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Knowledge of Male Caregivers on Childhood Routine Immunization and Zero Dose Children in Borno State

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Abstract

Immunization remains a mainstay in safeguarding children's health worldwide, but achieving universal vaccination coverage has been a significant global challenge. Nigeria faces a particularly alarming situation among these countries, with over 2.2 million estimated zero-dose children in 2021. This study determined male caregivers' knowledge of childhood RI and zero-dose children in Borno. It is a settlement-based descriptive cross-sectional study, and a multi-stage sampling technique was employed to recruit 1,318 respondents. Data collection involved a structured questionnaire and data analysis was completed using IBM SPSS version 25 and STATA SE Version 17. The level of significance was set at 5%. Overall, 56% of respondents demonstrated poor knowledge of childhood RI and ZD, whereas 44% showed good knowledge. Using the Chi-Square Test, there was a statistically significant association between socio-demographic factors (educational status, occupation, and income) and poor understanding of childhood RI and zero-dose vaccination. Also, the multivariate logistics regression analysis results further buttress the outcome of the Chi Square tests; analysis showed that participants who attained secondary education (AOR=0.45, 95% CI=0.26-0.79) and those with tertiary education (AOR=0.46, 95% CI=0.24-0.88) had statistically significantly lower odds for poor knowledge compared to their counterparts with none, Qur'anic or primary education. Despite some positives regarding increased awareness of childhood RI, the understanding of male caregivers about childhood RI and zero-dose vaccination remains poor. Initiatives such as health education and community engagement targeting men should be incorporated into immunization activities.

Keywords: *Childhood Routine Immunization, Knowledge, Vaccination, Zero Dose.*

Introduction

Immunization is the process by which a person becomes resistant to a disease, typically by receiving a vaccine. The vaccines stimulate the body's own immune system to protect the person against subsequent infection or disease [1, 2]. Infectious diseases known as vaccine-preventable diseases (VPDs), such as cervical cancer, poliomyelitis, measles, rubella, parotitis, diphtheria, tetanus, pertussis, hepatitis A and B, bacterial pneumonias, rotavirus diarrheal diseases and bacterial meningitis can be prevented through immunization [1, 2]. Vaccination is a very significant factor in the decline in the prevalence and related mortality from infectious diseases. Over 51.5 million deaths have been averted from 2021 to date, and 5.2 million deaths as immunization coverage increases across the globe [3].

Zero-dose children are those who have not received the first dose of routine vaccination, such as diphtheria, tetanus, and pertussis (DTP), and this remains a significant public

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health challenge [4]. Zero dose prevalence is influenced by several factors like geographic, economic and social determinants. Rural and conflict-affected areas experience disproportionately higher rates due to inaccessibility, weak health systems and cultural resistance. Nigeria accounts for the largest country with the highest number of zero-dose children globally, with an estimated number of 2.3 million unvaccinated children in 2024 [5–7].

Initiatives to increase the Expanded Program on Immunization globally have been made over the years, including the Global Alliance for Vaccines and Immunization (Gavi), universal childhood vaccination, the Global Immunization Vision and Strategy, and, most recently, the Global Vaccine Action Plan. These efforts with a specific strategy, like Reaching Every District, implemented in the African region have increased immunization coverage globally. The percentage of children who received three doses of DTP3 vaccination at 12 months of age increased from 5% in 1974 to 85% in 2010 globally [8].

Globally, strategies to address zero-dose children, a major problem in Nigeria, focus on strengthening healthcare systems, increasing and improving community engagement, and leveraging technology [9, 10]. Outreach campaigns, health worker training, and innovative service delivery models, such as mobile vaccination units, have proven effective in various settings. Also, integration of vaccination services with broader maternal and child health programs is also critical [11–13].

Immunization remains a major problem in Nigeria, and in Borno state, immunization coverage has been adversely affected since the advent of a violent insurgency that started in 2013. The insecurity has left a large number of the population displaced and isolated. The factors have made the state susceptible to wild polio virus transmission discovered in Borno in 2016, and also posed the risk of the spread of serotype two vaccine-derived polio virus. All these factors, coupled with insecurity, have led to insufficient healthcare services in both immunization and surveillance efforts [14, 15].

Studies consistently reveal low levels of caregiver knowledge about immunization in Northern Nigeria. Similar research found that only 3% of caregivers in rural Northwestern communities could accurately describe the immunization schedule, while over 50% displayed negative attitudes toward vaccines due to misinformation and mistrust. This knowledge deficit is worsened by limited access to education, with maternal literacy rates remarkably low in rural and semi-urban areas [16].

A study in 2019 found that only 15% of male caregivers could correctly list the names of childhood vaccines in the National Program of Immunization compared to higher percentage in female caregiver. It is crucial to note that male caregivers, especially, play a significant role in successful vaccination coverage and hold considerable authority over family health decisions, particularly in Northern Nigeria. It is crucial to note that without the consent of and support of male partners, the vaccination program may not succeed. [17, 18]. There are limited studies on male caregivers' knowledge of childhood routine immunization (RI). This research was conducted to determine male caregivers' understanding of childhood RI and zero dose in Borno state.

The findings of the study might contribute to local policy formulation on immunization and improve advocacy for immunization which will be an essential tool that can help in improving immunization coverage in Borno state and other parts of Nigeria.

Materials and Methods

Study Design

This research is a settlement-based descriptive cross-sectional study aimed at comprehensively assessing the levels of knowledge of male caregivers regarding childhood routine immunizations (RIs) and

zero-dose children within of Borno State. The rationale for the selection of this particular research design is predicated upon the fundamental characteristics of cross-sectional studies, which are inherently observational in nature and are employed to effectively analyze and interpret data gleaned from a specified population at a singular point in time; this methodological approach is frequently usually used within various fields, including but not limited to the social sciences, medical research, and health-related studies [19, 20].

Study Area, Participant, Sample Size and Sampling Technique

The research was conducted in Borno State, the state has an approximate population of 7.5 million people, comprises 27 local government areas, and is divided into three political zones north, central and south [21–23].

The study participants are fathers and other male caregivers of children under 5 who have given consent. Inclusion criteria included consenting fathers or male givers with children aged 0 to 59 months who provide financial or social support, inform family or social decisions, and are responsible for the health and well-being of the children in the family, while male caregivers who do not have a child or children within the age of 0 – 59 months were excluded from the study.

To calculate the sample size for this study, the formula below was used.

$$\boldsymbol{n = \frac{DEFF * Np(1-p)}{[(d^2/Z^2_{1-\alpha/2})) * (N-1) + p(1-p)]}}$$ [24]

n=sample size

N=Population size (2,090,893) [22]

p=hypothesized frequency/prevalence of study (47.5) [25]

DEFF=design effect for cluster survey (2)

d= margin of error (4%)

$Z_{1-\alpha/2}$=z-score for desired confidence (1.96 for 95%)

The total number of males above 18 years old in Borno state was calculated according to National Population Commission [22], a total of 2,090,893 individuals. The prevalence rate used for this study, based on previous research, was 47.5% for male caregivers' overall knowledge of childhood RI, which was used for the sample size calculation [25]. Based on the formula, a sample of 1,198 respondents was recruited for the study, with a 10% margin added to account for non-participation or refusal, yielding a final sample size of 1,318.

A multi-stage sampling technique was employed in this research study. The research consists of four-unit clusters. The state was divided into three zones: Borno South, North and Central. In each zone, three Local Government Areas (LGAs) were randomly selected, and the last unit was a settlement chosen by simple random sampling. Upon selecting the settlement, all eligible households with a male caregiver aged 18 or older and children aged 0–59 months were sampled, while others were excluded. Of the 1,318 male caregivers interviewed for this study, 10 declined to participate, resulting in a high response rate. This was achieved through community entry meetings conducted in each settlement, bringing the total number of respondents to 1,308.

Data Collection and Analysis

A structured questionnaire was used to evaluate the extent of respondents' knowledge. It was thoroughly scripted using the Kobo toolbox, which was used for data collection across the study locations. Quantitative data were analysed descriptively using International Business Machines (IBM) Statistical Package for the Social Sciences (SPSS) version 25 and STATA Special Edition Version 17. Descriptive statistics were used to analyse categorical variables, and frequency tables and bar charts were also used to present the data. In addition, inferential statistics were used for categorical data, with p-values below 0.05 for the chi-squared test. Multivariate regression analysis was also used to assess the relationships among the variables in this study.

Each respondent was comprehensively assessed and scored on questions on the knowledge of childhood RI and the zero dose. The cumulative aggregated total score based on respondents' responses was categorized into two distinct classifications, namely good and poor knowledge, to facilitate the interpretation of the data, for further analysis, and thereby allowing for a thorough understanding of their overall performance. Based on previous study, benchmark of 70% and above was employed to designate a score of good knowledge, while any score that fell below the 70% (69 and below) threshold was classified as poor knowledge in a similar research study [26]. The average administration time for the questionnaire was 15–20 minutes, which ensured completeness and data quality. Missing data were minimized by digitizing the questionnaire and making all critical fields mandatory. Multicollinearity among independent variables, including age, income, occupation, and education, was evaluated using bivariate correlation to assess the association between the variables with an r <0.7 as a significant level.

Results

In the study 1308 respondents were surveyed under this research. Table 1 shows that most of the respondents were Muslims (98.6%), and Christians were small in number (2.4%). Concerning age, the majority of respondents were adults (63.4% aged 30-49 years), and only a small percentage were younger than 20 years (0.4%), and older than 70 years (1%). The majority of the respondents were located in rural settings (83.3%), with only a minority located in urban settings (16.7%). On educational status, more than half have Quranic education (52.4%), while secondary education stands at (15.6%), primary education (13.8%) and tertiary education with the lowest proportion of (8.6%). It was also noteworthy that 9.6% did not have any education. Under the occupation of the respondents, the majority (68.7%) were farmers or traders, and the rest were employed (10.2%), unemployed (9.8%), entrepreneurs (9.3%), and a minor fraction of students (2.1%). The majority of the respondents indicated they were earning low and almost 6 out of 10 incomes were below $20. The highest reports were at 3.3%, with earnings above $100. As for marital status, most were married (97.1%), followed by singles (1.8%), divorced (0.5%), separated (0.3%), and widows (0.2%).

Table 1. Sociodemographic Characteristics of Respondents

Variables	Frequency	Percentage
Religion		
Christianity	32	2.4
Islam	1276	98.6
Age of respondent		
<20years	5	0.4
20-29years	233	17.8
30-39years	433	33.1
40-49years	396	30.3
50-59years	177	13.5
60-69years	51	3.9
70 and above	13	1
Geographic Location		
Rural	1089	83.3

Urban	219	16.7
Educational status of respondents		
None	125	9.6
Primary	181	13.8
Qur'anic	686	52.4
Secondary	204	15.6
Tertiary	112	8.6
Occupation of respondents		
Employed	134	10.2
Entrepreneur	121	9.3
Farmer/Trader	898	68.7
Student	27	2.1
Unemployed	128	9.8
Average monthly income (in USD)		
0 - <20	782	59.8
20 - <50	324	24.8
50 - 100	159	12.2
Greater than 100	43	3.3
Marital Status		
Divorced	7	0.5
Married	1270	97.1
Separated	4	0.3
Single	24	1.8
Widower	3	0.2

Knowledge of Male caregivers towards childhood routine immunization and zero dose children

The knowledge of the male caregivers was assessed, where 1214(92.8%) of respondents agreed with the need for immunization in keeping children safe, and the percentage that disagreed with this opinion is small (7.2%). Approximately, 60.7% of the people who responded had heard about diphtheria infection, yet a significant 39.3% responded they were unaware or had no knowledge of diphtheria infection. However, only 28.6% could name the vaccines that prevent diphtheria, and 71.4% could not state whether a vaccine exists to prevent diphtheria in children. An immense percentage (70.6%) had heard about hepatitis infection but nearly one in three people had not heard of the hepatitis infection. A great majority (67.7%) were able to state that first contact for immunization for children occurs at birth. Still, a smaller respondents (21.7%) gave "I don't know," with respondents choosing 6 weeks, 8 weeks, and 9 months for first contact for children's immunization respectively (0.4%, 0.4%, and 0.4%). A high percentage of respondents (45.9%) said 'I don't know' when asked about the last immunization for children under 5 years old, while only 25.7% had the correct answer of 15 months. Some of them provided the wrong answer because they replied at birth (7.8%), 6 weeks (1.0%), 8 weeks (0.8%) and duration of 9 months (7.0%).

Most of the respondents (92.1%), were in agreement that vaccines are also key to child health with only 7.9% indicating otherwise. The majority (86.1%) of the respondents had heard about childhood vaccination, but 13.9% reported being unaware of childhood RI. Almost three-quarters (72.9%) responded that vaccines are only given to children under 5 years of age, while a minority (27.1%) knew otherwise. A large proportion of respondents (38.8%) believed that vaccines could make children sick, whereas 61.2% said this was not true. A majority of the respondents (87.3%) knew the vaccination status of their children but 12.7% have no idea on the vaccination status of their children.

In Figure 1, cumulatively, 773(44%) of the respondents have good knowledge of childhood routine immunization and zero dose children, while 575(56%) have poor knowledge, which shows that knowledge of childhood RI is generally poor among male givers.

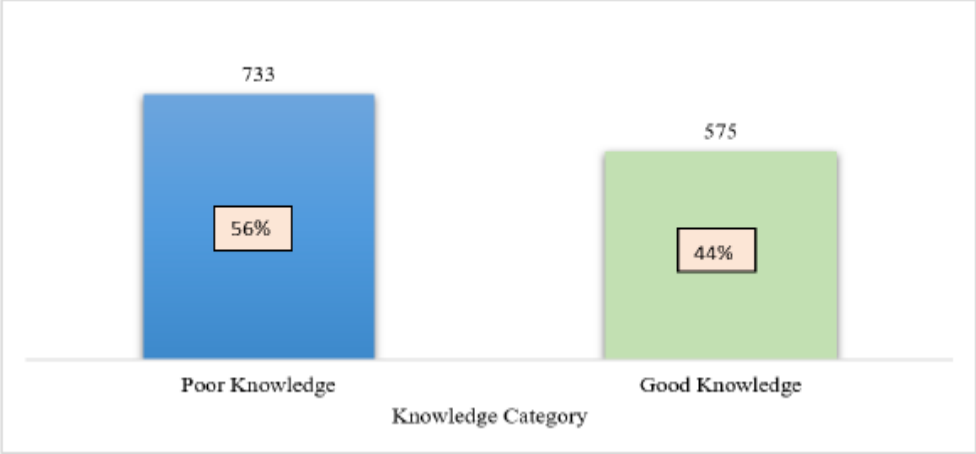

Figure 1. Knowledge of male caregivers towards childhood RI and zero dose children

Association Between Socio-Demographic Characteristics and Knowledge of Respondents

In Table 2, the chi-square test was carried out, showing that most of the socio-demographic characteristics of the respondents (religion, location, educational status, occupation, and income) were significantly associated with male caregivers' knowledge of childhood routine immunization and zero dose children (all p-values <0.05). Respondents who identified as Christians' faith demonstrated higher good knowledge (71.9%) compared to Muslim faith (43.8%) and those of other faiths (13.0%), and this difference was statistically significant ($\chi^2 = 19.1, p = 0.001$). The place of residence of the respondents also showed a strong association, with urban dwellers having substantially better knowledge (73.5%) than their rural counterparts (38.0%) and p-value = 0.001.

Educational qualifications of the respondents were also positively associated with knowledge status, with respondents with tertiary (66.1%) and secondary (63.2%) education reporting significantly higher knowledge than those with Qur'anic education only (34.1%) ($\chi^2 = 83.4, p = 0.001$). Moreover, occupation of the respondents was significantly linked with knowledge, those in formal employment (71.6%) were more knowledgeable than farmers/traders (39.0%) and entrepreneurs (37.2%) ($\chi^2 = 59.7, p = 0.001$). Interestingly, monthly income displayed a reverse pattern, with respondents earning above $100 reporting the lowest proportion of good knowledge (9.3%), while those in the lower income brackets ($0-$20 = 49.2%; $20-$50 = 47.8%; $50–$100 = 31.3%) had comparatively higher knowledge, and this association was statistically significant ($\chi^2 = 36.2, p = 0.001$) (Table 2).

Regression Analysis to Determine the Determinants Poor knowledge for Childhood RI and Zero dose vaccination

In Table 3, the result shows that the age group of the respondent was not statistically significant in determining knowledge of childhood RI and zero dose vaccination. All the age groups, however, had increased odds for poor understanding of childhood RI compared to age <20 years. The age group >70, however, had 32% reduced odds for poor knowledge of childhood RI and zero dose children ($\boldsymbol{AOR = 0.68, 95\% CI = 0.07 - 6.79}$). The result also shows that the Shuwa tribe had statistically significant lower odds for poor knowledge of childhood RI and zero-dose vaccination ($\boldsymbol{AOR = 0.5, 95\% CI = 0.25 - 0.98}$). The odds for poor knowledge of childhood RI were estimated 9 times higher for the traditional religions compared to Christianity ($\boldsymbol{AOR = 8.70, 95\% CI = 1.82 - 41.52}$).

The participants who attained secondary (AOR=0.45, 95% CI=0.26-0.79) and those with Tertiary education ($\boldsymbol{AOR = 0.46, 95\% CI = 0.24 - 0.88}$) had statistically significant lower odds for poor knowledge compared to their counterparts with none, qur'anic or primary education. The farmers ($\boldsymbol{AOR = 2.77, 95\% CI = 1.72 - 4.46}$) and the unemployed ($\boldsymbol{AOR = 2.98, 95\% CI = 1.58 - 5.62}$) also had increased odds for poor knowledge compared to the other occupational group. The middle income; $50-<$100 ($\boldsymbol{AOR = 2.03, 95\% CI = 1.32 - 3.12}$) and higher income group; >$100 ($\boldsymbol{AOR = 12.56, 95\% CI = 3.93 - 40.16}$) were noted to present with increase odds for poor knowledge of childhood RI compared to the low-income group; < $20 (Table 3). Multicollinearity among independent variables shows no strong association as the results found were r ≥ 0.7.

Table 2. Association between socio-demographic characteristics and knowledge of respondents

Variables		Knowledge		Chi-Square Value	P-Value
		Good Knowledge Freq.(%)	Poor Knowledge Freq.(%)		
Age group	<20years	3(60.0)	2(40.0)	9.0	0.179
	20-29years	87(37.3)	146(62.7)		
	30-39years	204(47.1)	229(52.9)		
	40-49years	174(43.9)	222(56.1)		
	50-59years	74(41.8)	103(58.2)		
	60-69years	25(49.0)	26(51.0)		
	70 and above	8(61.5)	5(38.5)		
Tribe	Babur	45(49.5)	46(50.5)	7.2	0.125
	Fulfulde	37(37.4)	62(62.6)		
	Kanuri	313(42.6)	422(57.4)		
	Others	124(44.6)	154(55.4)		
	Shuwa	56(53.3)	49(46.7)		
Religion	Christianity	23(71.9)	9(28.1)	19.1	0.001
	Islam	549(43.8)	704(56.2)		
	Others	3(13.0)	20(87.0)		
Location	Rural	414(38.0)	675(62.0)	93.3	0.001
	Urban	161(73.5)	588(26.5)		
Educational status	None	64(51.2)	61(48.8)	83.4	0.001
	Primary	74(40.9)	107(59.1)		

	Qur'anic	234(34.1)	452(65.9)		
	Secondary	129(63.2)	75(36.8)		
	Tertiary	74(66.1)	38(33.9)		
Occupation	Employed	96(71.6)	38(28.4)	59.7	0.001
	Entrepreneur	45(37.2)	76(62.8)		
	Farmer/Trader	350(39.0)	548(61.0)		
	Student	14(51.9)	13(48.1)		
	Unemployed	70(54.7)	58(45.3)		
Income (USD)	0 - <20	362(46.3)	420(53.7)	36.2	0.001
	20 - <50	159(49.1)	165(50.9)		
	50 - 100	50(31.4)	109(68.6)		
	> 100	4(9.3)	39(90.7)		
Marital Status	Divorced	3(42.9)	4(57.1)	1.3	0.867
	Married	559(44.0)	711(56.0)		
	Separated	1(25.0)	3(75.0)		
	Single	10(41.7)	14(58.3)		
	Widower	2(66.7)	1(33.3)		

Table 3. Multivariate logistic regression for the sociodemographic determinants of poor knowledge of childhood RI and Zero-dose vaccination

Variable	**Adjusted Odds Ratio**	**P-value**	**95%CI**
Age group in years			
<20	1 [Reference]		
20-29	3.95	0.179	0.53-29.29
30-39	2.44	0.380	0.33-18.00
40-49	2.56	0.358	0.35-18.89
50-59	2.74	0.327	0.36-20.68
60-69	1.59	0.663	0.20-12.72
>=70	0.68	0.743	0.07-6.79
Tribe			
Babur	1 [Reference]		
Fulfulde	1.22	0.558	0.62-2.41
Kanuri	0.66	0.123	0.39-1.12
Shuwa	0.50	0.043*	0.25-.98
*Others	0.89	0.673	0.52-1.53
Religion			
Christianity	1 [Reference]		
Islam	2.21	0.081	0.91-5.41
Others	8.70	0.007*	1.82-41.52
Residence			
Rural	1 [Reference]		
Urban	0.18	0.001*	0.12-.26
Highest education level			
None	1 [Reference]		

Primary	1.23	0.455	0.71-2.12
Quranic	1.97	0.003*	1.26-3.08
Secondary	0.45	0.005*	0.26-.79
Tertiary	0.46	0.018*	0.24-.88
Employment status			
Self Employed	1 [Reference]		
Entrepreneur	3.59	0.001*	1.96-6.56
Farmer	2.77	0.001*	1.72-4.46
Student	2.44	0.198	0.63-9.50
Unemployed	2.98	0.001*	1.58-5.62
Average monthly income in USD			
<20	1 [Reference]		
20-<50	1.05	0.746	0.77-1.44
50-<100	2.03	0.001*	1.32-3.12
>100	12.56	0.001*	3.93-40.16
Marital status			
Divorced	1	-	-
Married	1.21	0.891	0.22-5.77
Separated	8.67	0.171	0.39-191.46
Single	1.65	0.641	0.20-13.36
Widower	0.50	0.641	0.03-9.33

Discussion

Significant relationships between the socio-demographic factors of education, occupation, religion and locality of male caregivers in Borno State and knowledge of childhood immunization were established. As reflected in national evidence, paternal education became an influential factor, fathers having at least secondary level education were more likely to express appropriate knowledge of immunization, matching the results of another national survey, the Demographic and Health survey of Nigeria [27]. However, advanced statistics such as linearity of the logit among the continuous predictors, Hosmer Lemeshow goodness of fit, pseudo-R2 estimates and interaction effects were not utilized in this model and require further analytical improvements in the future. This research evaluated the male caregivers knowledge on childhood routine immunization and zero-dose children in Borno State. Most of the male caregivers acknowledged that vaccination is effective in preventing child disease but there are still huge gaps in knowledge related to vaccine-preventable diseases, schedules and safety. These results are reflective of prior research in Northwestern Nigeria where similar studies discovered that the majority of caregivers had knowledge of routine immunization but lacked understanding of specific vaccines and schedules [28]. Although many respondents had heard of diphtheria, only a few could name vaccines that prevent it. This is a typical situation in the Nigerian context, where caregivers have general awareness of immunization but not of the disease in question [29]. Similarly, while awareness of hepatitis infection was relatively high, a considerable number of caregivers had never heard of it, showing that knowledge of certain vaccine-preventable diseases remains uneven. Similarly, it was documented that while awareness levels were high in Kaduna, recall of specific vaccines

and their schedules was poor [30]. Knowledge of immunization schedules also showed striking gaps. Many respondents correctly mentioned that the first vaccination contact occurs at birth. However, only a small subset identified the correct age of the last contact at 15 months, while many either gave incorrect answers or admitted they did not know.

This knowledge gap has also been highlighted in Lagos [31], where the study found that caregivers with generally positive attitudes still lacked an accurate understanding of the complete immunization schedule, limiting vaccine completion [31]. The other interesting result was a general misunderstanding that vaccination is solely for children under 5 years old. This misunderstanding suggests inadequate communication strategies and reliance on informal sources of information. A study in Zamfara State similarly reported that caregivers often relied on traditional and religious leaders for health information, which sometimes perpetuated vaccination myths [32]. The question of vaccine safety also featured prominently and many of the respondents believed that vaccines were likely to cause sickness in children. This view is consistent with past studies on the subject, as fear of side effects was among the significant vaccine correlates of hesitancy in Nigerian communities [33]. It is important to discuss these fears with the community and provide clear information about vaccine safety.

The overall knowledge was categorized; less than half of the respondents were found to have good knowledge, and more than half were found to have poor knowledge. This is in accordance with regional evidence. Recently, it was reported that a high level of inadequate immunization knowledge in Northwestern Nigeria, and poor vaccine knowledge and hesitancy, have been consistently associated with low literacy, cultural beliefs, and economic hardship across West Africa [28]. These findings show that while male caregivers in Borno value immunization, their knowledge about specific vaccines, schedules, and safety remains weak. Similar trends across Nigeria and West Africa emphasize the urgent need for targeted interventions. Male-focused, culturally sensitive health education delivered through trusted community leaders and supported by health systems would address knowledge gaps, dispel misconceptions, and ultimately reduce zero-dose prevalence in Northern Nigeria and the wider region [29, 30, 33].

The results of this research show a strong relationship between socio-demographic factors and male caregivers' awareness of child routine immunization. Religion also was a significant predictor, and Christians showed superior knowledge relative to Muslim and other religious caregivers. This is similar to previous research in Northern Nigeria that made similar conclusions that religious beliefs and the role of faith leaders can inform the perceptions and acceptance of immunization programs by caregivers [32]. In most rural North Nigerian communities with high Muslim populations, some misbeliefs on vaccines as alien intervention or unsafe practices exist that could be attributed as the source of the identified gap in knowledge. Another critical factor was residence, as urban dwellers had significantly better knowledge than their rural counterparts. This supports the results of previous studies that reported that rural caregivers tend to lack access to immunization information and health promotion activities more frequently than urban residents, where health facilities are more concentrated, and where health promotion campaigns are more active [29]. The difference between urban and rural care makers indicates a need to implement targeted awareness activities in less-served rural settings.

Knowledge was closely linked to respondents' educational qualifications, with caregivers with secondary or tertiary education having higher levels of knowledge than those with Quranic education only. This finding

supports the results of other investigations in Kaduna and Kano States, which emphasized that formal education enables caregivers to perceive immunization messages and counter misinformation [35]. It is also consistent with broader West African evidence that more educated caregivers tend to recognize vaccination's benefits and follow immunization schedules [35]. There was also a strong association with occupation, as caregivers who are in formal employment exhibited more knowledge than farmers, traders and entrepreneurs. This is elucidated by the reality that employees, who are formally engaged, have generally a superior chance of accessing formal health education through places of work, social systems, and urban residence. In contrast, subsistence farmers and merchants, particularly in rural settings, might depend on informal sources of information. Similar associations have been reported in studies from Zamfara and Sokoto States, where occupational class influenced exposure to immunization campaigns and health promotion messages [32].

Furthermore, household income did not show statistical significance differences. This finding may suggest that low-income caregivers, particularly those who depend on primary health care services, are more exposed to vaccination information at health facilities during child welfare visits. In contrast, wealthier households may underutilize public immunization services, relying instead on private facilities where structured health education may be less emphasized. A similar pattern was observed in a Lagos study, where caregivers from higher socio-economic classes had lower awareness of specific vaccine-preventable diseases despite accessing private hospitals [31].

Regression analysis offers further understanding of the factors underlying poor knowledge of childhood routine immunization (RI), and zero-dose vaccination among male caregivers. Although age was not a statistically significant determinant, the trend suggests that older caregivers were not always better informed. Surprisingly, older caregivers (aged over 70) were less likely to have poor knowledge than the youngest, which may be because of their lived experience with vaccine-preventable diseases (VPDs), e.g., measles, polio, and diphtheria, which can impact their perception of the benefits of immunization. Similar outcomes have been reported in Northern Nigeria, where older caregivers, particularly grandparents, were more supportive of vaccination due to witnessing disease outbreaks in the past than the younger ones [30, 32]. Another significant determinant was also ethnicity, the Shuwa Arab tribe were found to show much lower probability of poor knowledge than other ethnic groups, which implies that within this group, cultural orientation and community leadership arrangements could serve to enhance positive knowledge and awareness of immunization. This follows the results of Sokoto and Zamfara States that showed that ethnic and cultural settings had a substantial impact on care-givers attitude towards immunization uptake [32]. Another predictor of knowledge was religion, the association reflects broader evidence from West Africa that certain traditional beliefs contribute to mistrust in biomedical interventions and fuel vaccine hesitancy [36]. In Nigeria, Christian caregivers are often reached more effectively through faith-based health campaigns. In contrast, traditionalists and some Muslim caregivers remain more resistant due to entrenched socio-cultural narratives around vaccination safety and intent [35].

Knowledge of male caregivers towards immunization was also affected by occupational status. Unemployed caregivers and farmers were much more likely to be poorly informed than other occupational groups. Similar relations have been found in rural Northern Nigeria, where subsistence farmers and unemployed caregivers were less exposed

to vaccination awareness campaigns than the ones who worked in salaried jobs [29]. Probably the least anticipated was the correlation of income and knowledge. Caregivers with middle and high incomes had better odds of having poor knowledge than low-income caregivers. The income of those making over 100 a month was also under risk especially increasing odds by over a dozen times. This is in contrast with the expectation that better knowledge should be associated with higher income. One potential reason is that better-off caregivers tend to use privately owned health facilities, where health education on the importance of routine immunization is not as heavily promoted as in state-owned facilities. A study in Lagos similarly reported that caregivers of higher socio-economic status underutilized public immunization services and had poorer awareness of specific VPDs, despite having financial access to health services [31].

Conclusion

The article highlights the importance of socio-demographic variables such as education, occupation, religion and the place of residence as determining knowledge in male caregivers in Borno State, Nigeria about childhood RI and ZD vaccination. Although the general awareness about immunisation and its significance was quite impressive, as well as caregivers' understanding of RI for children is free.

In conclusion, the findings of this research have demonstrated convincingly that the level of understanding among male caregivers regarding childhood routine immunisation, as well as the concept of zero-dose children, remains alarmingly inadequate.

Recommendations

1. The active involvement of men in health education initiatives, alongside having a friendly and supportive environments that promote health awareness and proactive health behaviours towards immunisation, has the potential to improve knowledge of male givers significantly.
2. To effectively promote good social behaviour towards childhood RI, it is essential for government agency and other key immunization stake holder like UN agencies and civil societies, to initiate advocacy campaigns and social mobilization efforts that are specifically designed to resonate with male caregivers, thereby ensuring widespread acceptance among community members regarding the critical significance of vaccinations while simultaneously addressing key issues.
3. Strategic advocacy efforts led by the government and supported by immunisation stakeholders to sensitise and engage stakeholders, including traditional leaders, influential religious figures, men's groups, and other key stakeholders, in advocating for childhood RI and reducing zero-dose children in the community.

Conflict of Interest

I hereby declare that I have no conflict of interest regarding the publication of the article titled “Knowledge of Male Caregivers on Childhood Routine Immunization and Zero Dose Children in Borno State”. This research is independent and does not represent the views of any organization or body.

Ethics Approval

Ethics approval for the study was obtained from the TAU University Review Board (URB) and the State Ministry of Health in Borno state. All participants were informed, both in writing and orally, before the administration of the questionnaire about the nature and scope of the study, while they were also informed of their willingness to participate or withdraw at any time during data collection and were informed that their information would only be used for research purposes. No personal information or identifiers, such as names, phone numbers and house addresses, were collected to maintain

confidentiality. Data collected were stored on a password-protected computer accessible only to the research team.

Authors' Contribution

Bashir Adebayo Elegbede: The corresponding author and a PhD student with Texila American University, conceived and designed, analysed and interpreted the data and wrote the paper.

Adegboyega Oyefabi: The supervisor of my PhD research work, and served as the lead technical supervisor for the writing of this paper.

Shettima Abdul–Kadir: Served as technical supervisor for this research work.

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Data Availability

The data of this research are available upon request from the corresponding author.

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References

[1]. Bulut, A., Immunization and Vaccines, 2023, *Experimental and Applied Medical Science*, 4(1), 502-7.

[2]. Lakshmanan, M. T., Karunakaran, U., 2020, Polio vaccination coverage among children aged 12-23 months in a health block in North Kerala. *International Journal of Community Medicine and Public Health*, May 27, 7(6), 2291–7.

[3]. Carter, A., Msemburi, W., Sim, S. Y., Gaythorpe, K. A. M., Lambach, P., and Lindstrand, A., 2024, Modeling the impact of vaccination for the immunization Agenda 2030, Deaths averted due to vaccination against 14 pathogens in 194 countries from 2021 to 2030. *Vaccine*. 42, S28–37.

[4]. Wonodi, C., Farrenkopf, B. A., 2023, 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*. 11(10):1543.

[5]. Bergen, N., Cata-Preta, B. O., Schlotheuber, A., Santos, T. M., Danovaro-Holliday, M. C., Mengistu, T., 2022, Economic-Related Inequalities in Zero-Dose Children - A Study of Non-Receipt of Diphtheria-Tetanus-Pertussis Immunization Using Household Health Survey Data from 89 Low- and Middle-Income Countries. *Vaccines*. 10(4), 633.

[6]. Santos, T. M., Cata-Preta, B. O., Wendt, A., Arroyave, L., Blumenberg, C., Mengistu, T., 2024, Exploring the Urban Advantage in Access to Immunization Services - A Comparison of Zero-Dose Prevalence Between Rural, and Poor and Non-poor Urban Households Across 97 Low- and Middle-Income Countries. *Journal of urban health*, Bulletin of the New York Academy of Medicine. 101(3):638–47.

[7]. Jean-Baptiste, A. E., Wagai, J., Hahné, S., Adeniran, A., Koko, R. I., Vos, S. D., 2024, High-Resolution Geospatial Mapping of Zero-Dose and Under-immunized Children Following Nigeria's 2021 Multiple Indicator Cluster Survey/National Immunization Coverage Survey. *The Journal of Infectious Diseases*. 230(1), e131–8.

[8]. Abdullahi, S., 2018. Factors affecting completion of childhood immunization in Northwest Nigeria. *Walden University*.

[9]. Ingle, E. A., Shrestha, P., Seth, A., Lalika, M. S., Azie, J. I., Patel, R. C., 2023, Interventions to Vaccinate Zero-Dose Children, A Narrative Review and Synthesis. *Viruses*. 15(10).

[10]. Khan, S., Gupta, G. K., Agrawal, D., Zaidi, S. H. N., Batra, J., Syed, S., Sharma, L., et al., 2024, The Big Catch-up: Addressing Zero-Dose Children as a Surrogate of Vaccination Disruptions During Public Health Emergencies. *European Scientific Journal, ESJ*, 33, pp.286-286.

[11]. Parsekar, S. S., Vadrevu, L., Jain, M., Menon, S., Taneja, G., 2024, Interventions addressing routine childhood immunization and its behavioural and social drivers. *Frontiers in Public Health*.

[12]. Oyo-Ita, A., Oduwole, O., Arikpo, D., Effa, E. E., Esu, E. B., and Balakrishna, Y., 2023, Interventions for improving coverage of childhood immunisation in low- and middle-income countries. T*he Cochrane database of systematic reviews*. 12(12), CD008145.

[13]. Shah, M. P., Morgan, C. J., Beeson, J. G., Peach, E., Davis, J., McPake, B., 2024, Integrated Approaches for the Delivery of Maternal and Child Health Services with Childhood Immunization Programs in Low- and Middle-Income Countries, Systematic Review Update 2011–2020. *Vaccines*. 12(12):1313.

[14]. Kalkowska, D. A., Duintjer, Tebbens, R. J., & Thompson, K. M., 2014. Modelling strategies to increase population immunity and prevent poliovirus transmission in the high-risk area of northwest. *Journal of Infectious Diseases*. 210(Suppl 1), 412–23.

[15]. Kalkowska, D. A., Franka, R., Higgins, J., Kovacs, S. D., Forbi, J. C., Wassilak, S. G., 2021, Modeling Poliovirus Transmission in Borno and Yobe, Northeast Nigeria. Risk Analysis, 41(2), pp.289-302.

[16]. Ameen, H. A., Musa, S., Ibraheem, R. M., Oladiji, F., Musa, O. I., Salaudeen, A. G., 2023. Routine immunization uptake and knowledge of caregivers in selected rural communities in Northwestern Nigeria. *Nigerian Journal of Basic and Clinical Sciences*. 20(2), 135–41.

[17]. Aliyu, I., Mohammed, A., Ibrahim, H. U., Ghidazuka, Y. B., 2019, Acceptance of immunization by caregivers of children attending a tertiary health facility in Northwestern Nigeria. *Acta Medica International*. 6(1), 17–21.

[18]. Sato, R., 2022, Zero-Dose, Under-Immunized, and Dropout Children in Nigeria: The Trend and Its Contributing Factors over Time. *Vaccines*. 11(1):181.

[19]. Singh, B., Singh, A., 2015, Strategies for analyzing quantitative data in research. *International Journal of Engineering Sciences & Management Research*. 2(8), 1-5.

[20]. Stefan, H., Michael, B., 2022, Cross-Sectional Study as Research Design in Medicine. *Archives of The Medicine and Case Reports*. 3(2), 256–9.

[21]. Adamu, Y. M., Monguno, A. K., 2009, Distribution of Public Health Facilities in Borno State. Issues in the Geography of Borno State. 1(1), 120.

[22]. NPC., 2024, *Nigeria Population Projection from Census 2006* [Annual Population Projection using Growth Rate], National Population Commission. Accessed January 2024 https://nationalpopulation.gov.ng/census-enumeration.

[23]. Onumba, Z., 2024, Borno State | *Zaccheus Onumba Dibiaezue Memorial Libraries*. Accessed August 2024, https://zodml.org/discover-nigeria/states/borno-state.

[24]. Papagiannis, D., Tiganis, N., Kotsiou, O. S., Lampropoulos, I. C., Fradelos, E. C., Malli, F., 2024, Assessment of Knowledge, Attitudes, and Vaccination Practices Regarding the New RSV Vaccine among Health Professionals in Greece. *Healthcare*. 12(15), 1536.

[25]. Raji, M. O., Sani, A. A., Ibrahim, L. S., Muhammad, H., Oladigbolu, R. A., Kaoje, A. U., 2019, Assessment of the knowledge of fathers, uptake of routine immunization, and its associated factors in a rural community of North West Nigeria, *Annals of African medicine*. 18(2), 97–102.

[26]. Idowu, T. O., Obohwemu, K. O., Iyevhobu, K. O., 2024, Knowledge, attitudes and practices of mothers towards childhood vaccination in Lagos state, Nigeria. *International Journal of Medical Science and Public Health Research*. 5(09), 69–100.

[27]. Idowu, A. E., Yusuf, O. B., Oladele, D. A., 2024, Socio-demographic determinants of immunization uptake in Nigeria, Insights from the 2021 Nigeria Demographic and Health Survey. *BMC Public Health*. 24(1), 1510.

[28]. Ameen, H. A., Musa, S., Ibraheem, R. M., Oladiji, F., Musa, O. I., Salaudeen, A. G., 2023, Routine immunization uptake and knowledge of caregivers in selected rural communities in

Northwestern Nigeria. *Nigerian Journal of Basic and Clinical Sciences*. 20(2), 135–41.

[29]. Orofuke, N. G., Ighosewe, A. P., Ofonakara, U., Elusoji, C. I., Ofilia, C. C., Otutua, M. O., 2024, Knowledge level of caregivers on immunization for children (under-5 years) in Nigeria. *Asian Journal of Medicine and Health*. 22(8):158–73.

[30]. Ishaku, S. M., Ibrahim, S., Ahmed, A., 2021, Awareness and knowledge of immunization schedules among caregivers in Kaduna State, Nigeria. *African Journal of Reproductive Health*. 25(4):112–21.

[31]. Oluwadamilola, O., Adeola, A., Adebayo, F., 2024. Knowledge and attitude of caregivers towards immunization completion in Lagos, Nigeria. *Nigerian Medical Journal*. 65(1):18–26.

[32]. Olatunji, O. A., Babalola, A. B., Musa, Y., 2022, The role of community and religious leaders in influencing vaccination uptake in Zamfara State, Nigeria. *Texila International Journal of Public Health*. 10(2):55–64.

[33]. Olaniyan, A., Isiguzo, C., Agbomeji, S., Akinlade-Omeni, O., Ifie, B., Hawk, M., 2022, Barriers, facilitators, and recommendations for childhood immunisation in Nigeria: perspectives from caregivers, community leaders, and healthcare workers. *The Pan African Medical Journal*. 43:97.

[34]. Adeyanju, G. C., Sprengholz, P., Betsch, C., Essoh, T. A., 2019, Caregivers' views on childhood immunization and the sources of information in Northern Nigeria. *Vaccine*. 37(45), 6724–31.

[35]. Sobieh, A. E., Kamara, M. K., Johnson, F. T., 2020, Education and immunization uptake, Evidence from West African caregivers. *Pan African Medical Journal*. 36, 210.

[36]. Sobieh, A. E., Adamu, Y., Conteh, A., 2020, Traditional beliefs and immunization uptake in West Africa, A systematic review, *West African Journal of Medicine*. 37(6), 601–9.