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Original Research

Correlates of Uptake of Routine Immunization amongst Under-Five Children: Comparison of Nomadic and Non-nomadic Fulani in Yobe State, Nigeria

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Abstract

Background: Immunization is an important public health intervention that reduces morbidity and mortality associated with vaccine-preventable diseases (VPDs). This study aimed to determine and compare the correlates of routine immunization uptake among under-five children of nomadic and non-nomadic Fulani in Yobe State, Nigeria.
Methodology: A multistage sampling technique was used to study the eligible caregivers and under-five children in the selected households using an interviewer-administered questionnaire, observation for the child immunization card, or a recall of immunization history. Data were analysed using IBM SPSS version 22.0 with a statistical significance set at p≤5%.
Results: The response rate among nomadic and non-nomadic Fulani was (348/348, 100% vs. 345/348, 99%).The Penta 1 uptake based on routine immunization cards among nomadic and non-nomadic under-five children was (23.6% vs.76.4% P<0.001).Availability of the vaccine (adjusted odds ratio = 22, 95% confidence interval = 13.7–35.5), the purpose of vaccination (adjusted odds ratio = 1.9, 95% confidence interval = 1.1–3.4), vaccines safety (adjusted odds ratio = 17.3, 95% confidence interval = 10.0–29.8), and friendly healthcare workers (adjusted odds ratio = 18.8, 95% confidence interval = 11.3–31.3) were found to be independent predictors facilitating uptake of routine immunization among nomadic and non-nomadic under-five children, while long distance to the health facility (adjusted odds ratio = 9.6, 95% confidence interval = 6.6–14.0), lack of knowledge on immunization (adjusted odds ratio = 2.1, 95% confidence interval = 1.4–2.9), fear of side effect (adjusted odds ratio = 1.6, 95% confidence interval = 1.1–2.5), were independent barriers to uptake of routine immunization among nomad and non-nomadic under-five children.
Conclusions: Vaccine uptake is still a problem among nomads and non-nomadic under-five children. The government and relevant stakeholders should ensure a strategy for improved outreach services to all the nomads and hard-to-reach settlements.

Keywords: Routine Immunization; Facilitators; Barriers; Nomads; Non-Nomads; Yobe, Nigeria.

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Introduction

Immunization is one of the cost-effective and highly successful public health interventions capable of reducing morbidity and mortality due to vaccine-preventable diseases (VPDs). Before the advent of the global immunization programs, of the estimated 125 million children born every year worldwide, approximately 12 million, or nearly 10%, die before reaching their first birthday with the majority occurring in developing countries. [4] It was found that 67 million measles cases occurred every year in developing countries resulting in more than 2 million mortalities, and fifty-one million cases of pertussis with 600,000 mortalities.[5] Furthermore, over 800,000 tetanus-related deaths among newborn babies were reported,[5]while tuberculosis had more than 10 million cases; out of which, about 2 million were children under the age of five.[5]

It was noted that children with a high birth order, those living in rural areas, low socioeconomic background, and children from large households had significantly lower immunization coverage levels than children from other groups, similarly, higher birth order, delivery at home increased the risk of non–immunization significantly. [6,7] Researchers identified limited knowledge of specific diseases, including lack of education, more generally, and limited familiarity with, and value of formal health services to prevent and treat disease, as barriers to immunization and health services uptake.[8] Nomadic populations face significant challenges regarding access to health services. [8] The nomadic communities' cultural beliefs and practices are linked with the uptake and utilization of immunization and other essential services.[9] The factors linked to the uptake of immunization amongst the nomads are limited transportation infrastructure, poor service quality, prevalent traditional/cultural practices, and women's low decision-making power. [10]

According to the global projection, approximately 34 million children especially in developing countries including Nigeria are still not fully vaccinated despite the availability of the vaccines.[11] A global target to reduce morbidity and mortality related to VPDs requires combined efforts by the government, communities, partners, and the private sectors.[12] A fully immunized child sounds ambitious but is a practical and achievable indicator that should be used to measure the health progress of any country.[13] A major strategy to reduce VPDs is ensuring a good communication plan with well-defined and organized strategies that will ensure fully immunized children in all the settlements.[14] The partially and un-immunized children are potential obstacles to achieving herd immunity to various VPDs and are the major factors causing resurgences of VPDs, high infant mortality rates, and a high burden of health facility admissions resulting in increased demand on available health facilities and other resources.[15] Nigeria was reported to contribute significantly to the global burden of unimmunized children.[16] In Northern Nigeria, the likelihood of a child having full immunization increases with parental knowledge, understanding, and the frequency with which mothers seek health care.[17,18]

There is a general lack of studies on the correlations of uptake of routine immunization among nomadic and non-nomadic under-five children. Similarly, the existing national and international borders in Yobe State provide unrestricted movement of nomads in the state, constituting temporary settlements across various Local Government Areas (LGAs) of the state. This facilitates interaction with the members of the host communities and could provide a good interaction ground capable of transmitting or acquiring infection if not vaccinated. Furthermore, there is a paucity of comparative studies conducted among nomads and non-nomads nationally and internationally. This study therefore sets out to find and compare the facilitators and barriers to uptake of routine immunization among nomads and non-nomads in Yobe State. The finding could potentially influence policy on immunization programs and border immunization activities and control of outbreaks of VPDs, more so, it could provide baseline data for future research.

Methodology

Ethical approval

The permission to conduct this study was obtained from the Health Research Ethics Committee of the Yobe State Ministry of Health with registration number MOH/GEN/747/VOL1 dated 24thAugust, 2023. All the principles of research ethics in dealing with human subjects were strictly adhered to throughout the conduct of this research.

Study Area

Yobe State is one of the 36 States of Nigeria and covers 47,153 km^2 with a projected population of 3,749,600 in 2024 based on the population growth rate of the 2006 National Population Census. [17,20] The state has 17 Local Government Areas (LGAs) with some LGAs sharing borders to the west with Jigawa and Bauchi States, Gombe and Borno States to the south-east and an international boundary of 323 km with the Niger Republic to the north. The borders provide free movement of nomadic Fulani from within and outside the country. The LGAs reported to have a higher influx of nomads over the last two years were Bursari, Yunusari, Fune, and Geidam respectively.

The nomads and their children are provided with essential health and other services including routine and supplemental immunization services throughout their stay at the LGAs. They also interact with the people of the host and nearby communities for business and other social activities. Furthermore, the basis for their movement is for rearing of their animals and farming activities.

Study design and population

A comparative cross-sectional design was used to study the eligible respondents. The criteria for inclusion include: households/nomadic with at least one child aged 0-59 months, present for at least 6 months in the settlement/study area, and the caregivers should be living with the child for a minimum of 6 months, while the households with no under-fives, the caregivers who were absent during the data collection process and those whose children were seriously unwell or not at home during the data collection process were excluded from the study.

Sample size estimation

The sample size was calculated using a formula for comparing two proportions. [21]

$$n = \frac{(Z\alpha + Z_1\text{-}\beta)^2 [P_1 (1-P_1) + P_2 (1-P_2)]}{(P_1-P_2)^2}$$

Using:

n = Minimum sample size for each group, Z_α = Value of the standard normal deviate corresponding to a 5% level of significance. The value obtained from the normal distribution table = 1.96, $Z1_{-\beta}$ = Standard normal deviate corresponding to the probability of type II error (β)of Power at 80%=0.84 (obtained from normal distribution table), P_1 = Proportion for nomadic willingness to accept vaccines = (87.1%) = 0.871.[22], P_2 =Proportion for non-nomadic with measles uptake coverage at 9 months of (78.6%) = 0.786.[22], ($P_1 – P_2$) = Minimum difference in proportion (0.871 – 0.786 = 0.085)

$$n = \frac{(1.96 + 0.84)^2 \{0.877(1- 0.871) + 0.786(1-0.786)}{(0.871 – 0.786)^2}$$

$$n = \frac{(2.8)^2 \{0.11) + 0.17\}}{0.007}$$

n = 314

Up to 10% of the calculated sample size was added to account for possible non-response, therefore the estimated minimum sample size was 348 per study arm among nomadic and non-nomadic communities.

Participant's selection
A multistage sampling technique consisting of five stages was used to study the eligible respondents.

Stage one: Selection of the LGAs
The list of the LGAs with the highest clusters of nomadic and non-nomadic Fulani was obtained (Geidam, Bursari, Fune, Geidam LGAs) from which Yunsari LGA was randomly selected by simple balloting.

Stage two: Selection of the Political Wards
The list of all the 10 political wards of the selected LGA was obtained from the LGA headquarters, from which three political wards were randomly selected by balloting.

Stage three: Selection of the settlements
The lists of all the nomadic and non-nomadic settlements were obtained for each of the selected political wards from which 25% of the total settlements were selected by balloting.

Stage four: Selection of households
The sample size was equally allocated to each of the selected nomadic and non-nomadic settlements. House numbering in the non-nomadic settlements, census, and temporary shelter numbering for nomadic were conducted. The numbering was done from the centrally identified location of the settlement, moving rightward. The total number of households in the settlements was the sampling frame of that settlement. The sampling interval was obtained as the ratio of the sampling frame (total number of households in the selected settlement) to the equally allocated sample size in the settlement. The first household to be studied was obtained by balloting using the numbers within the calculated sampling interval for each settlement. Thereafter, the subsequent households for the study were obtained by adding the calculated sampling interval for that settlement until the equally allocated sample size was obtained.

Stage four: Selection of respondents
In each of the selected households, one eligible mother/caregiver was studied, where the households consisted of more than one caregiver and their children, balloting was conducted to select one out of the total number of caregivers/children.

Data collection
The data for this study were collected using two instruments a pre-tested semi-structured interviewer-administered adapted, [1-13,22] questionnaire was used to collect data from the caregivers of the selected households, while immunization record cards checking or recalls of the immunization status of the selected child were used to collect secondary data. The questionnaire had section A consisting of the socio-demographic characteristics of the child and the caregivers. Section B sought information about the child and the immunization status. Section C identified the facilitators to the uptake of immunization in the communities and section D identified the barriers to the uptake of immunization. The secondary data was obtained by checking out the under-five children's immunization record cards for immunization uptake status, and the information collected from each caregiver was appropriately documented in the spaces provided in the questionnaire for secondary data entry.

The data were collected by trained Community Health Extension Workers (CEWS) who were familiar with the study area, with previous experience in data collection for community-based surveys. They were

trained on the research protocol including ethics in dealing with human subjects, after which 40 questionnaires were pre-tested among nomadic and non-nomadic communities outside the state, and appropriate modifications were made where necessary.

Data analysis and measurement of variables

Data collected from the field was entered into a Microsoft Excel spreadsheet and analyzed using IBM SPSS Statistics for Windows, version 22.0. Armonk, NY, USA: IBM Corporation. The numerical variables were summarized using mean and standard deviation (SD) or median and interquartile range as appropriate, while categorical variables were summarized using frequencies and percentages. The outcome variable was categorized as (nomadic and non-nomadic) while the facilitators and barriers to the uptake of the uptake of routine immunization were the independent variables.

Nomadic Fulani were defined as herders who move from one place to another due to spatial-temporal variability in pasture and water availability through carefully calculated and organized herd movements. They usually construct a temporary settlement in the identified area, usually outside the host community.[22] Non-nomad Fulani are settled Fulani who usually keep smaller herds than those found in nomadic Fulani because they no longer rely solely on livestock and depend on an identified grazing area that can be reached from their villages within a day. They do not depend on seasonal movement and are sometimes integrated into the host communities.[22]

The proportions were compared using Pearson's Chi-squared test between the outcome and socio-demographic characteristics, immunization uptake by immunization card evidence, immunization uptake by recall, the facilitators, and barriers to immunization uptake respectively at 5% α-level of significance. Binary logistic regression was used to determine correlations of routine immunization uptake.

Results

Socio-demographic Characteristics of the Child and Caregiver

The response rate among nomadic and non-nomadic Fulani was (348/348, 100% vs. 345/348, 99%). The maximum age of the nomadic and non-nomadic caregivers was (60 vs. 78) and the minimum was (17 vs 17) years with a mean ±SD of (28.2±7.7 vs.33.0±10.0) years. The minimum age of the children of nomadic Fulani surveyed was one month and the maximum was 50 months with a median age of 18 months, IQR (21.5, 31.0) months. The minimum age of the children of non-nomadic Fulani surveyed was two months and the maximum was 56 months with a mean ±SD 28.0±12.6 months. The maximal birth order of the nomadic and non-nomadic children was (9 vs. 10) and the minimal was (1vs1) with a mean ±SD of (4±1.7 vs.4.5±1.6).

The caregivers of nomadic children and non-nomadic who were less than 24 years of age were (66.7% vs. 33.3%). The proportion of female children among nomadic and non-nomadic was (49.8%vs. 50.2%), while the proportions of the husbands of nomadic and non-nomadic caregivers with no form of education were (80.8% vs. 19.2%), monthly income less than #18,000 per month (56.9% vs. 43.1%), while the proportions of civil servants were (3.8% vs. 96.2%). Similarly, the proportion of caregivers of nomadic and non-nomadic children who were full-term housewives was (52.4% vs47.6%), with a monthly income of less than #18,000 per month (50% vs.50%) (Table 1a and 1b).

Table 1a: Socio-demographic Characteristics of the Child and Caregivers

Variable	**n=345 (%)**	**n=348(%)**				
	Nomadic	**Non-Nomadic**	**χ^2**	**p-value**	**aOR (95% CI)**	**P-value**
Age of the caregiver (years)						
<24	118(66.7)	59(33.3)	52.0	<0.001*	2.3 (1.9-3.0)	<0.001*
24-35	185(51.2)	176(48.8)				
>35 (Reference)	42(27.1)	113(72.9)			1	
Sex of the child						
Male	96(49.7)	97(50.3)	0.1	1.0	0.9 (0.7-1.4)	1.0
Female (Reference)	249(49.8)	251(50.2)			1	
Religion						
Islam	344(49.7)	348(50.3)		†0.5		
Christianity (Reference)	1(100)	0(0)			1	
Respondents Highest Educational Qualification						
None	238(62.8)	141(37.2)		†<0.001*		
Quranic	1(2.5)	39(97.5)				
Primary	106(45.5)	127(54.5)				
Secondary	0(0)	40(100)				
Tertiary (Reference)	0(0)	1(100)			1	
Husband's Highest Educational Qualification						
None	160(80.8)	38(19.2)		†<0.001*		
Quranic	185(44.7)	229(55.3)				
Primary	0(0)	10(100)				
Secondary	0(0)	29(100)				
Tertiary (Reference)	0(0)	42(100)			1	
Husbands Occupation						
Civil servant	1(3.8)	25(96.2)		†<0.001*		
Business	0(0)	49(100)				

Farming/animal rearing	339(55.8)	269(44.2)				
Petty trading	0(0)	1(100)				
None (Reference)	5(55.6)	4(44.4)			1	
The primary occupation of the caregiver						
Housewife	323(52.4)	294(47.6)		†<0.001*		
Trading	0(0)	28(100)				
Farming	22(51.2)	21(48.8)				
Teaching	0(0)	2(100)				
Student (Reference)	0(0)	3(100)			1	
Monthly income of caregiver(naira)						
<18,000	345(50)	345(50)		†0.1		
≥18,000	0(0)	3(100)				
The monthly income of the husband						
<18,000	345(56.9)	261(43.1)		†<0.001*		
≥18,000	0(0)	87(100)				

* Statistically significant, Fishers exact, aOR =Adjusted odds Ratio, CI=Confidence Interval, blank cells=Invalid for regression analysis

Table 1b: Socio-demographic Characteristics of the Child and Caregivers

Variables	**n=345**	**n=348**				
	Nomadic	**Non-nomadic**	**χ^2**	**P-value**	**aOR (95% CI)**	**P-value**
Marital status						
Single	3(33.3)	6(66.7)		†0.01*	3.8 (0.4-18.5)	0.12
Married	291(48.3)	311(51.7)				
Divorced	23(74.2)	8(25.8)				
Widowed	19(65.5)	10(34.5)				
Separated (Reference)	9(14.9)	13(59.1)			1	
Relationship with the child						
Mother	282(52.0)	260(48.0)		†0.01*	0.6 (0.4-0.9)	0.01*
Stepmother	41(38.7)	65(61.3)				
Aunty	1(33.3)	2(66.7)				
Grandmother	21(56.8)	16(43.2)				

Elder sister (Reference)	0(0)	5(100)			1	
Mode of transport to the health facility						
Walk on foot	344(63.1)	209(36.9)		†<0.001*	1.7 (0.1-27.5)	0.7
Bus	1(50.0)	1(50.0)				
Motorcycle	0(0)	14(100)				
Private vehicle (Reference)	0(0)	1(100)			1	
Availability of child's vaccination cards						
Yes	102(28.3)	258(71.7)	137.9	<0.001*	0.1 (0.1-0.2)	<0.001*
No (Reference)	243(73.0)	90(27.0)			1	
Place of vaccination						
Health facility	0(0)	82(100)	642.4	<0.001*	2445 (744-8029)	<0.001*
Health facility and outreach	9(3.3)	262(96.7)				
Outreach (Reference)	336(98.8)	4(1.2)			1	
Private clinic						
Others						
Husband/father accompanies for immunization.						
Yes	33(20.1)	131(79.9)	75.6	†0.001*	0.2 (0.1-0.3)	<0.01*
No (Reference)	312(59.0)	217(41.0)			1	
Willingness to accept any immunization						
Yes	255(44.0)	324(56.0)	46.4	<0.001*	0.2 (0.1-0.3)	<0.001*
No(Reference)	90(78.9)	24(21.1)			1	
Marriage type						
Monogamous	146(45.6)	174(54.4)	4.1	0.04*	1.4 (1.0-1.8)	0.04*
Polygamous (Reference)	199(53.4)	174(46.6)			1	
Family type						
Nuclear	137(44.5)	171(55.5)	6.2	0.01*	0.7 (0.5-0.9)	0.01*
Extended	208(54.0)	177(46.0)			1	

* Statistically significant, Fishers exact, aOR =Adjusted odds Ratio, CI=Confidence Interval

A significantly higher proportion of nomadic caregivers compared with non-nomadic were divorced (74.2% vs. 25.8%, P=†0.01). The proportion of the nomadic and non-nomadic children under the care of their aunties was (33.3% vs. 66.7%, P=†0.01), while the proportion of nomadic and non-nomadic caregivers who walked by foot to the health facility for immunization were (63.1% vs. 36.9%, P=†<0.001), availability of child immunization card (28.3% vs. 71.7%, P<0.001), husband accompanied the caregivers with the child for immunization (20.1% vs.79.9%, P<†0.001). Similarly, the proportion of nomadic and non-nomadic caregivers who expressed willingness to receive vaccines for their children was (44.0% vs. 56.0%, <0.001) (Table 2).

Table 2: Distribution of Antigen Received Based on Child Immunization Cards Observation

Variable	**n=345 (%)**	**n=348(%)**			**aOR (95% CI)**	**P-value**
	Nomadic	Non-Nomadic	χ^2	p-value		
BCG(at birth)	108(29.1)	263(70.9)	137.3	<0.001*	0.1 (0.10-0.10)	<0.001*
OPV0(at birth)	85(25.8)	244(74.2)	147.5	<0.001*	0.3 (0.10-0.50)	<0.001*
Pentavalent 1 (at 6 weeks)	77(23.6)	249(76.4)	168.6	<0.001*	0.1 (0.10-0.30)	<0.001*
OPV1(at 6 weeks)	75(23.1)	249(76.9)	172.7	<0.001*	0.1 (0.06-0.20)	<0.001*
PCV1 (at 6 weeks)	77(23.6)	249(76.8)	168.6	<0.001*	0.1 (0.06-0.24)	<0.001*
Pentavalent 2 (at 10 weeks)	62(21.7)	224(78.3)	165.1	<0.001*	0.1 (0.10-0.40)	<0.001*
OPV 2 (at 10 weeks)	62(21.8)	223(78.2)	162.5	<0.001*	0.1 (0.10-0.40)	<0.001*
PCV 2 (at 10 weeks)	62(21.8)	223(28.2)	162.5	<0.001*	0.2 (0.10-0.40)	<0.001*
Pentavalent 3 (at 14 weeks)	65(22.7)	221(77.3)	154.9	<0.001*	0.1 (0.10-0.20)	<0.001*
OPV 3 (at 14 weeks)	64(22.5)	221(77.5)	157.6	<0.001*	0.3 (0.20-0.40)	<0.001*
PCV 3 (at 14 weeks)	65(22.7)	221(77.3)	154.9	<0.001*	0.3 (0.20-0.40)	<0.001*
Measles (at 9 months)	90(28.0)	231(72.0)	139.8	<0.001*	0.7 (0.40-1.30)	<0.001*
Measles booster (at 18 months)	26(33.8)	51(66.2)	131.8	<0.001*	1.3 (0.80-2.30)	<0.001*

***** Statistically significant, Fishers exact, aOR =Adjusted odds Ratio, CI=Confidence Interval

Distribution of Antigens Received among Nomadic and Non-Nomadic Children

Using the child immunization card, a significantly lower nomadic under-five children received BCG at birth (29.1% vs.70.9%, P<0.001), Penta 1 at 6 weeks (23.6% vs.76.4% P<0.001), Penta 2 at 10 weeks (21.8% vs. 78.2%, P<0.001), Penta 3 at 14 weeks (22.7% vs.77.3%, P<0.001), measles-1 at 9 month (28.0% vs.72.0, p<0001) and measles-2 at 18 months (33.8% vs. 66.2%, P<0.001) compared with non-nomadic under-five children (Table 2). Uptake of routine immunization by recall revealed that a significantly higher proportion of nomadic under-five children received BCG at birth (58.3% vs.41.7%, P<0.001), Penta 2 at 10 weeks (64.0% vs. 36.0%, P<0.001), Penta 3 at 14 weeks (73.3% vs.26.6%, P<0.001), measles-1 at 9 months (61.2% vs.38.8%, p<0001) compared with non-nomadic under-five children. However, a significantly lower proportion of nomadic under five received Penta 1 at 6 weeks (43.5% vs.56.5% P<0.001), and measles-2 at 18 months (20.0% vs. 80.0%, P<0.001) (Table 3).

Table 3: Distribution of Antigen Received Based on Recall

Variable	n=345 (%)	n=348(%)				
	Nomadic	Non-Nomadic	χ^2	P-value	aOR (95% CI)	P-value
BCG (at birth)	77(58.3)	55(41.7)	162.5	<0.001*	3.5 (2.30-5.30)	<0.001*
OPV0(at birth)	24(33.3)	48(66.7)	198.7	<0.001*	1.2 (0.70-2.10)	<0.001*
Pentavalent (at 6 weeks)	28(43.1)	36(56.9)	173.0	<0.001*	1.8 (1.10-3.10)	0.03*
OPV1(at 6 weeks)	30(43.5)	39(56.5)	171.2	<0.001*	1.9 (1.10-3.20)	0.02*
PCV1 (at 6 weeks)	29(43.3)	38(56.7)	173.1	<0.001*	1.8 (1.10-3.10)	0.03*
Pentavalent 2 (at 10 weeks)	16(64.0)	9(36.0)	143.2	<0.001*	4.4 (1.90-10.20)	0.001*
OPV 2 (at 10 weeks	16(69.6)	7(30.4)	140.5	<0.001*	5.6 (2.90-15.40)	<0.001*
PCV 2 (at 10 weeks)	16(69.6)	7(30.4)	140.5	<0.001*	6.7 (2.90-15.40)	<0.001
Pentavalent 3 (at 14 weeks)	22(73.3)	8(26.7)	138.6	<0.001*	5.8 (2.60-12.90)	<0.001*
OPV 3 (at 14 weeks)	22(71.0)	9(29.0)	135.4	<0.001*	5.3 (2.40-11.50)	<0.001*
PCV 3 (at 14 weeks)	22(68.8)	10(31.2)	139.1	<0.001*	3.8 (2.50-5.80)	<0.001*
Measles (at 9 months)	74(61.2)	47(38.8)	147.1	<0.001*	0.6 (0.20-1.90)	0.4
Measles booster (at 18 months)	4(20.0)	16(80.0)	170.0	<0.001*	23.8 (11.5-48.9)	<0.001*

* Statistically significant, Fishers exact, aOR =Adjusted odds Ratio, CI=Confidence Interval

Facilitators of Uptake of Routine Immunization

A significantly higher proportion of the nomads (51%, p=0.03) reported the purpose of vaccination as an important facilitator for their uptake of routine immunization. Similarly, a significantly higher proportion of nomads acknowledged vaccine safety (63.5%, p<0.001), vaccines were given freely (70.1%, P<0.001), vaccines were readily available (70.5%, p<0.001), and provision of incentives after vaccination (51.1%, p<0=0.003) as important facilitators of uptake of routine immunization (Table 4). Availability of the vaccine (adjusted odds ratio = 22, 95% confidence interval = 13.7–35.5), purpose of vaccination (adjusted odds ratio = 1.9, 95% confidence interval = 1.1–3.4), safety (adjusted odds ratio = 17.3, 95% confidence interval = 10.0–29.8), freely given (adjusted odds ratio = 28.7,95% confidence interval = 16.8–48.8), and friendly healthcare workers (adjusted odds ratio = 18.8, 95% confidence interval = 11.3–31.3) were found to be independent predictors of uptake of routine immunization among nomadic and non-nomadic under-five children (Table 4).

Barriers to Uptake of Routine Immunization

The reported barriers among the nomadic and non-nomadic under five were: Hospitals being far from the settlement (68.5% vs. 31.5%), local clinics not providing immunization services (66.2% vs. 33.8%), fear of side effects due to the vaccine (51.8% vs. 48.2%), caregiver's busy schedule (75.6% vs. 24.4%), child too young to receive injections (74.1% vs. 25.9%). A significantly higher proportion of nomads reported not aware of where to receive the vaccination (64.4%, p<0.001), lack of outreach services (81.7%, p<0.001), influence of culture and tradition (65.5%, p<0.001), not permitted by husband to go for vaccination (57.4%, p<0.001), cost of transportation to the health facility for immunization were important barriers to uptake of routine immunization (Table 5).

Table 4: Facilitators to uptake of immunization among respondents

Variable	n=345(%)	n=348(%)				
	Nomadic	**Non-nomadic**	**χ^2**	**P-value**	**aOR (95% CI)**	**P-value**
Purpose of vaccination						
Yes	326(51.0)	313(49.0)	5.0	0.03*	1.9 (1.1-3.4)	0.03*
No (Reference)	19(35.2)	35(64.8)			1	
Help a child to grow						
Yes	326(49.0)	339(51.0)	3.8	0.05*	0.5 (0.2-1.0)	0.1
No (Reference)	19(67.9)	9(32.1)			1	
Protecting a child from diseases						
Yes	330(49.4)	338(50.6)	1.1	0.3	0.7 (0.3-1.5)	0.3
No (Reference)	15(60.0)	10(40.0)				
Gives a child strength						
Yes	331(49.7)	335(50.3)	0.04	0.8	0.9 (0.4-2.0)	0.8
No (Reference)	14(51.9)	13(48.1)				
Safety						
Yes	329(63.5)	189(36.5)	154.7	<0.001*	17.3 (10.0-29.8)	<0.001*
No (Reference)	16(9.1)	159(90.0)			1	
Freely given						
Yes	328 (70.1)	140(29.9)	237.7	<0.001*	28.7 (16.8-48.8)	<0.001*
No (Reference)	17(7.6)	208(92.4)			1	
Readily available						
Yes	322(70.5)	135(29.5)	229.5	<0.001*	22 (13.7-35.5)	<0.001*
No (Reference)	23(9.7)	213(90.3)			1	
Healthcare workers are friendly						
Yes	326(66.3)	166(33.7)	184.2	<0.001*	18.8 (11.3-31.3)	<0.001*
No (Reference)	19(9.5)	182(90.5)			1	
Good knowledge of immunization						
Yes	327(55.1)	266(44.9)	47.2	<0.001*	5.6 (3.3-9.6)	<0.001*

No (Reference)	18(18.0)	82(82.0)			1	
Provided with incentives						
Yes	335(51.1)	320(48.9)	8.9	0.003*	2.9 (1.4-6.1)	0.004*
No (Reference)	10(26.3)	28(73.7)			1	

* Statistically significant, Fishers exact, aOR =Adjusted odds Ratio, CI=Confidence Interval

'Long distance to the health facility (adjusted odds ratio = 9.6, 95% confidence interval = 6.6–14.0), lack of knowledge on immunization (adjusted odds ratio = 2.1, 95% confidence interval = 1.4–2.9), fear of side effect (adjusted odds ratio = 1.6, 95% confidence interval = 1.1–2.5), culture and tradition (adjusted odds ratio = 2.8, 95% confidence interval = 2.0–3.9), not permitted by the spouse (adjusted odds ratio = 1.8, 95% confidence interval = 1.3–2.5) were independent barriers to uptake of routine immunization among nomad and nomad under-five children (Table 5).

Table 5: Barriers to Uptake of Routine Immunization among Respondents

Variable	**n=345(%) Nomadic**	**n=348(%) Non-nomadic**	**χ^2**	**P-value**	**aOR (95% CI)**	**P-Value**
Not aware of the need for vaccination						
Yes	285(54.0)	243(46.0)	15.6	<0.001*	2.1 (1.4-2.9)	<0.001*
No (Reference)	60(36.4)	105(63.6)			1	
Do not know where to receive						
Yes	217(64.4)	120(35.6)	56.0	<0001*	3.2 (2.4-4.4)	<0.001*
No (Reference)	128(36.0)	228(64.0)			1	
The hospital is far away from home						
Yes	298(68.5)	137(31.5)		†<0.001*	9.6 (6.6-14.0)	<0.001*
No	47(18.4)	208(81.6)				
No response (Reference)	0(0)	3(100)			1	
Local clinics do not provide immunization						
Yes	43(66.2)	22(33.8)	7.7	0.006*	2.1 (1.2-3.6)	0.01*
No (Reference)	302(48.1)	326(51.9)			1	
No one comes to our village						
Yes	152(81.7)	34(18.3)	103.7	<0.001*	7.3 (4.8-11.0)	<0.001*
No (Reference)	193(38.1)	314(61.9)			1	
Fear of side effects of the vaccine						
Yes	299(51.8)	278(48.2)	5.7	0.02*	1.6 (1.1-2.5)	0.02*
No (Reference)	46(39.7)	70(60.3)			1	
Busy schedule						
Yes	220(75.6)	71(24.4)	133.8	<0.001*	6.9 (4.9-9.7)	<0.001*
No (Reference)	125(31.1)	277(68.9)			1	
Children not old enough for injection						
Yes	295(74.1)	103(25.9)	221.5	<0.001*	14 (9.6-20.5)	<0.001*

No (Reference)	50(16.9)	245(83.1)			1	
Clinics collect charges for vaccine						
Yes	42(73.7)	5(26.3)	14.2	<0.001*	3.1 (1.7-5.7)	<0.001*
No (Reference)	303(47.6)	333(52.4)			1	
Culture and tradition						
Yes	157(66.5)	79(33.5)	40.1	<0.001*	2.8 (2.0-3.9)	<0.001*
No (Reference)	188(41.1)	269(58.9)			1	
Religion						
Yes	28(41.8)	39(58.2)	1.9	0.2	0.7 (0.4-1.2)	0.2
No (Reference)	317(50.6)	309(49.4)			1	
Not permitted by husband						
Yes	195(57.4)	145(42.6)	15.3	<0.001*	1.8 (1.3-2.5)	<0.001*
No (Reference)	150(42.5)	203(57.5)			1	
Cost of transportation						
Yes	293(61.3)	185(38.7)	81.7	<0.001*	5 (3.4-7.1)	<0.001*
No	52(24.2)	163(75.8)				

* Statistically significant, Fishers exact, aOR =Adjusted odds Ratio, CI=Confidence Interval

Long distance to the health facility (adjusted odds ratio = 9.6, 95% confidence interval = 6.6–14.0), lack of knowledge on immunization (adjusted odds ratio = 2.1, 95% confidence interval = 1.4–2.9), fear of side effect (adjusted odds ratio = 1.6, 95% confidence interval = 1.1–2.5), culture and tradition (adjusted odds ratio = 2.8, 95% confidence interval = 2.0–3.9), not permitted by the spouse (adjusted odds ratio = 1.8, 95% confidence interval = 1.3–2.5) were independent barriers to uptake of routine immunization among nomad and nomad under-five children (Table 5).

Discussion

Immunization against preventable diseases of childhood is an important intervention that is critical in preventing child morbidity and mortality worldwide. [1-5] It is noteworthy that VPDs are up to date the commonest and leading cause of under-five mortality and morbidity in Africa, including Nigeria, and Asia. It is also worrisome that, these vaccines are readily available at minimal or no cost and proven to be effective in providing the desired herd immunity needed to prevent the outbreak of these diseases, but uptake of the vaccines is still a major challenge, especially among nomads. In a similar development, the nomadic Fulani are mobile, in search of food for their animals, they are to identify such areas for temporary shelter and usually relocate to other areas when they cannot obtain the required food for their animals. While they are provided with basic health and other services similar to the members of the host communities, it is not unlikely that there are existing drivers or barriers to access to routine immunization services for their eligible children.

The uptake of all the antigens in line with the Nigerian immunization schedule was found to be higher among the non-nomads, this is not unrelated to their permanent residence near health facilities and other social services including amenities. This study identified more nomads to provide information related to the immunization status of their children using recall which was not unconnected with their movement from one place to another which could result in misplacement of the cards. For example, a study conducted in Kenya reported the proportion of fully vaccinated children among the nomads and non-nomads to be (11.6% vs.50.3%).[22] Though our findings were significantly better than this report, the disproportionate, and significantly higher coverage among the non-nomads is comparable to our findings

of higher coverage using both the immunization cards and recalls by the caregivers, which applied to all the antigens. This result can be linked to the movement nature of the nomads which could result in missed antigens. The implication of this is decreased herd immunity among the nomads which could result in an outbreak of diseases locally within their communities and can potentially result in widespread outbreaks due to cross-border activities nationally and internationally.

Similarly, the nomads were more convinced of the safety, availability, and free vaccines as important reasons for accepting the vaccine than the non-nomads. This signifies that hesitancy related to vaccine safety and quality is not a major barrier to uptake and therefore underscores the importance of outreach sessions to the nomadic settlements, especially in Yobe State known to have some pockets of security challenges that can limit movement for immunization services.

An important reported facilitator related to incentives was reported among nomads in this study. While some stakeholders, especially the non-governmental organizations, are in the country supporting immunization services uptake, sustainable models must be used for routine immunization interventions. For example, it will be more sustainable to provide health education on the importance the vaccines and improve the existing outreach services rather than using incentives to influence uptake. These are more sustainable approaches by the government and the communities that can be achieved with minimal resources and could significantly improve the confidence of the people regarding the vaccine's safety.

The barriers related to the uptake were like the report by a study conducted in the Democratic Republic of Congo.[23] Notably, the social factors attributable to poor knowledge of the need for and or where and when to receive the vaccination, especially among the nomads, and distance from the facilities providing immunization services. This particularly highlighted the weakness of the outreach services conducted in the areas that should be targeted towards reaching all the temporary, hard-to-reach, and far-to-reach areas. The services should also provide a platform for understanding the importance of immunization. In line with this, all the relevant stakeholders should therefore ensure regular and timely mapping of nomadic Fulani settlements and should be appropriately included in the reaching every ward and settlement routine immunization plans by the appropriate catchment health facilities.

Other barriers reported by the two categories were similar to qualitative research conducted in Ethiopia and other African countries,[8] like attitude of the healthcare workers, side effects of the vaccines, information being provided by health workers, irregularities in service provision, suboptimal staff motivation, distance to the health facilities, lack of functional health facilities, limited hours and days selected for the services, and gender norms of dedicating only females as responsible for childcare.[8,24] Similar finding was reported by a study conducted in Somalia.[10] More so, the influence of culture was reported to be more of a barrier among the nomadic Fulani compared with non-nomadic Fulani. More nomadic husbands were reported to stop their wives from taking their children for routine immunization and also reported collection of charges at the clinic as a potential barrier. While this can be attributable to the cost of transportation and other logistics from their settlements to the facility, it is also important to identify any potential points where money is collected for these services. This is because, all the public facilities in Nigeria provides free routine immunization services. Furthermore, addressing this barrier will improve immunization uptake among the two categories of the study population.

This study was able to identify and compare the facilitators and barriers among the nomads and non-nomads. Furthermore, this study has the additional strength of observing child immunization cards and using recalls where there was a history of missing cards. Though recall bias can occur, it was minimized by training the research assistants on eliciting good information on the timing and sites of administration of various antigens. However, the study is limited by a paucity of literature for comparison of findings across and within countries.

Conclusion

The uptake of immunization among nomads and non-nomads is suboptimal. The safety, effectiveness, and minimal cost were important facilitators influencing uptake among the nomads and non-nomads, while the distance to the health facilities, side effects of immunization, healthcare worker's attitude, and gender role assigned to the caregivers were reported barriers to uptake. The government and relevant stakeholders should develop strategies for improving the delivery of vaccines to all the nomads and other hard-to-reach settlements.

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