

Determinants of childhood immunization among rural mothers in Nigeria

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ABSTRACT

INTRODUCTION In Sub-Saharan Africa, children have been reported to have the highest mortality rate, accounting for about 68–86 deaths per 1000 live births. The low immunization rate has made children more vulnerable to diseases such as diarrhea, pneumonia, measles, and many others, which has increased the mortality rate among children aged <5 years. The objective of this study was to assess the factors that determine the uptake of childhood immunization among rural mothers in Nigeria.

METHODS This was a cross-sectional study analyzing a secondary dataset extracted from the 2018 National Demographic and Health Survey (NDHS) database. A total of 1426 women (aged 15–49 years) across the six geopolitical regions of Nigeria were included in the study. The descriptive and inferential data analysis (binary logistic regression) was

carried out using the SPSS version 26.

RESULTS Mothers aged 35–44 years were 1.76 times more likely to receive complete immunization for their children (AOR=1.76; 95% CI: 1.25–2.48) compared to mothers aged 15–24 years. Mothers who visited antenatal clinics between 1–8 times, and ≥9 were 4.6 and 8.2 times, respectively, more likely to receive complete immunization for their children (AOR=4.58; 95% CI: 3.17–6.61 and AOR=8.21; 95% CI: 5.06–13.31) compared to mothers who did not visit antenatal clinics.

CONCLUSIONS The findings show that age, region, education level, wealth index, and the number of visits to a place of antenatal care (ANC) are the major determinants of the completion of immunization. Interventions should focus on addressing and educating rural mothers, especially those who are less likely to complete immunization for their children.

INTRODUCTION

Globally, in 2022, about 20.5 million children were either unvaccinated or under-vaccinated, with about 14.3 million children having not received any vaccination¹. Immunization has prevented an estimated 4.4 million deaths annually¹. About 6.2 million children in Nigeria have never received vaccination in the past five years^{2,3}. Children in Sub-Saharan Africa continue to have the highest rates of mortality in the world at 74 (68–86) deaths per 1000 live births⁴. Due to the low immunity that commonly characterizes childhood age, children are particularly vulnerable, and the mortality of children aged <5 years mainly caused by malaria, pneumonia, diarrhea, pertussis, measles, meningitis, and infectious disease attacks^{5,6}. To reduce infectious and

vaccine-preventable diseases (VPDs) among children, the World Health Organization (WHO) and the government have developed an Expanded Program on Immunization (EPI) to improve and strengthen regular immunization coverage across member nations⁷. Immunization is the process of improving the first line of defence against vaccine-preventable infections, as well as one of the most effective health benefits for lowering mortality rates of children⁷. Immunization against polio, as well as rubella, meningitis, measles, diarrhea, and pneumonia, has considerably reduced the occurrence of disabilities such as mental retardation, hearing loss or deafness, meningitis, intellectual disability, and mobility impairment⁵. However, there has been low uptake of immunization in Nigeria especially in rural areas^{8,9}.

Nigeria, as part of the Global Vaccine Action Plan (GVAP), has implemented many strategies to address the country's low immunization coverage including, but not limited to, routine immunization intensification, supplemental immunization activities, a global positioning system (GPS) tracker, emergency vaccination centers, and many community-level interventions to reach different parts of the country⁹. However, a major finding from the 2021 Multiple Indicators Cluster Survey/National Immunization Survey Coverage (MICS/NICS) revealed that among children aged 12–23 months in Nigeria, 17.8% did not receive any recommended routine vaccination³, with 51.9% receiving full immunization for the basic antigens in urban areas compared with about 26.4% in rural areas³. The MICS 2021 survey in Nigeria also revealed that the percentage of children aged 12–23 months who did not receive any vaccination was higher in the rural areas (22.5%) than in urban areas (9.3%)³. This can be attributed to the fact that mothers living in rural areas have low knowledge of vaccine-preventable diseases and routine immunization which affects their uptake of immunization¹⁰. A total of 13.0% of children aged 24–35 months did not receive any vaccinations³.

However, there is dearth of research focusing on the rural area of the country; understanding the determinants influencing childhood immunization among rural mothers is critical for developing targeted interventions to improve vaccine coverage and ultimately protect the health and wellbeing of children in these vulnerable communities. There is limited literature on the social factors that influence mothers living in the rural areas of Nigeria for the uptake of immunization of their children aged <5 years. The study of determinants for this uptake will shed light on the strengths and weaknesses of the existing health system and service delivery mechanisms in rural Nigeria. Identifying areas where the health system falls short in delivering immunization services can inform policymakers on potential improvements needed in infrastructure, health workforce training, supply chain management, and community engagement. A more robust and efficient health system can ensure the availability and accessibility of vaccines and improve overall immunization coverage in rural areas. Therefore, this study aims to investigate the factors that can influence the uptake of childhood immunization among mothers in rural areas of Nigeria.

METHODS

Study design

This is a descriptive cross-sectional study and secondary analysis of the 2018 Nigeria Demographic and Health Survey (NDHS).

Data source and extraction

The data used in this study were extracted from the 2018 Nigeria Demographic and Health Survey (NDHS) website which was implemented by the Nigerian National

Population Commission (https://dhsprogram.com/data/dataset/Nigeria_Standard-DHS_2018.cfm?flag=0). The NDHS used a two-stage cluster sampling procedure in a national population-based household survey. The data used in this study were extracted from the women's dataset; specifically, a representative sample of women living in rural areas aged 15–49 years whose children were aged <5 years. The variables extracted from the dataset included sociodemographic characteristics of respondents, and determinants of childhood immunization such as the place of Antenatal Care (ANC), the number of living children, and whether their children received complete immunization.

Participants

Of the total population of 41821 surveyed in the 2018 NDHS, the data of 1426 rural mothers with children aged <5 years (12–59 months) were analyzed. That is, 3.4% of the total population was analyzed. The respondents were aged 15–49 years, across all six geopolitical regions of Nigeria.

Inclusion and exclusion criteria

The data extracted from the women's dataset included:

- Mothers with children aged <5 years
 - Mothers living in rural areas
 - Mothers aged 15–49 years
- Mothers of children aged <12 months were excluded from the study.

Measures of the outcome variable

The dependent variable was the completion of immunization, and it was determined by the respondent's response to the completion of immunization for their children. The dependent variable was captured in responses to whether their children received or not all the basic vaccination/antigen immunization like Bacille Calmette-Guerin vaccine (BCG), Diphtheria, Tetanus, Pertussis (DTP) 1, DTP 2, DTP 3, Polio (IPV) 1, Polio (IPV) 2, Polio (IPV) 3, and Measles, Mumps, Rubella (MMR) 1. The BCG is a vaccine for the prevention of childhood tuberculosis meningitis disease. The DTPs are vaccines given to prevent diphtheria, tetanus, and pertussis; and it is recommended for children to receive 5 doses of DTPs. The MMR vaccine protects against three diseases: measles, mumps, and rubella. The IPV (Inactivated Poliovirus vaccine) protects from Polio (a contagious respiratory virus) that invades the central nervous system, and it is recommended that children receive about 4 doses at intervals. Respondents who received all the immunizations for their children responded 'Yes' to the completion of immunization question, and those who did not receive all the immunizations listed above responded 'No' to the question about completion of immunization.

Measures of explanatory variables

The independent variables included the sociodemographic characteristics of women, the number of visits to an ANC,

and the place of the ANC for their children. The respondents' sociodemographic characteristics included age, geopolitical region, education level, combined wealth index (the composite measure of a household's cumulative living standard), marital status, and the number of living children.

The information was obtained on the places where antenatal care was received such as government hospitals, government health care, private hospitals/clinics, government health post, respondent's home, other homes, other public sectors, and other. The places of ANC visits were then recoded into three categories: health facility, not health facility, and no ANC visit. Those that were recoded as 'health facility' were those that received ANC from government hospitals, government health care, private hospitals/clinics, and government health posts. Those that were coded as 'not health facility' were those that received ANC in their homes, other homes, other public sectors, and other.

Statistical analysis

After the NDHS data were extracted, it was checked for completeness, and incomplete data were cleaned and removed from the data. The SPSS software version 26 was used in analyzing the data for both descriptive and logistic regression. Descriptive analysis was done via SPSS to determine the frequency and percentage of the sociodemographic characteristics of the individual and the classification of the variables for the description was done regionally. To evaluate the association between the predictor variables and the outcome variable, binary logistic regression was used. Using logistic regression, the adjusted odds ratio (AOR), 95% confidence interval (CI), and p values were determined for each of the predictor variables, adjusting for all sociodemographic variables in the analysis. The level of significance was set at $p < 0.05$.

RESULTS

Sociodemographic characteristics

The mean age for those not immunized was 28.4 years, and for those immunized was slightly higher at 29.3 years. The majority of those aged 15–24 (80.3%) and 25–34 years (73.3%) did not have completed immunization, while the trend shifts for older age groups. Education level plays a role, as 85.0% of individuals with no education lacked complete immunization. The pattern varies across education levels, with 29.7% of those with primary education and 40.2% with secondary education having completed immunization. Geographical regions also show differences, with the North West having the highest proportion (84.2%) of individuals not immunized, while the South South has a higher percentage (39.8%) of those who have completed it. Wealth distribution reveals that immunization completion increases as wealth rises, with 47.7% of the richest group completing it. Similarly, antenatal care (ANC) visits show that 91.3% of those who did not visit an ANC place lacked immunization, while 8.7% who visit an ANC place were immunized. The

number of births also influences immunization, with a higher percentage (26.0%) of those who had 1–3 births being immunized. Marital status indicates that 25.1% of married respondents were immunized. Participants who access healthcare facilities had a higher immunization rate (32.6%). Overall, these data underscore the complex interplay of various variables in determining immunization status among the respondents (Table 1).

Table 1. Descriptive analysis of sociodemographic characteristics of rural mothers of under 5 years children in Nigeria, a secondary analysis of the 2018 Nigerian Demographic Health Survey (N=1426)

Characteristics	Complete immunization	
	No n (%)	Yes n (%)
Age (years)		
Mean ± SD	28.4 ± 6.9	29.3 ± 6.4
15–24	338 (80.3)	83 (19.7)
25–34	489 (73.3)	178 (26.7)
35–44	217 (69.8)	94 (30.2)
≥45	24 (88.9)	3 (11.1)
Education level		
No education	648 (85.0)	114 (15.0)
Primary	163 (70.3)	69 (29.7)
Secondary	232 (59.8)	156 (40.2)
Higher	25 (56.8)	19 (43.2)
Region		
North Central	195 (71.4)	78 (28.6)
North East	281 (79.6)	72 (20.4)
North West	358 (84.2)	67 (15.8)
South East	56 (56.0)	44 (44.0)
South South	106 (60.2)	70 (39.8)
South West	72 (72.7)	27 (27.3)
Wealth index combined		
Poorest	388 (81.5)	88 (18.5)
Poorer	336 (84.8)	60 (15.2)
Middle	202 (68.9)	91 (31.1)
Richer	96 (55.5)	77 (44.5)
Richest	46 (52.3)	42 (47.7)
Number of antenatal visits		
0	389 (91.3)	37 (8.7)
1–8	597 (69.7)	260 (30.3)
≥9	73 (56.2)	57 (43.8)
Don't know	9 (69.2)	4 (30.8)

Continued

Table 1. Continued

Characteristics	Complete immunization	
	No n (%)	Yes n (%)
Number of living children		
1-3	592 (74.0)	208 (26.0)
4-6	351 (75.8)	112 (24.2)
7-9	115 (75.7)	37 (24.3)
>9	10 (90.9)	1 (9.1)
Currently working		
No	397 (79.4)	103 (20.6)
Yes	671 (72.5)	255 (27.5)
Marital status		
Never married	26 (63.4)	15 (36.6)
Married	975 (74.9)	327 (25.1)
Living with partner	37 (82.2)	8 (17.8)
Widowed	11 (84.6)	2 (15.4)
Divorced	13 (86.7)	2 (13.3)
Separated	6 (60.0)	4 (40.0)
Place of ANC		
Not health facility	26 (83.9)	5 (16.1)
Health facility	653 (67.4)	316 (32.6)
No ANC	389 (91.3)	37 (8.7)

ANC: antenatal care.

Influence of sociodemographic characteristics on childhood immunization

Mothers aged 35–44 years were 1.76 times more likely to receive complete immunization for their children (AOR=1.76; 95% CI: 1.25–2.48) compared to mothers aged 15–24 years. Mothers in the North West were 53% less likely to complete immunization for their children (AOR=0.47; 95% CI: 0.32–0.68) compared to mothers in the North Central region. Mothers who had primary, secondary, and higher education were 2.41 (AOR=2.41; 95% CI: 1.71–3.40), 3.82 (AOR=3.82; 95% CI: 2.88–5.08), and 4.32 times (AOR=4.32; 95% CI: 2.30–8.10), respectively, more likely to receive complete immunization for their children compared to those with no education. Middle wealth, richer, and the richest mothers were 2 (AOR=1.99; 95% CI: 1.42–2.79), 3.5 (AOR=3.54; 95% CI: 2.42–5.17), and 4 times (AOR=4.03; 95% CI: 2.50–6.49), respectively, more likely to complete immunization for their children compared to the poorest mothers. Mothers who visited antenatal clinics 1–8, and ≥9 times were 4.6 (AOR=4.58; 95% CI: 3.17–6.61) and 8.2 times (AOR=8.21; 95% CI: 5.06–13.31), respectively, more likely to receive complete immunization for their children compared to

mothers who did not visit antenatal clinics. Mothers who had 7–9 children were 8% less likely to complete immunization uptake for their children compared to mothers with 1–3 children (AOR=0.92; 95% CI: 0.612–1.370). Mothers that were currently working were 1.47 times more likely to

Table 2. Determinants of childhood immunization (binary logistic regression) among rural mothers of under 5 years children in Nigeria, a secondary analysis of the 2018 Nigerian Demographic Health Survey (N=1426)

Variables	AOR (95% CI)
Age (years)	
15–24 (Ref.)	1
25–34	1.48 (1.104–1.991)**
35–44	1.76 (1.254–2.481)**
≥45	0.51 (0.150–1.731)
Region	
North Central (Ref.)	1
North East	0.64 (0.443–0.926)**
North West	0.47 (0.323–0.677)**
South East	1.96 (1.223–3.156)**
South South	1.65 (1.107–2.463)**
South West	0.94 (0.561–1.568)
Education level	
No education (Ref.)	1
Primary	2.41 (1.705–3.397)**
Secondary	3.82 (2.876–5.079)**
Higher	4.32 (2.303–8.102)**
Wealth index combined	
Poorest (Ref.)	1
Poorer	0.79 (0.550–1.128)
Middle	1.99 (1.415–2.787)**
Richer	3.54 (2.421–5.165)**
Richest	4.03 (2.496–6.493)**
Number of antenatal visits	
0 (Ref.)	1
1–8	4.58 (3.171–6.611)**
≥9	8.21 (5.062–13.312)**
Don't know	4.67 (1.372–15.908)**
Number of living children	
1–3 (Ref.)	1
4–6	0.91 (0.697–1.184)
7–9	0.92 (0.612–1.370)**
>9	0.29 (0.036–1.237)

Continued

Table 2. Continued

Variables	AOR (95% CI)
Currently working	
No (Ref.)	1
Yes	1.47 (1.129–1.900)**
Marital status	
Never married (Ref.)	1
Married	0.58 (0.304–1.111)
Living with partner	0.38 (0.139–1.013)
Widowed	0.32 (0.61–1.617)
Divorced	0.27 (0.53–1.346)
Separated	1.16 (0.280–4.761)
Place of ANC	
Not health facility (Ref.)	1
Health facility	2.52 (0.957–6.615)
No ANC	0.50 (0.179–1.364)

AOR: adjusted odds ratio; adjusted for all sociodemographic variables. **Statistically significant. ANC: antenatal care.

complete immunization uptake for their children compared to mothers that were not currently working (AOR=1.47; 95% CI: 1.129–1.900) (Table 2).

DISCUSSION

This study analyzed the various factors that can determine childhood immunization uptake among rural mothers in six geopolitical zones in Nigeria. Our results showed that age, region, education level, wealth index, and the number of visits to a place of ANC were the major determinants of childhood immunization uptake among rural women in Nigeria.

Maternal age had an impact on full childhood immunization as mothers aged 35–44 years were 1.76 times more likely to receive complete childhood immunization coverage for their children than mothers aged 15–24 years. Aside from the fact that younger mothers are often unable to make decisions on their own, older mothers have more experience in raising children and are more knowledgeable about children's health, as reported in a study carried out among mothers of children aged 12–23 months in Indonesia¹¹. Maternal education was also found to have a significant impact on the completion of immunization. Mothers that had higher education were 4.32 times more likely to complete immunization for their children compared to mothers with no education. This is similar to findings from a study carried out by Fenta et al.¹², and many other countries in Africa like Ghana, Somalia, and Ethiopia, amongst others. This is because educated mothers understand the importance of childhood immunization and have greater exposure to the benefits of immunization than uneducated mothers¹³. Also, educated mothers are more

open to accepting ideas that are beneficial, more confident in making decisions for their health, have more access to obtaining health information, and are more receptive to preventive health services^{11,14}. Moreover, educated women are more likely to be wealthier, and thus tend to have better access to health facilities and immunization services¹⁵.

Compared to mothers in the poorest wealth index group, mothers in the richer and richest groups are 3.54 and 4.03 times, respectively, more likely to complete immunization for their children. This is similar to a study which showed that compared the poorer mothers, middle-income and high-income earners were more likely to complete immunization coverage for their children¹⁶. A previous study has also shown that children from households with a higher wealth index were more likely to be fully immunized¹². This may be attributed to the capability of mothers with higher wealth index to afford the cost of immunization doses that are not free. Also, the exorbitant cost of transportation to access health facilities or time spent away from work may discourage mothers with low wealth index from completing immunization for their children even when there are free vaccination services. Besides, a higher wealth index is associated with better health status and health-seeking practices⁶. There is a relationship between the employment status of mothers and full childhood immunization as observed in this study. The report showed that working-class mothers completed immunization for their children compared to their counterparts who were not working. It may be associated with working-class mothers having a high wealth index and can afford costs for vaccinations and transportation to access healthcare facilities.

The study also revealed that the number of antenatal care visits, and place of antenatal care have a significant impact on full childhood immunization. Mothers who attended a place of ANC 1–8 times and ≥ 9 times were more likely to ensure their children received complete immunization than mothers who never visited places of antenatal care. Also, mothers who received antenatal care in a healthcare facility were likely to complete immunization for their children compared to their counterparts. It is consistent with the results of a study carried out by Maharani et al.¹¹ which also had a high rate of child immunization with increased visits to healthcare facilities, professional parents, and education. The fact that mothers who deliver in a healthcare facility were more likely to have received lectures from professional healthcare providers on the benefits of childhood immunization^{17–20} justifies this inference. In a study carried out by Adedire et al.²¹, the attendance of mothers at places of ANC influenced the completion of immunization of their children. Hence, it suggested that mothers should be made aware of the need for ANC services during pregnancy to promote the utilization of health facilities following childbirth²¹.

Strengths and limitations

The strength of this study is that it explored rural mothers

across all the geopolitical areas in Nigeria. However, the study has some limitations. First, this study was cross-sectional and cannot determine causal relationships. Second, recall bias which is quite common in cross-sectional studies may have resulted in the reporting of uptake of childhood immunization. Another limitation that could have influenced the outcomes of this study was the social desirability bias. The respondents might have exaggerated the response to the uptake of childhood immunization.

CONCLUSIONS

Many factors have been shown to influence the uptake of childhood immunization among mothers of children aged <5 years in rural areas. The findings showed that mothers who were older, richer, more educated, and visited more frequently places of ANC, were more likely to complete the immunization of their children. Public health intervention programs including innovative education campaigns should be provided for young, poor, and less-educated women living in rural communities. Healthcare workers should encourage community engagement via community outreaches in rural settings to raise awareness of childhood immunization and its benefits.

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CONFLICTS OF INTEREST

The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

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ETHICAL APPROVAL AND INFORMED CONSENT

The Nigerian DHS survey was carried out following the Nigerian research ethical regulations. Further research ethics approval was not necessary since this was an analysis of secondary data. All data were retrieved from the NDHS database following Demographic Health Survey (DHS) norms for this study and treated as confidential, with survey respondents remaining anonymous.

DATA AVAILABILITY

The data supporting this research are available from the author(s) on reasonable request.

AUTHORS' CONTRIBUTIONS

MAA: conceptualization, resources, writing of original draft, writing, reviewing and editing of manuscript. IIO: conceptualization, resources, writing of original draft, writing, reviewing and editing of manuscript, supervision, and project administration. RIO: conceptualization, resources, writing, reviewing and editing of manuscript. AS: data analysis, writing, reviewing and editing of manuscript. CO: resources, writing of original draft. All authors read and approved the final manuscript.

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