2479-2513.
19. Anyene BC. Routine immunization in Nigeria: The role of politics, religion and cultural practices. *African Journal of Health Economics*.2014;3:1-9.
20. NDHS. Nigeria demographic and health survey key indicators report: Abuja;2018.
21. Oleribe O, Kumar V, Awosika-Olumo A, Taylor-Robinson SD. Individual and socioeconomic factors associated with childhood immunization coverage in Nigeria. *The Pan African Medical Journal*.2017;26.
22. Aregawi HG, Gebrehiwot TG, Abebe YG, Meles KG, Wuneh AD. Determinants of defaulting from completion of child immunization in Laelay Adiabo District, Tigray Region, Northern Ethiopia: A case-control study. *PloS one*.2017;12(9):e0185533.
23. Tamirat KS, Sisay MM. Full immunization coverage and its associated factors among children aged 12–23 months in Ethiopia: further analysis from the 2016 Ethiopia demographic and health survey. *BMC public health*.2019;19(1):1019.
24. Balogun SA, Yusuff HA, Yusuf KQ, Al-Shenqiti AM, Balogun MT, Tettey P. Maternal education and child immunization: The mediating roles of maternal literacy and socioeconomic status. *The Pan African Medical Journal*.2017;26.
25. Danis K, Georgakopoulou T, Stavrou T, Laggas D, Panagiotopoulos T. Socioeconomic factors play a more important role in childhood vaccination coverage than parental perceptions: A cross-sectional study in Greece. *Vaccine*.2010;28(7):1861-1869.
26. Hu Y, Chen Y, Guo J, Tang X, Shen L. Completeness and timeliness of vaccination and determinants for low and late uptake among young children in eastern China. *Human vaccines & immunotherapeutics*.2014;10(5):1408-1415. DOI: 10.4161/hv.28054
27. Danovaro-Holliday M, Ortiz C, Cochi S, Ruiz-Matus C. Electronic immunization registries in Latin America: Progress and lessons learned. *Revista Panamericana de Salud Pública*.2014;35:453-457.

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