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Original Research

Prevalence and Factors Associated with Zero-Dose Children amongst Nomadic and Non-Nomadic Fulani in Yobe State, North-East Nigeria

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Abstract

Background: Immunization is a very cost-effective and readily available intervention capable of preventing Vaccines Preventable Diseases (VPDs). This study aimed to identify and compare the prevalence and factors associated with zero-dose immunization status among children of nomadic and non-nomadic Fulani in Yobe State, North-East Nigeria.

Methodology: A comparative cross-sectional design was used to study 348 nomadic, and 345 non-nomadic under-five children, selected using a multi-staged sampling technique. Data were collected using interviewer administered questionnaire, observation of child immunization card, and recall by the caregivers, and were analysed using IBM SPSS version 22.0 with a statistical significance set at P ≤5%.

Results: The maximum age of the nomadic caregivers was 60 and the minimum was 17 years with a mean ±SD of 28.2±7.7 years. The maximum age of the non-nomadic caregivers was 78 and the minimum was 17 years with a mean ±SD of 33.0±10.0 years. The prevalence of zero dose children among nomadic and non-nomadic Fulani were (70.1%, 242), (61.8%, 63) respectively. The zero-dose children were significantly higher among nomads (87.2%, p<0.001) and non-nomad (54.4%, p<0.001) with no available child immunization card.The children of vaccines hesitant caregivers of nomads and non-nomads were 10 or more times more likely to be zero dose than non-hesitant caregivers (adjusted odds ratio [aOR] =477, 95% CI = [177–13031]), and (Adjusted odds ratio [aOR] =9.7, 95% CI = [2.1–44.3]) respectively.

Conclusions: The burden of zero-dose was alarmingly high among nomads compared to non-nomad Fulani despite widespread immunization outreach services in the study area. The government and relevant stakeholders should intensify Context-specific health promotion activities and outreach services targeting these underserved populations.

Keywords: Nomads; Non-Nomads; Fulani; Prevalence; Zero-dose; Vaccine hesitancy; Yobe.

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Introduction

Despite the significant improvement in coverage of newly introduced vaccines in developing countries within the last two decades, effort to ensure that routine immunization services are at the doorstep of every community, and that all children are reached is faced with numerous challenges.[1] Many countries have below 90% routine immunization coverage set by the World Health Organization (WHO) if outbreaks of Vaccine Preventable Diseases (VPDs) are to be prevented.[1,2] Routine immunization service is an essential public health intervention capable of preventing morbidity and mortality associated with epidemics-prone diseases that can be prevented through vaccination.[3-5] Before implementation of the global immunization programs, about 10% children globally die yearly before their first year of life in developing countries.[6]

Achieving optimal immunization coverage among eligible children is a significant challenge in Nigeria, with reported coverage rates of 65% for diphtheria-tetanus-pertussis containing vaccine first dose (DTP1) and 57% for third dose for (DTP3) in 2020 respectively; and a figure ranging between 54–67 percent coverage rates estimated for other routine vaccination antigens.[7] Children that are unvaccinated are at increased risk of developing vaccine-preventable diseases. These children are mostly from a disadvantaged families and households affected by lack of access to basic health services, due to poverty, and sometimes man-made or natural disasters. [8]

The zero-dose children are those children who do not receive any vaccine in the national routine immunization schedule, while 'missed dose' children are those who do not complete scheduled routine immunization.[8] Similarly, children who do not receive Penta1 are usually used as an indicator for zero-dose children, while completing three doses of Penta vaccine before 12 months of age is a WHO's proxy indicator for performance of routine immunization program.[8] It is therefore essential that newborn babies receive their first dose of vaccines, because up to 80 % of those who received at least one dose of any vaccine will receive at least one more vaccine, and about two-thirds will go on to complete the full schedule.[9] Worldwide, 22.7 million under-five were estimated to be either zero- or missed-dose children, out of which, 3.1 million representing 14 % are in Nigeria.[10]

In a global drive to leave no child behind with immunization in the Sustainable Development Goals era, there is increasing interest in reaching "zero-dose" children worldwide.[11] In Nigeria, routine immunization was declared a Public Health Concern, In 2017, which resulted in setting up of the National Emergency Routine Immunization Coordination Centers (NERICC) at the national level, State Emergency Routine Immunization Coordination Centers (SERICC) and Local Government Emergency Routine Immunization Coordination Centers (LERICC) in low performing States, and Local Government Areas (LGAs) respectively.[8] Nigerian government and development partners are committed to improving the quality of immunization services to address the increasing risk of vaccine-preventable diseases like yellow fever, measles, and meningitis within the set transition period by the GAVI (2018 – 2028).[12] This aligns with the global targets such as the Immunization Agenda 2030 (IA2030) and GAVI's 5.0 strategy.[8]

The increasing security challenges in northern Nigeria especially in the north-east geo-political zone is an important risk for decrease immunization uptake resulting in higher burden of zero dose children. Similarly, Yobe State is faced with a significant security problem over the last decade. The state also shares borders with some states of the country, and international borders that facilitates the free movement of nomads from within and outside the country. Similarly, there is existing SERICC at the state, and LERICC at LGA levels targeted towards coordination and providing quality routine immunization services. A targeted strategy of Reaching Every Ward (REW) is in use, and micro plans are developed to meet the goal of the strategy to consist of all the settlement in each ward including new settlements that can facilitate identification and inclusion of nomad in the outreach sessions. More so, outreach sessions are planned monthly and being monitored as an importance performance indicator of routine immunization at the facility, ward and LGA levels in the State. Furthermore, there were reported cases of outbreaks of VPDs, notably, cholera, diphtheria, meningitis among others over the years, which can be potentially linked to cross-border activities and movements by nomads. This study therefore aimed to assess and compare the prevalence and factors associated with zero dose among nomads and non-

nomads in Yobe State, Nigeria. The finding could provide information to the relevant stakeholders on the performance of immunization services in the state.

Materials and Methods

Ethical approval

Ethical approval for 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 24th August 2023. Data were collected from September 2023 to January 2024. All the principles of research ethics in dealing with human subjects were strictly adhered to throughout the research.

Study area

Yobe State is one of the 36 States of Nigeria with a projected population of 3,749,600 in 2024 based on the population growth rate of the 2006 National Population Census.[12] The state has 17 Local Government Areas (LGAs) with some sharing borders to the west with Jigawa and Bauchi States, Gombe, and Borno States to the south-east and an international boundary with the Niger Republic to the north. The borders provide free movement of nomadic Fulani from within and outside the country. The LGAs in the State with reported higher influx of the nomads over the last two years were Bursari, Yunusari, Fune and Geidam. 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 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 study area, and the caregivers should be living with the child for a minimum of 6 months, while the households whose caregivers 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.

Nomadic Fulani are 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.[14] 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. [14]

Sample size estimation

An estimated minimum sample size of 348 per study arm among nomadic and non-nomadic communities was obtained using a formula for comparing two proportions. [13] Using the 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 willing to accept vaccines = (87.1%) = 0.871.[14], P_2 =Proportion for non-nomadic with measles uptake coverage at 9 month of (78.6%) = 0.786. [14] Up to 10% of the calculated sample size was added to account for possible non-response.

Participant's selection

A multistage sampling technique consisting of five stages was used to study the eligible respondents. In stage one (LGA selection), the list of the LGAs with highest clusters of nomadic and non-nomadic Fulanis was obtained (Geidam, Bursari, Fune, Geidam LGAs) from which Yunusari LGA was randomly by simple balloting. In stage two (political ward selection), the list of all the 10 political wards of the selected LGA was obtained from the local government headquarters from which three political wards were randomly selected by balloting.

In stage three (settlement selection), the list of all the nomadic and non-nomadic settlements was obtained for each of the selected political wards from which 25% of the total settlements were selected by balloting. In stage four (household selection), 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 settlement 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 conducting 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. In stage five (Respondent's selection), in each of the selected household, 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 the caregivers/children.

Data collection

The data for this study were collected using two instruments a pre-tested semi-structured interviewer-administered adapted [1-14] 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 chosen 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 using either an immunization card or recall. 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 and had 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 and clarification were made where necessary. Field supervision was conducted during data collection to ensure data quality and adherence to the study protocol.

Data analysis and measurement of variables

Data collected from the field were entered into a Microsoft Excel spreadsheet and analyzed using IBM SPSS Statistics for Windows, version 22.0. Armonk, NY, USA: IBM Corporation. The quantitative data were presented using mean and standard deviation (SD) or median and interquartile range as appropriate, while qualitative variables were presented using frequency and percentage.

Zero dose children were defined as those who do not receive Penta1 (either by evidence of routine immunization card or recall).[8] The outcome variable was defined as (Penta-1 received based on recall, did not receive Penta-1 by either card or recall, and Penta-1 received based on immunization card). The independent variables were the socio-demographic characteristics of the mother and or the caregivers and the under-five children, access to immunization services, availability of routine immunization card among others. Proportions were compared using Pearson's Chi-squared test between the dependent and independent variables 5% α-level of significance. Multivariate analysis was performed to identify independent predictors of zero-dose immunization status, with a p-value ≤0.2 at the bivariate level considered for inclusion in the regression analysis model.

Results

Socio-demographic Characteristics of the Caregiver

The response rate among nomadic and non-nomadic Fulani were 100% and 99% respectively, with only 1% non-response among the non-nomadic Fuani compared to the nomadic Fulani. The maximum age of the

nomadic caregivers was 60 and the minimum was 17 years with a mean ±SD of 28.2±7.7 years. The maximum age of the non-nomadic caregivers was 78 and the minimum was 17 years with a mean ±SD of 33.0±10.0 years.

Table 1: Socio-demographic Characteristics of Caregivers

Variable(s)	Nomadic, n=345 (%)	Non-Nomadic, n=348(%)	χ^2	p-value
Age of the caregiver (years)				
<24	118(66.7)	59(33.3)	52	<0.001*
24-35	185(51.2)	176(48.8)		
>35	42(27.1)	113(72.9)		
Religion				
Islam	344(49.7)	348(50.3)		†0.5
Christianity	1(100)	0(0)		
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	0(0)	1(100)		
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	0(0)	42(100)		
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	5(55.6)	4(44.4)		
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	0(0)	3(100)		
Monthly income of caregiver(naira)				
<18,000	345(50)	345(50)		†0.1
≥18,000	0(0)	3(100)		
Monthly income of husband				
<18,000	345(56.9)	261(43.1)		†<0.001*
≥18,000	0(0)	87(100)		
Marital status				
Single	3(33.3)	6(66.7)		†0.01*
Married	291(48.3)	311(51.7)		
Divorced	23(74.2)	8(25.8)		
Widowed	19(65.5)	10(34.5)		
Separated	9(14.9)	13(59.1)		
Relationship with the child				
Mother	282(52.0)	260(48.0)		†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	0(0)	5(100)		
Marriage type				
Monogamous	146(45.6)	174(54.4)	4.1	0.04
Polygamous	199(53.4)	174(46.6)		
Family type				
Nuclear	137(44.5)	171(55.5)	6.2	0.01*
Extended	208(54.0)	177(46.0)		

*** Statistically significant, †Fishers exact**

Table 1 shows that a significantly higher proportion of nomadic compared to non-nomadic caregivers who were less than 24 years of age (66.7% vs. 33.3%, p<0.001), while the proportion of those between the age of 24-27, and > 35 years were (51.2% vs. 48.8%), and (27.1% vs. 72.9%) respectively. A significantly higher proportion of the nomadic caregivers had no education compared to the non-nomadic caregivers (62.8% vs. 37.2%, p<0.00.

1†), while the proportion of nomadic and non-nomadic caregivers with Quranic education, primary and secondary, and tertiary level of education was (2.5% vs. 97.5%), (45.5% vs. 54.5%), (0% vs. 0%) respectively. Similarly, a significantly higher proportion of husbands of nomadic caregivers compared to the husbands of non-nomadic caregivers had no education (80.8% vs. 19.2% p<0.00. 1†), while the proportion of husbands of nomadic and non-nomadic caregivers with Quranic education, primary and secondary, and tertiary level of education was (44.7% vs. 55.3%), (0% vs.100%), (0% vs. 100%), (0% vs. 100%) respectively.

A significantly lower proportion of the husbands of nomadic caregivers compared to husbands of non-nomadic caregivers (3.8% vs. 96.2%, p†<0.001) were civil servants, while (55.8% vs. 44.2%) were engaged in farming and rearing of animals. Similarly, a significantly higher proportion of nomadic caregivers compared to non-nomadic caregivers (52.4% vs. 47.8%, p†<0.001) were full-term housewives, while (51.2% vs. 48.8%) were engaged in farming and rearing of animals. In addition, a significantly higher proportion of husbands of nomadic caregivers compared to husbands of non-nomadic caregivers had a monthly income <#18,000 per month (Table 1). A significantly higher proportion of nomadic and non-nomadic caregivers (52.0% vs. 48.0%, p= †0.01) were the biological mothers of the under-five children while (38.7% vs. 61.3%) were the stepmothers of the children.

Access to Health Facilities and Willingness of the Caregivers to Accept Vaccines

Table 2: Access to Health Facilities and Willingness of the Caregivers to Accept Vaccines

	n=345	**n=348**		
	Nomadic	Non-nomadic	χ^2	p-value
Mode of transport to the health facility				
Walk on foot	344(63.1)	209(36.9)		†<0.001*
Bus	1(50.0)	1(50.0)		
Motorcycle	0(0)	14(100)		
Private vehicle	0(0)	1(100)		
Availability of child's vaccination cards				
Yes	102(28.3)	258(71.7)	137.9	<0.001*
No	243(73.0)	90(27.0)		
Place of vaccination				
Health facility	0(0)	82(100)	642.4	<0.001*
Outreach	336(98.8)	4(1.2)		
Health facility and outreach	9(3.3)	262(96.7)		
Husband/father accompanies for immunization				
Yes	33(20.1)	131(79.9)	75.6	†0.001*

No	312(59.0)	217(41.0)		
Willingness to accept any immunization				
Yes	255(44.0)	324(56.0)	46.4	<0.001*
No	90(78.9)	24(21.1)		

*** Statistically significant, †Fishers exact**

Table 2 shows a significantly higher proportion of nomadic under-five compared to non-nomadic under-five (63.1% vs.36.9%, p†<0.001) accessed the immunization services by walking on foot to the health facility, while an equal proportion of the two groups accessed the services using bus as a means of transportation to the facility. A significantly lower proportion of nomadic husbands compared to non-nomadic accompanies (20.1% vs. 79.9%, p†<0.001) the caregivers to the health facility for immunization services. In addition, a significantly lower proportion of nomadic caregivers compared to non-nomadic caregivers (44.0% vs. 56.0%, p†<0.001) were willing to accept any immunization.

Demographics of Nomadic and Non-nomadic Children

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 children of nomadic and non-nomadic was (9 vs.10) and the minimal was (1 vs.1) with a mean ±SD of (4±1.7 vs. 4.5±1.6). The proportion of nomadic and non-nomadic male children studied was (49.7% vs. 50.3%). A significantly higher proportion of nomadic children compared to non-nomadic children (64.7% vs. 35.5%, p<0.001) were between 0-18 months of age, and birth order less than 5 (53.1% vs. 46.9%, p=0.001) (Table 3).

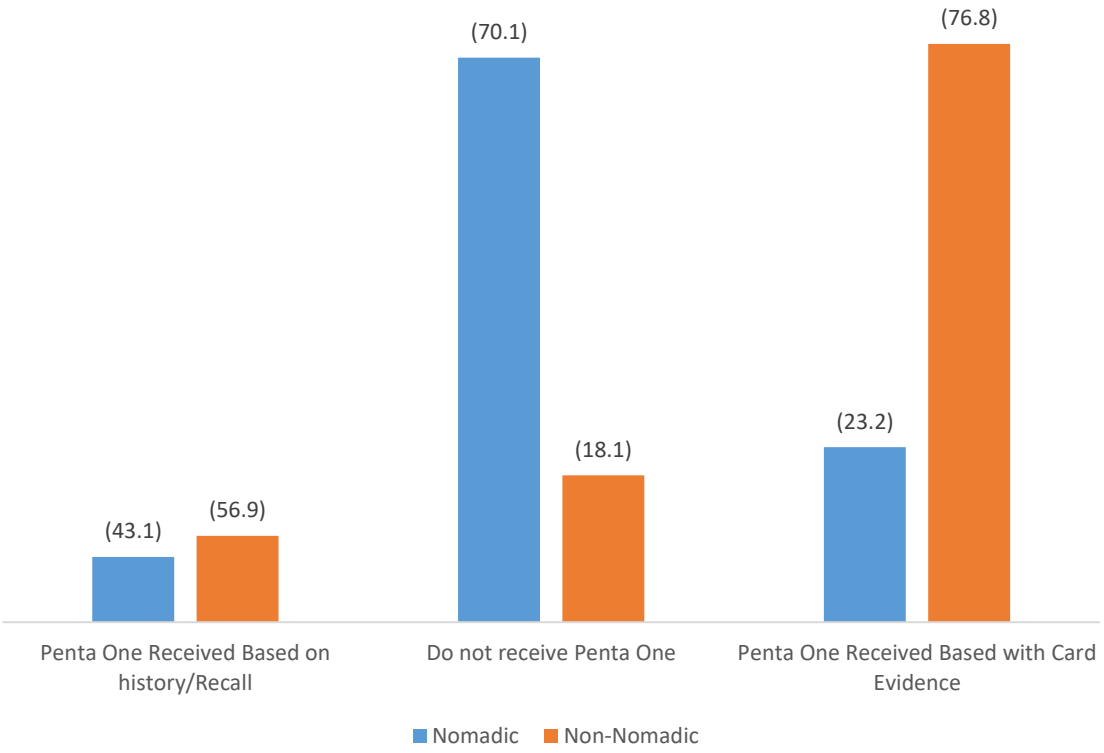
Table 3: Socio-demographic Characteristics of under-five children

Variable (s)	Nomadic	Non-nomadic	χ^2	p-value
Sex				
Male	96(49.7)	97(50.3)	0.1	1.0
Female	249(49.8)	251(50.2)		
Age (month)				
0-18	176 (64.7)	96 (35.3)	40.0	<0.001*
>18	169 (40.1)	252 (59.9)		
Birth order				
<5	288 (53.1)	254(46.9)	11.0	0.001*
≥5	57(37.7)	94 (62.3)		

Prevalence of Zero Dose Children among Nomadic and Non-Nomadic Fulani

A significantly higher proportion of nomadic children didn't receive Penta 1 (zero dose) compared to non-nomadic children (70.1% vs. 18.1%, p<0.001). The uptake of Penta1 among nomadic and non-nomadic children was (43.1% vs. 56.9%) by recall, while the uptake using child immunization card was (23.2% vs.

76.8%). The prevalence of Zero dose children among nomadic (242/345) vs. non-nomadic (63/348) was 70.1% and 18.1% respectively (Figure 1).



χ^2=199.0, P<0.001*

Figure 1: Prevalence of Zero Dose Children among Nomadic and Non-Nomadic Fulani

Factors Associated with Zero Dose among Nomadic Children

Table 4 shows that the odds of being a zero-dose child was higher among children of nomads who were >18 months of age. The children of nomadic Fulani who were >18 months of age were 3 times more likely to be zero-dose compared to those nomadic Fulani between the age of 0-18 months of age (adjusted odds ratio [aOR] =3.4, 95% CI = [1.4–10.5]). Similarly, a significantly higher proportion of nomadic Fulani whose fathers had no education (82.5%, †<0.001) were zero-dose compared to nomadic children whose father had a tertiary education. The nomadic children whose fathers had no education were 3 times more likely to be zero-dose compared to those nomadic Fulani whose fathers had a tertiary education (adjusted odds ratio [aOR] =3.2, 95% CI = [1.1–9.2]).

Table 5 shows that, a significantly higher proportion of nomadic children with no immunization cards were zero dose (87.2%, p<0.001). The nomadic children with immunization cards were 27 times less likely to be zero-dose (adjusted odds ratio [aOR] =27, 95% CI = [4.1–181.7]) compared to nomadic children with no immunization card. More so, zero-dose children were higher among nomads who were not accompanied to the health facility by their spouses (76.6%, p<0.001) compared to non-nomads who were accompanied to the health facility by their spouses for routine immunization.

Table 4: Factors associated with Zero Dose Status among Nomads

Variables	n=345, % **Historically Received penta1**	**penta 1 not given**	**Card Evidence of penta1**	**p-value**	**aOR(95%CI)**
Age of the caregiver(years)					
<24	13(10.2)	92(72.4)	22(17.3)	0.3	
24-35	12(6.8)	118(67.0)	46(26.1)		
>35(reference)	3(7.1)	32(76.2)	7(16.7)		1
Childs age(months)					
0-18	20(11.4)	119(67.6)	37(21.0)	0.1	3.4(1.4-10.5)
>18(reference)	8(4.7)	123(72.8)	38(22.5)		1
Caregivers monthly income(naira)					
<18,000	28(8.1)	242(70.1)	75(21.7)		
≥18,000(reference)	0(0)	0(0)	0(0)		1
Husbands monthly income(naira)					
<18,000	28(8.1)	242(70.1)	75(21.7)		
≥18,000(reference)	0(0)	0(0)	0(0)		1
Birth order of the child					
<5	20(6.9)	202(70.1)	66(22.9)	0.1	2.4(0.4-16)
≥5(reference)	8(14.0)	40(70.2)	9(15.8)		1
Caregivers educational qualification					
None	22(9.2)	182(76.5)	34(14.3)	†<0.001*	2.3(0.9-8.2)
Primary	0(0)	0(0)	1(100)		
Quranic	6(5.7)	60(56.6)	40(37.7)		
Secondary	0(0)	0(0)	0(0)		
Tertiary(reference)	0(0)	0(0)	0(0)		1
Fathers educational qualification					
None	14(8.8)	132(82.5)	14(8.8)	†<0.001*	3.2(1.1-9.2)
Primary	0(0)	0(0)	0(0)		
Quranic	14(7.6)	110(59.5)	61(33.0)		
Secondary	0(0)	0(0)	0(0)		
Tertiary(reference)	0(0)	0(0)	0(0)		1
Occupation of the father					
Business	0(0)	0(0)	0(0)	†0.1	
Civil servant	0(0)	1(100)	0(0)		
Farming/animal rearing	26(7.7)	238(70.2)	75(22.1)		
None	2(20.0)	3(60.0)	0(0)		
Perry trading(reference)	0(0)	0(0)	0(0)		
Marital status					
Divorced	2(8.7)	20(87.0)	1(4.3)	†0.1	
Married	23(7.9)	195(67.0)	73(25.1)		
Separated	1(11.1)	8(88.9)	0(0)		
Single	0(0)	2(66.7)	1(33.3)		
Widowed(reference)	2(10.5)	17(89.5)	0(0)		1

*** Statistically significant, †Fishers exact**

The nomad's children whose fathers accompanied their caregiver to the health facility for routine immunization were 50 times less likely to be zero dose compared to nomads whose fathers do not accompany their caregivers to the health facility for routine immunization (adjusted odds ratio [aOR] =50, 95% CI = [14.7–171.8]). In addition, a significantly higher proportion of children of nomadic children with no available child immunization card (89.4%, p†<0.001), and those whose caregivers were not willing to receive or complete immunization (94.4%, p†<0.001) were zero dose. The nomadic caregivers who were not willing to receive or complete immunization were many folds more likely to have zero-dose children (adjusted odds ratio [aOR] =477, 95% CI = [177–13031]) (Table 5).

Table 5: Factors associated with Zero Dose Status among Nomads

Variables	n=345, % Historically Received penta1	penta1 not given	Card Evidence of penta1	p-value	aOR(95%CI)	p-value
Caregivers relationship with the child						
Aunty	0(0)	1(100)	0(0)	†0.03*	0.4(0.1-1.7)	0.2
Elder sister	0(0)	0(0)	0(0)			
Grand mother	4(19.0)	17(81.0)	0(0)			
Mother	20(19.0)	17(81.0)	0(0)			
Step mother(reference)	4(9.8)	33(80.5)	4(9.8)		1	
Mode of transportation to the facility						
Bus	1(100)	0(0)	0(0)	†<0.03*		
Motorcycle	0(0)	0(0)	0(0)			
Private vehicle	0(0)	0(0)	0(0)			
Walk on foot(reference)	27(7.8)	242(70.3)	75(21.8)		1	
Child has vaccination card						
Yes	3(2.9)	30(29.4)	69(67.6)	<0.001*	27(4.1-181.7)	0.001*
No(reference)	25(10.3)	212(87.2)	6(2.5)		1	
Source of immunization						
Health facility	0(0)	0(0)	0(0)	†0.2	0.7(0.1-6.1)	0.7
Outreach	27(8.0)	238(70.8)	71(21.1)			
Health facility and outreach (reference)	1(11.2)	4(44.4)	4(44.4)		1	
Husband accompanied to the facility						
Yes	1(3.0)	3(9.1)	29(87.9)	<0.001*	50(14.7-171.8)	P<0.001*
No(reference)	27(8.7)	239(76.6)	46(14.7)		1	
Willingness to receive or complete immunization						
Yes	23(9.0)	157(61.6)	75(29.4)	†<0.001*	477(177-13031)	P<0.001*
No(reference)	5(5.6)	85(94.4)	0(0)		1	
Marriage type						
Monogamous	7(4.8)	75(51.4)	64(43.8)	<0.001*	0.8(0.1-7.2)	0.9
Polygamous(reference)	21(10.6)	167(83.9)	11(5.5)		1	
Family type						
Nuclear	4(2.9)	68(49.6)	65(47.4)	<0.001*	12.7(1.0-155.0)	0.04*
Extended(reference)	24(1.5)	174(83.7)	10(4.8)		1	
Sex of the child						
Male	4(4.2)	58(60.4)	34(35.4)	<0.001*	5.8(1.2-29.1)	0.03*
Female(reference)	24(9.6)	184(73.9)	41(16.5)		1	
Availability of immunization card						
Yes	3(2.8)	31(28.4)	75(68.8)	†<0.001*	56(561-5616)	P<0.001*
No(reference)	25(10.6)	211(89.4)	0(0)		1	

*** Statistically significant, †Fishers exact**

Table 6: Factors associated with Zero Dose Status among Non-nomads

Variables	Historically Received penta1	Penta1 not given	Card Evidence of penta1	p-value	aOR(95%CI)	p-value
	n=348, %					
Caregiver Age (years)						
<24	2(3.3)	28(45.9)	31(50.8)	<0.001*	0.6(0.3-1.3)	0.2
24-35	15(8.6)	23(13.2)	136(78.2)			
>35(reference)	20(17.7)	12(10.6)	81(71.1)		1	
Childs age(months)						
0-18	3(3.1)	36(37.5)	57(59.4)	<0.001*	0.4(0.1-1.4)	0.2
>18(reference)	34(13.5)	27(10.7)	191(75.8)		1	
Caregivers monthly income(naira)						
<18,000	37(10.7)	63(18.3)	245(71.0)	†0.3		
≥18,000(reference)	0(0)	0(0)	3(100)		1	
Husbands monthly income(naira)						
<18,000	28(10.7)	60(23.0)	173(66.3)	<0.001*	1.5(0.7-3.4)	0.3
≥18,000(reference)	9(10.3)	3(3.4)	75(86.2		1	
Birth order of the child						
<5	18(7.1)	42(16.5)	194(76.4)	<0.001*	0.7(0.3-1.7)	0.4
≥5(reference)	19(20.2)	21(23.3)	54(57.4)		1	
Caregivers educational qualification						
None	14(9.9)	44(31.2)	83(58.9)	†<0.001*		
Primary	5(12.8)	1(2.6)	33(84.6)			
Quranic	17(13.4)	18(14.2)	92(72.4)			
Secondary	1(2.5)	0(0)	39(97.5)			
Tertiary(reference)	0(0)	0(0)	1(100)		1	
Fathers educational qualification						
None	5(13.2)	17(44.7)	16(42.1)	†<0.001*	0.6(0.1-5.7)	0.6
Primary	2(20.0)	0(0)	8(80)			
Quranic	23(10.0)	45(19.7)	161(70.3)			
Secondary	3(10.3)	1(3.4)	25(86.2)			
Tertiary(reference)	4(9.5)	0(0)	38(90.5)		1	
Occupation of the father						
Business	4(8.2)	1(2.0)	44(89.8)	†0.003*	341(114-1017)	<0.001*
Civil servant	2(8.0)	0(0)	23(92.0)			
Farming/animal rearing	31(11.5)	60(22.3)	178(66.2)			

*** Statistically significant, †Fishers exact**

Table 6 shows that a significantly higher proportion of non-nomads whose father's had no occupation were zero dose compared to those non-nomads whose father's occupation was petty trading. The children of non-nomads whose father's had no occupation were many times more likely to be zero dose compared to non-nomad children whose father's occupation was petty trading (Adjusted odds ratio [aOR] =341, 95% CI = [114–1017]).

Table 7 shows that non-nomadic children whose caregivers were their grandmothers were 40% more likely to be zero-dose compared to those whose caregivers were their stepmothers (Adjusted odds ratio [aOR] =0.4, 95% CI = [0.2–0.8]). A significantly higher proportion of non-nomadic children with no immunization cards (54.4%, p<0.001) were zero-dose. The non-nomadic children with child immunization cards were many times less likely

to be zero dose compared to those with no child immunization cards (Adjusted odds ratio [aOR] =280, 95% CI = [74.5–1057]).

In addition, a significantly higher proportion of non-nomad children whose sources of routine immunization was outreach service (50.0%, p<0.001) were zero-dose. The non-nomad children whose source of routine immunization was outreach service were many times more likely to be zero-dose children compared to those receiving from health facilities (Adjusted odds ratio [aOR] =384, 95% CI = [183–1057]). More so, a significantly higher proportion on non-nomadic children whose caregivers were not willing to receive, or complete immunization were zero-dose (66.7%, p<0.001). The odds of being a zero-dose child were lower among non-nomads whose caregivers were willing to receive or complete routine immunization compared to non-nomads who were not willing to receive or complete routine immunization, the non-nomads who were not willing to receive or complete routine immunization were 10 times more likely to have a zero dose child compared to those willing to receive or complete routine immunization (adjusted odds ratio [aOR] =9.7, 95% CI = [2.1–44.3])

Table 7: Factors associated with Zero Dose Status among Non-nomads

	n=348, %					
Variables	**Historically Received penta1**	**Penta1 not given**	**Card Evidence of penta1**	**p-value**	**aOR(95%CI)**	**p-value**
Caregivers relationship with the child						
Aunty	1(50.0)	0(0)	1(50.0)	†0.1	0.4(0.2-0.8)	0.02*
Elder sister	1(20.0)	0(0)	4(80.0)			
Grand mother	2(12.5)	5(31.3)	9(56.3)			
Mother	21(8.1)	50(19.2)	189(72.7)			
Step mother(reference)	12(18.5)	8(12.3)	45(69.2)		1	
Mode of transportation to the facility						
Bus	0(0)	0(0)	1(100)	†<0.001*	2.3(0.6-8.0)	0.2
Motorcycle	20(13.8)	3(2.1)	122(84.1)			
Private vehicle	0(0)	0(0)	1(100)			
Walk on foot(reference)	17(8.5)	60(29.9)	124(61.7)		1	
Child has vaccination card						
Yes	4(1.6)	14(5.4)	240(93.0)	<0.001*	280(74.5-1057)	<0.001*
No(reference)	33(36.7)	49(54.4)	8(8.9)		1	
Source of immunization						
Health facility	15(18.3)	4(4.9)	63(76.8)	†0.001*	384(183-1057)	<0.001*
Outreach	0(0)	2(50)	2(50)			

Health facility and outreach (reference)	**22(8.4)**	**57(21.8)**	**183(69.8)**		**1**	
Husband accompanied to the facility						
Yes	11(8.4)	5(3.8)	115(87.8)	<0.001*	1.8(0.8-4.0)	0.7
No(reference)	26(12.0)	58(26.7)	133(61.3)		1	
Willingness to receive or complete immunization						
Yes	32(9.9)	47(14.5)	245(75.6)	<0.001*	9.7(2.1-44.3)	0.003*
No(reference)	5(20.8)	16(66.7)	3(12.5)		1	
Marriage type						
Monogamous	15(8.6)	23(13.2)	136(78.2)	0.02*	0.5(0.1-2.6)	0.4
Polygamous(reference)	22(12.6)	40(23.0)	112(64.4)		1	
Family type						
Nuclear	15(8.8)	25(14.6)	131(76.6)	0.1	0.8(0.2-4.6)	0.8
Extended*reference)	22(12.4)	38(21.5)	117(66.1)		1	
Sex of the child						
Male	8(8.2)	21(21.6)	68(70.1)	0.4		
Female(reference)	29(11.6)	42(16.7)	180(71.7)		1	
Availability of immunization card						
Yes	1(0.4)	14(5.3)	248(94.3)	†<0.001*		
No(reference)	36(42.4)	49(57.6)	0(0)		1	

*** Statistically significant, †Fishers exact**

Discussion

Despite the successes recorded in immunization coverage especially in the developed countries, scaling up childhood routine immunization services to reach all the eligible children and underserved population and communities has proven to be more difficult. Up to 13.6 million children were not able to receive a first dose of the diphtheria-tetanus-pertussis containing vaccine in 2019 which significantly increased to 17.1 million in 2020, which was attributable to COVID-19 pandemic.[15] More so, the proportion of eligible children receiving three doses of the diphtheria-tetanus-pertussis containing vaccine reduced by about 5% from 2019 to 2021, signifying a progressive decrease in coverage of the antigens. [15]

This study found the prevalence of zero dose children among nomads to be 70.1%, while that of non-nomads to be 18.1%. Our finding reported higher number of zero dose children among the nomads and lower among the non-nomads in comparison with studies conducted in Ethiopia, 33.7%,[16] Bangladesh 32%,[17] and Nigeria.[8] However, the findings were higher than the reported global figure of 14.2% penta-zero children, dose and 7.5% a truly zero dose children. [18]. However, the studies were not comparative in design, with no disaggregation of the study population to include nomads and non-nomads considered by our study. Even though, the above studies were conducted among general population, nomads, non-nomads and non-Fulani were all involved in the studies. For example, the study conducted in Ethiopia has similarity with the targeted study population by this study in terms of

security challenges in our study area, and perhaps availability and access to essential health services and social amenities which are critical barriers to access of immunization services.

The findings of high proportion of zero-dose children will potentially slow down the achievement of 2030 Agenda for Sustainable Development, and the WHO Immunization Agenda 2030 (IA2030) posing a serious challenge to the vision of "leave no one behind" which targets elimination of within- country disparities due to income, gender, age, race, ethnicity and other relevant public health intervention including immunization.[19]For IA2030, the key goal is 'a world where everyone, everywhere, at every age, fully benefits from vaccines to improve health and well- being' and has as one of its important targets the reduction of the number of zero- dose children worldwide by 50% by 2030. [20]

To achieve optimal coverage therefore, a sustainable cost-effective strategy should be developed to address the critical barriers that can improve uptake of immunization services among children of nomads and non-nomads. For example, child age of more than 18 month among the nomads unlike the non-nomads was found to be an important factor influencing non-uptake of at least penta-1, presumably due to movement by the caregivers which could result in non-planned immunization sessions to cover for the nomads. More so, the nomads had to walk to the facility to access immunization services for their children. This could be mitigated by conducting regular border surveillance and census of the nomad settlements to ensure entry of new nomads into the community to plan for regular and timely outreach sessions, which was further corroborated by the report of outreach immunization session as the major source of child immunization among the nomads. This is in keeping with the recommendations by a study conducted in Nigeria and other studies. [8, 21, 22, 23]

In addition, the cultural barrier of mandating only the caregiver in conveying the child for immunization is contributing to the burden of zero dose especially among the nomads, looking at the higher number among the non-nomad caregivers who were less than 24 years of age. More so, educational attainment of the two categories of our study population was found to influence vaccination uptake which is in keeping with the role of educational attainment and health seeking behavior. [21, 23, 24] Similarly, the non-availability of the child immunization card was significantly found to influence zero dose status. This is corroborated by having the same finding among the nomads and non-nomad children, implying the possibility of a deliberate attempt to avoid the vaccines due to deep-rooted cultural belief, [22,24] as evidenced by non-willingness to accept or complete immunization of their children among the study groups. These findings are also in tandem with review by a study conducted among nomads in Africa.[24]

This study was able to compare immunization uptake among the nomads and non-nomads despite paucity of literature for comparison. The study was limited by recall bias used to assess the immunization status of the children with reported missed cards which was minimized by providing proper training to the research assistants in the areas of eliciting immunization history based on the schedules for various antigens.

Conclusion:

The burden of zero dose was alarmingly high among nomads compared to non-nomads Fulani despite widespread immunisation outreach services in the study area. Government and relevant stakeholders should develop context-specific health promotion activities and outreach services targeting these underserved population

Conflict of Interest

There are no conflicts of interest

References

1. VanderEnde K, Gacic-Dobo M, Diallo MS, Conklin LM, Wallace AS. Global Routine Vaccination Coverage — 2017. Morb Mortal Wkly Rep. 2018;**67**
2. World Health Organization. Immunization coverage. https://www.who.int/news-room/fact-sheets/detail/immunization-coverage. Accessed 14/07/2024.
3. Aalemi AK, Shahpar K, Mubarak MY. Factors influencing vaccination coverage among children age 12–23 months in Afghanistan: Analysis of the 2015 Demographic and Health Survey. PLOS ONE. 2020;15(8):23-35.

4. Oyo-Ita AE, Hanlon P, Nwankwo O, Bosch-Capblanch X, Arikpo D, Esu E, et al. Cost-effectiveness analysis of an intervention project engaging Traditional and Religious Leaders to improve uptake of childhood immunization in Nigeria. PLOS ONE. 2021;16(9):257277.
5. Ashipala DO, Tomas N, Costa Tenete G. Barriers, and Facilitators Affecting the Uptake of COVID-19 Vaccines: A Qualitative Perspective of Frontline Nurses in Namibia. SAGE Open Nursing. 2023/01/01 2023; 9:23-41
6. Aslam F, Ali I, Babar Z, Yang Y. Building evidence for improving vaccine adoption and uptake of childhood vaccinations in low- and middle-income countries: a systematic review. Drugs & Therapy Perspectives. 2022/03/01 2022;38(3):133-145.
7. Adebimpe W.O., Adeoye O.A. Knowledge and practice of vaccination logistics management among primary health care workers in Nigeria. Human vaccines & immunotherapeutics. 2021;**17**(5):1490–1495
8. Mahachi K, Kessels J, Boateng K, Jean Baptiste AE, Mitula P, Ekeman E, et al. Zero- or missed-dose children in Nigeria: Contributing factors and interventions to overcome immunization service delivery challenges. Vaccine. 2022 Sep 2;40(37):5433-5444. doi: 10.1016/j.vaccine.2022.07.058.
9. World Health Organization. *Immunization coverage*. Key Facts 2020; Available from: https://www.who.int/news-room/fact-sheets/detail/immunization-coverage.
10. *Vaccine Action Plan (GVAP)*, WHO, Editor. 2016, WHO: WHO Library Cataloguing-in-Publication Data.
11. Cata-Preta BO, Santos TM, Mengistu T, Hogan DR, Barros AJD, Victora CG. Zero-dose children and the immunisation cascade: Understanding immunisation pathways in low and middle-income countries. Vaccine. 2021 Jul 22;39(32):4564-4570. doi: 10.1016/j.vaccine.2021.02.072. PMC8314014.
12. National Population Commission. Official Results for 2006 House and Population Census Figures. Bureau for National Statistics Abuj; 2006. http://population.gov.ng/. Accessed 14thJuly, 2024.
13. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? Indian J Psychol Med 2013; **35**:121-6
14. Unshur A, Kikuvi G, Karama M. Determinants of Vaccination Coverage among Pastoralists in North Eastern Kenya. East African Medical Journal. 2016;93(8):333-344.
15. Wigley A, Lorin J, Hogan D, Utazi CE, Hagedorn B, Dansereau E, et al. Estimates of the number and distribution of zero-dose and under-immunised children across remote-rural, urban, and conflict-affected settings in low and middle-income countries. PLOS Glob Public Health 2022;2(10): e0001126. https://doi.org/10.1371/journal.pgph.0001126
16. Biks GA, Shiferie F, Tsegaye DA, Asefa W, Alemayehu L, Wondie T, et al. High prevalence of zero-dose children in underserved and special setting populations in Ethiopia using a generalize estimating equation and concentration index analysis BMC Public Health (2024) 24:592 https://doi.org/10.1186/s12889-024-18077-w
17. Das H, Jannat Z, Fatema K, Momo J, Ali W, Alam N. Prevalence of and factors associated with zero-dose and under-immunized children in selected areas of Bangladesh: Findings from Lot Quality Assurance Sampling Survey. Vaccine2024;42(13):3247-3256. https://doi.org/10.1016/j.vaccine.2024.04.018.
18. Wonodi, C.; Farrenkopf, B.A. Defining the Zero Dose Child: A Comparative Analysis of Two Approaches and Their Impact on Assessing the Zero Dose Burden and Vulnerability Profiles across 82 Low- and Middle-Income Countries. Vaccines 2023;11:543.https:// doi.org/10.3390/vaccines11101543
19. Abbas K, Procter SR, van Zandvoort K, Clark A, Funk S, Mengistu T, et al. Routine childhood immunisation during the COVID-19 pandemic in Africa: a benefit–risk analysis of health benefits versus excess risk of SARS-CoV-2 infection. Lancet Glob Health 2020;8:e1264–e1272. https://doi.org/10.1016/S2214-109X(20)30308-9
20. United Nations. Sustainable development goals 2015.Available: https://www.un.org/sustainabledevelopment/

21. Hu X, Cook S, Salazar MA. Internal migration and health in China. The Lancet 2008:372:1717–1719.
22. Ogundele OA, Ogundele T, Beloved O. Vaccine hesitancy in Nigeria: Contributing factors – way forward. Niger J Gen Pract2020; 18:1-4.
23. Galadima AN, Zulkefli AM, Said S, Ahmad N. Factors influencing childhood immunisation uptake in Africa: a systematic review. BMC Public Health 2021; 21:1475https://doi.org/10.1186/s12889-021-11466-5.
24. Gammino VM, Diaz MR, Pallas SW, Greenleaf AR, Kurnit MR. Health services uptake among nomadic pastoralist populations in Africa: A systematic review of the literature. PLoS Negl Trop Dis2020 ;14(7):e0008474. https://doi.org/ 10.1371/journal.pntd.0008474