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Determinants of completion of routine immunization among children in rural areas of Jigawa State Nigeria

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Abstract

Background: Globally, the incidence of vaccine-preventable diseases has been declining as a result of increased uptake and utilization of vaccines; but, there are still many children with delayed or incomplete immunization status in many developing countries. This study assessed the determinants of completion of routine immunization among under five children in rural areas of Jigawa State Nigeria.

Methods: A cross-sectional descriptive study design was used. Data was collected using a pre-tested semi-structured questionnaire and analyzed using SPSS version 16 statistical software. A multi-stage sampling technique was used to select 180 mothers of children within the age of 12 to 23 months. Data was analyzed using SPSS 21.0 statistical software. Bivariate analyses were done to identify independent factors for complete immunization status.

Results: The immunization coverage was 16.7% and the drop-out rate was 51.6%. The determinants of completion of routine immunization were mothers/caregiver attendance of antenatal care during the last pregnancy (X^2=22.488, p<0.05), presence of health facility in the settlement (X^2=6.956, p<0.05), place of delivery (health facility vs home) (X^2=19.361, p<0.05), occupational status of trading (X^2=25.92, p<0.05) and higher household income (X^2=21.37, p<0.05).

Conclusion: Creating awareness and raising the level of maternal education, provision of health facilities in underserved communities and access to adequate health care during pregnancy were recommended in order to increase immunization coverage at the community level.

Keywords: Immunization coverage; Immunization status; maternal education; Socio economic factors

1. Introduction

Immunization is one of the oldest, safest and most cost-effective public health interventions to prevent both the morbidity and mortality as a result of vaccine-preventable diseases [1]. A child is considered fully vaccinated if he/she has received BCG (Bacillus Calmette-Guérin) vaccine, at least three doses of Polio vaccine, three doses of Pentavalent vaccine (Diphtheria, Pertussis, Tetanus, Hemophilus Influenza Type B and Hepatitis B), one of Measles containing vaccine (MCV), Inactivated Polio vaccine (IPV) and Yellow Fever vaccine [1]. But, a substantial number of children

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worldwide do not complete immunization schedules because of certain factors like socio-economic, cultural or health system that impede either the complete or non-uptake of any of the prescribed antigen at an appropriate age[1].

Routine immunization is the recommended sustainable strategy for the delivery of these vaccines to children in both developed and developing countries [1]. Sequel to the launching of the Expanded Programme on Immunization (EPI) by the World Health Organization (WHO) in 1974 and its subsequent introduction in Nigeria in 1979, the range of vaccines delivered keeps on changing and widening, with more diseases being added to the Nigerian national immunization guidelines [1]. It set out to increase coverage in line with the international commitment to achieve the universal child immunization goal of 80% coverage in every country [1].

Globally, its use has led to the eradication of small pox, regional and country specific elimination of measles and poliomyelitis, and substantial reductions in morbidity and mortality attributed to childhood killer diseases like tuberculosis, diphtheria, tetanus and pertussis. It is estimated that globally, 2-3 million deaths are averted annually through immunization against diphtheria, tetanus, pertussis and measles, and many more future deaths related to hepatitis B (from cirrhosis and hepatocellular carcinoma) averted in older groups. Increasing access to immunization in developing countries is a key reason for the decline in under-5 mortality. According to the demographic health survey (NDHS, 2018) of Nigeria, Infant and under-5 mortality rates were 67 and 132 deaths per 1,000 live births, respectively [3]. The neonatal mortality rate was 39 deaths per 1,000 live births. These findings were similar to the Multiple Indicator Cluster Survey of 2016/2017 in Nigeria. At these mortality levels, 1 in every 8 Nigerian children does not survive to their fifth birthday: This child mortality is among the highest in the world [3].

In Nigeria, different strategies are used to deliver routine immunization but different studies have reported very low coverage of routine immunization of 23% in both NDHS 2018 and MICS 2016/2017 [2],[3]. Immunization coverage is one of the indicators used to monitor progress toward reductions in child morbidity and mortality, as it is one of the most cost-effective public health interventions (National Population Commission (NPC) [Nigeria] & ICF, 2019). In Jigawa State, the immunization coverage was 23.8% almost similar to the national average but second to the coverage obtained by Kano State, 34.3% among the seven states of the North-western geo-political zone of Nigeria. In Jigawa State 20.3% of the children aged 12-23 months have not received any form of routine immunization as compared to the national average of 19.2% [3]. Other studies have consistently reported low immunization coverage below the national average, like studies by Gidado et al reported immunization coverage of 7.6% in Zamfara State [4], Taiwo etal reported 15.6% in Kaduna state [5], Odusanya et al reported immunization coverage of 18.9% among children vaccinated in government-owned health facility [6], Mabourissa et al reported immunization coverage of 72 – 81% over three year period (2012-2014) in rural areas of Burkina Faso [7], Tadesse et al reported 41.7% in southern Ethiopia [8]. But, surprisingly, Elizabeth et al obtained immunization coverage of 74.4% in Osun State [9]. This was similar to the findings by Adeyinka et al who reported immunization coverage of 76.9% [10]. Although, previous studies have indicated that low- and middle-income countries have a tendency to inflate the reported national vaccination coverage, represented by the third dose of DTP, to WHO and UNICEF as compared to household survey data [11], [12]. A quantitative analysis of the 2013 NDHS dataset by Obinna Oleribe et al found out that Immunization coverage was significantly associated with childbirth order, place of delivery, child number, and presence or absence of a child health card, maternal age, geographical location, education, religion, literacy, wealth index, marital status, and occupation [13]. Also, paternal education, occupation, and age were also significantly associated with coverage [13].

Meanwhile, several studies have reported on factors associated with either the complete uptake or non-completion of immunization among children 12 to 23 months. Socioeconomic factors are consistently linked to non-vaccination [4],[7],[11],[13]. Multiple factors may complicate immunization efforts in low and middle-income settings and contribute to underutilization of resources [14]. It has been found that lack of knowledge prevents mothers from playing an effective role in the eradication of vaccine-preventable diseases in Italy [15]. To reduce under-five (5) mortality rate mother's education is an important independent factor [4], [8]. There is a lot of misinformation, even amongst health care workers, about contraindications to immunization and many children's immunization can be delayed or even missed due to misconceptions [16].

There was an association between education status of mothers and missed opportunities for vaccination [16]. Non-vaccination is highly associated with the mother's and her partner's educational attainments [17]. Mothers who are educated have three times more chances to immunize their children than the uneducated mothers; therefore there was a significant relationship between mother's education status and child immunization status [17]. In another study, uneducated mothers are less concerned about their children's immunization status compared to highly educated mothers [6] Parents who have low levels of education and lack of information about immunization are major reasons for low coverage among children [6]. Mothers who completed primary education were less likely to have their children not fully immunized compared to women who have no education at all [4], [7] [11].

In a study conducted in south Ethiopia, only monthly family income among the socio-demographic variables was found to be predictor of non-completion of immunization among children aged 9 – 23 months [18]. The other socio-demographic variables such as family size, age of the mother or immediate care taker, occupational status, ethnicity, religion, parity, and educational status were not associated with non-completion of routine immunization. Even after adjusting for compounding effects of other socio-demographic characteristics, monthly family income had retained its significance [18]. Mothers or immediate caretakers who had monthly family income of 44–88 USD were less likely to have defaulter children than mothers or immediate caretakers, who had monthly family income below < 22 USD, [OR = 0.430 (95% CI: 0.20, 0.94)] [18]. Postponing of child immunization schedule, perceived health institute support, knowledge about measles and benefits of vaccination were the independent predictors [18]. Mothers who had poor knowledge about the benefit of vaccines were 6 times more likely to have defaulter children than mothers, who had good knowledge, [OR = 6.3, (95%CI: 1.24, 9.53)]. Similarly, mothers who had negative perception towards health institution support were 2.3 times more likely to have defaulter children than mothers with positive attitude, OR = 2.3 [18]. Abiyot Getachew Asfaw et al in the same south Ethiopia reported variables such as, educational status of caregiver, child death history, number of family size, and total number of children ever born, perceived side effect of vaccination, ANC, PNC, maternal knowledge towards immunization, and perception towards health services, time taken to reach to the health facilities (accessibility) as independent determinants of default to fully completion of immunization [19].

To improve the immunization coverage in Nigeria, community based studies has to be conducted in order to identify the determinants of completion of routine immunization as stipulated in the national guideline. Such community based studies are not available in the study area. The objective of this study was to identify the predictors of completion of immunization among children between 12–23 months of age in Birnin Kudu, Jigawa State, Nigeria.

2. Materials and Methods

2.1. Study area

This study was conducted in Birnin Kudu LGA of Jigawa State, Nigeria. Birnin Kudu is among the largest LGA in Jigawa State. This is composed of eleven wards of which predominantly were rural areas. The LGA has 4 urban and 7 rural wards. A multistage sampling technique was used to select the study participants. The LGA was classified in to two strata; urban and rural. Then two urban and four rural wards were randomly selected. For the purpose of this study, census was done to identify the eligible mothers.

2.2. Study Design

A cross-sectional descriptive study was used.

2.3. Study participants

The study populations include mothers/caregivers of children in the age group of 12 to 23 months in the selected Wards. Comprehensive census was done to identify the eligible mothers which start from the middle of each town and followed to the right.

2.4. Sample Size Determination

The minimum sample size for the study was estimated using an appropriate formula for calculating sample size for descriptive cross-sectional studies i.e

$$n = Z^2pq \times deff/d^2$$

Where;
n minimum sample size;
Z = The standard normal deviate corresponding to 5% level of significance1.96 at 95% confidence interval;
P = 7.6% or 0.076 (Hassan et al., 2016)
q = 1-0.076 =0.924 (complementary probability to p)
deff = 1.5 (stands for the design effect);
d = 0.05

By substituting the values obtained into the formula,

$$n = \frac{(1.96)^2(0.075 \text{ x } 0.924) \text{ x } 1.5}{(0.05)^2}$$

$$n = 161.86$$

$$n = 162$$

To cover for incomplete responses and to increase precision additional 16 (10%) was added to 162 to obtain 178. However, 180 questionnaires were administered to make up to the number of 10 eligible children per cluster.

2.5. Sampling Technique

We used multistage stage sampling technique to select eligible participants as followed:

- Stage I: Stratification of wards: the wards were classified as either urban (four) or rural (seven)
- Stage II: Selection of Wards: We used a simple random sampling to select six wards from the list of eleven wards in the LGA ie, two from the urban areas and four from the rural areas.
- Stage III: Random selection of settlements from the list of all the settlements in each ward was done
- Stage IV: Census: this was conducted in the selected settlements where the eligible children were selected with the assistant of the community leader.

2.6. Study Instruments

A semi-structured interviewer administered questionnaire that sought information on respondents' bio-data, information on uptake of routine immunization, socio-demographic and economic factors that affect uptake of RI was used.

2.7. Data Collection Methods

Data collection was done with the assistance of two trained research assistants. Questionnaires were administered immediately after the study participants agreed and signed or thumb print on the consent form for the study. The data was analyzed using SPSS Version 21 and Microsoft Excel 2007. Categorical data was presented as percentages; while quantitative data was described using descriptive statistics.

3. Results

The mean age and standard deviation of the study participants was 16.40 ± 5.50 months and that of their mothers/caregivers was 26.90 ±5.50. About 78% of the study participants were within the age range of 12-20 month and Hausa by tribes. Three quarter of the study participants had no any formal education and about two third of mothers were not working. Only one third of the mothers/caregivers had an income above twenty thousand Naira as indicated in Table 1.

Table 1 Distribution of respondents according to Socio-demographic/Economic status

Variables	Frequency	Percentage (%)
Mother/Caregiver Age (years)		
15 – 20	43	23.9
21 – 30	94	52.2
31 – 40	35	19.4
Above 40	8	4.4
Mean ± SD	26.90 ±5.50	
Ethnic Group		
Hausa	142	78.9
Fulani	36	20.0

Others	2	1.10
Educational Status		
Non-formal	135	75.0
Primary	18	10.0
Secondary & Post-secondary	27	15.0
Marital Status		
Married	177	98.1
Divorced	3	1.9
Occupation		
Not working	60	33.3
Working	120	66.7
Monthly Income		
N1000.00 – N 20,000.00	118	65.6
N20,001.00 – N40,000.00	31	17.2
N40,001.00 – N60,000.00	20	11.1
Above N60,000.00	11	6.1
Sex of Children		
Male	105	58.3
Female	75	41.7
Age of Children		
12 – 15 Months	82	45.6
16 – 20 Months	59	32.8
21 – 23 Months	39	21.7
Mean ± SD	16.40 ± 5.50	

About 52.8% of the study participants received BCG, OPV_0, HeB antigens at birth. At six weeks 55.6% received OPV_1 and Penta1 which decreased to 40.6% at ten weeks and 22.9% at fourteen weeks. Only about one quarter of the study participants had received last dose of immunization i.e Measles and Yellow Fever. The dropout rate for Penta was 57.0% and that of Measles was 51.6% (Table 2).

Table 2 Level of uptake of routine immunization among study participants

Vaccine	**Card Only**	**Recall only**	**Card plus Recall**
	n=180 (%)	n=180 (%)	n=180 (%)
Antigens administered at birth			
BCG	41(22.80)	54 (30.00)	95 (52.80)
OPV0	41 (22.80)	54 (30.00)	95 (52.80)
HepB	41 (22.80)	54 (30.00)	95 (52.80)
Antigens administered at 6 weeks			
OPV1	36 (20.00)	64 (35.60)	100 (55.60)
Penta1	36 (20.00)	64 (35.60)	100 (55.60)

Antigens administered at 10 weeks			
OPV2	25(13.90)	48 (26.70)	73 (40.60)
Penta2	25(13.90)	48 (26.70)	73 (40.60)
Antigens administered at 14 weeks			
OPV3	19(10.60)	24 (13.30)	43 (22.90)
Penta3	19(10.60)	24 (13.30)	43 (22.90)
IPV	19(10.60)	24 (13.30)	43 (22.90)
Antigens administered at 9 months			
Measles	20(11.10)	26 (14.40)	46 (25.60)
Yellow fever	20(11.10)	26 (14.40)	46 (25.60)
Fully Immunized	14(7.80)	16 (8.90)	30 (16.70)
Drop out			
Penta 1 – Penta 3	17(47.2)	20 (62.5)	57 (57.00)
BCG – Measles	21(51.2)	28 (51.9)	49 (51.60)

There was a statistically significant association between immunization coverage & age of mothers/caregivers (P=0.005), educational status (P=0.00067) and trading/working. Mothers and caregivers with age below thirty years were more likely to immunize their children. While those with primary, secondary and post-secondary educational status were more likely to immunize their children as outlined in Table 3 below. While, mothers or caregivers who are engaged in working or trading are more likely to immunize their children.

Table 3 Association between socio-demographic characteristics of study participants and immunization coverage

Variables	**Child Fully Immunized,**			
	Yes (%)	**No (%)**	**X2**	**P-value**
Mother/Caregiver Age (years)				
15 – 30	18(10.0)	119(66.1)	5.14	<0.05*
Above 30	12(6.7)	31(17.2)		
Ethnic Group				
Hausa	27(15.0)	130(72.2)	Fisher's T	0.6178
Fulani	3(1.7)	20(11.1)		
Educational Status				
Secondary and post-secondary	15(8.3)	12(6.7)	65.333	<0.05*
Primary	10(5.6)	8(4.4)		
Non-formal School	5(2.8)	130(73.3)		
Occupation				
Trading/working	22(12.2)	38(21.1)	25.92	<0.05*
Not working	8(4.4)	112(62.2)		
Sex of Children				
Male	13(7.22)	93(51.7)	3.599	0.0578
Female	17(9.44)	57(31.7)		

Age of Children				
12 – 15 Months	12(6.7)	70(38.9)	3.517	0.0607
16 – 20 Months	14(7.8)	45(25.0)		
21 – 23 Months	4(2.2)	35(19.4)		

*Statistically significant difference

Furthermore, there was a statistically significant association between immunization coverage & household income (P=0.00083) and occupational status (P=0.005) of mothers or caregivers of study participants. Mothers and caregivers with income of above twenty thousand Naira are more likely to immunize their children. While those mothers/caregivers that were involved in trading or other gainful employment were more likely to immunize their children as outlined in Table 4 below.

Table 4 Relationship between economic factors and immunization status of study participants

Variables	**Immunization status**		X^2	**P-value**
	Yes (%)	No (%)		
Family Income				
Above N20,001	22(12.2)	40 (22.2)	24.11	<0.05*
N10,000 – N20,000	8(07.8)	110 (61.1)		
Occupation				
Trading/working	22 (12.2)	38 (21.1)	25.92	<0.05*
Not working	8 (4.4)	112(62.2)		

*Statistically significant difference

Place of delivery, presence of health facility in the settlement and ANC attendance during the last pregnancy were found to have statistically significant association with immunization coverage. Those mothers who delivered at hospital were more likely immunize their children compared to those delivered at home. Presence of health facility in the settlement was positively correlated with immunization status of study participants. While, attendance of ANC clinic during the last pregnancy was a predictor of positive immunization coverage as indicated in table 5.

Table 5 Relationship between health system factors and Immunization status of study participants

Variables	**Immunization status**		X^2	**P-value**
	Yes (%)	No (%)		
Place of delivery				
Health Facility	22(12.2)	46(25.6)	19.361	<0.05*
Home	8 (4.4)	104(57.8)		
Presence of health facility in the settlement				
Yes	18(12.4)	62(34.4)	6.956	<0.05*
No	12(6.7)	88(48.9)		
ANC attendance during the last pregnancy				
Yes	24(13.3)	50(27.8)	22.488	<0.05*
No	6(3.3)	100(55.6)		
Proximity to health facility				
Yes	20(11.1)	74(41.1)	3.011	0.0827
No	10(5.6)	76(42.2)		

*Statistically significant difference

4. Discussion

Immunization coverage was found to be very low (16.7%) in this study. The determinants of immunization completion are complex and interwoven and factors found to be associated with high routine immunization coverage in Nigeria include mothers' attendance of antenatal care, mothers receipt of at least one dose of tetanus toxoid immunization, mothers having good knowledge of immunization and having access to information on routine immunization [9],[16]. Despite global progress in providing vaccinations, there still remains a challenge in reaching those most vulnerable: the poorest, most disadvantaged and remote communities. Immunization coverage in low-income countries remains significantly below the levels in middle- and high-income countries [4],[5],[9].

Antigens given at birth were reported to have higher immunization coverage than others during subsequent visits. Coverage by card was also lower than that of recall in line with other research work [20]. Fully immunized were found to be 24(7.80%) by card, 16(8.90%) by recall and 30(16.70) by card plus recall (crude coverage). The high drop-out rate observed for Penta1 – Penta3 (51.30%) and BCG – Measles (44.50%) indicates that children were being dropped out and not immunized as they grow older. The immunization coverage showed a decrement from the first doses of vaccine to the third doses of vaccines which in line with a study conducted in Addis Ababa [20] but slight increment was seen in the last doses of measles and yellow.

The findings of this study were quite the same and consistent with other literatures as reported by Odusanya et al. [6]. People with secondary and higher educational qualification tend to immunize their children more than people without education. This could be highly educated mothers will be more aware of the importance of vaccine thus understand dynamics and dangers of not immunizing their children and hence be aware of the need for immunizing their children. As a result of this, their children tend to receive full immunization.

Furthermore, children delivered at health facilities were more likely to be fully vaccinated than those delivered at home. This is similar to the study in Ethiopia in which children delivered at home were less likely to complete immunization [20]. It was documented that children who were delivered at health institution received the first dose of vaccination just after birth. Similarly, children of mothers who attended ANC during pregnancy were more likely to be fully immunized compared to mothers who did not attend ANC.

5. Conclusion

The immunization coverage rate among children 12-23 months in the rural areas of Birnin Kudu LGA Jigawa State Nigeria was 16.7%: this was extremely low and below the national target of at least 80% for all antigens. The factors that determine immunization uptake in this study included maternal educational status, presence of health facility in the settlements, ANC attendance during the last pregnancy, place of delivery as well as household income. It was recommended that the community supported by the State Ministry of Health and the State Ministry of Information should embark on focused public enlightenment and health education activities on the benefits of routine immunization and ANC attendance: as well as encouraging intending mothers to deliver at hospital. More hospitals should be built within PHC requirements.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors have declared no conflict of interest

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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