Research Paper

Vaccination coverage in children resident in a rural community in Nigeria: socio-ecological and contextual determinants

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Abstract

Objectives The national vaccination coverage rate and the coverage rate in rural communities in Nigeria are below the global vaccine action target of 80%; hence, evaluation of factors that determine vaccination status and determine the proportion of children aged 12–59 months who are fully immunised in the rural community should be conducted.

Methods A cross-sectional study was conducted using an interview-structured questionnaire that was pilot tested before being administered. In the study, a two-stage sampling technique was used and the sample size was determined using the EPI-Info, version 7, software.

Key Findings Of the 608 caregiver–child pairs that was assessed, the majority (525, 86.35%) were mothers. Assessment of immunisation status showed that the majority of the children (429, 70.56%) were completely vaccinated while 179 (29.44%) were incompletely vaccinated. Educational status ($\chi^2 = 59.85$, df = 4, $P < 0.001$), the level of knowledge about vaccination ($\chi^2 = 77.62$, df = 2, $P < 0.001$), family setting ($\chi^2 = 27.70$, df = 3, $P < 0.001$), maternal ANC visits ($\chi^2 = 85.37$, df = 2, $P < 0.001$), type of birth ($\chi^2 = 7.27$, df = 2, $P = 0.03$) and child's breastfeeding status ($\chi^2 = 80.75$, df = 2, $P < 0.001$) were all significantly associated with the vaccination status of the child.

Conclusion The study has shown that immunisation coverage in the rural community surveyed is still below the expected target; thus, public health intervention should still focus on individual, community, socio-cultural and healthcare-related factors as this will improve the immunisation status of children in rural communities.

Keywords: vaccination; socio-ecological determinants; public health intervention

Introduction

Vaccination is a vital public health intervention measure for the protection of the vulnerable population from infectious diseases such as respiratory infections, diarrhoea and other diseases with epidemic potential. This coverage is needed in children than in adults due to their poorly developed immune system, hence, the need for additional protection of this vulnerable group with the sole aim of reducing childhood mortality from vaccine-preventable diseases

(VPDs).[1] Additionally, vaccination prevents 2–3 million deaths annually and is responsible for the significant global reduction in childhood mortality from 2.5 million deaths in 1990 to 750 000 deaths in the year 2013 as well as the reduction in the global burden of polio, neonatal and maternal tetanus, and other childhood illnesses.[1–4] Hence, to achieve universal childhood vaccination, the target is to increase immunisation coverage to 90% in low-income countries that are mostly ravaged by infectious diseases.[5]

Table 1 Socio-demographic characteristics of respondents

Variables	Frequency (%)
Sex of Caregiver	
Missing value	1 (0.20)
Female	550 (90.50)
Male	57 (9.40)
Total	608 (100.0)
Family Setting	
Missing value	69 (11.30)
Monogamy	505 (83.10)
Polygamy	33 (5.40)
Single	1 (0.20)
Total	608 (100.0)
Marital Status	
Missing value	4 (0.70)
Divorced	2 (0.30)
Married	577 (94.90)
Separated	2 (0.30)
Single	16 (2.60)
Educational Status	
Missing value	9 (1.5)
No Formal	55 (9.0)
Primary	119 (19.6)
Secondary	249 (41.0)
Tertiary	176 (28.9)
Total	608 (100.0)
Occupational Status	
Missing value	15 (0.8)
Employed	453 (74.5)
Unemployed	150 (24.7)
Total	608 (100.0)
Residence	
Missing value	142 (23.4)
Rural	318 (52.3)
Urban	148 (24.3)
Total	608 (100.0)
Religion	
Missing value	12 (2.0)
Christian	543 (89.3)
Islam	50 (8.2)
Traditional	3 (0.5)
Total	608 (100.0)
Sex of Child	
Missing value	4 (0.7)
Female	310 (51.0)
Male	294 (48.4)
Total	608 (100.0)
Place of Birth	
Missing value	9 (1.5)
Health Facility	583 (95.9)
Home	16 (2.6)
Total	608 (100.0)
Type of Birth	
Missing value	3 (0.5)
CS	36 (5.9)
Vaginal	569 (93.6)
Total	608 (100.0)
ANC Attendance	
Missing value	56 (9.2)
Attended	503 (82.7)
Not Attended	49 (8.1)
Total	608 (100.0)
Breastfeeding Status	
Missing value	51 (8.4)
Exclusively Breastfed	261 (42.9)
Not Exclusively Breastfed	296 (48.7)

Table 1 Continued

Variables	Frequency (%)
Total	608 (100.0)
Household Income	
Missing value	19 (3.1)
<200USD	425 (69.9)
200-400USD	141 (23.2)
400-600USD	20 (3.3)
>600USD	3 (0.5)
Total	608

However, despite the progress made in vaccination coverage globally, countries in sub-Sahara Africa have been struggling to achieve the set objective of the WHO global vaccine action plan (GVAP) to ensure that countries within the sub-region can attain a target of 80% coverage in every district or administrative unit using recommended vaccines in the national immunisation programs.[6, 7] Additionally, the report has shown that vaccination coverage in sub-Saharan Africa has remained stagnant at 72% with only 13% of countries in the region being able to achieve the GVAP target of 80% coverage, thereby, predisposing the population to VPDs.[8] However, the vaccination trend in Nigeria has been fluctuating.[9, 10] Although there was an initial improvement in the overall coverage between 2007 and 2009, this was followed by a gradual decline from 2009 to 2013 and then a slight increase between 2013 and 2018. On the basis of the available data, the highest national coverage rate between 2007 and 2018 is 76%, which was achieved in 2009. The most recent estimate from WHO/UNICEF shows a national coverage rate of 53% with a similar trend observed for individual antigens.[11] Also, the low vaccine coverage in the country raises concern about the impact of the national immunisation program strategy because there is still an occasional outbreak of some VPDs in rural areas in Nigeria.[12]

Additionally, the goal of 80% full vaccination coverage of children by 2020 is presently being threatened by numerous challenges that include insufficient funding of immunisation programs, poor implementation and monitoring of micro-plans at the grass-root level, high dependence of funding from NGOs, the urban–rural disparity in the distribution of health personnel and inappropriate attitude of health workers at service delivery sites.[10] However, the urban–rural disparity in vaccination coverage in Nigeria demands that there should be an increased focus on rural communities that have a higher proportion of children with the majority from poor households.[13, 14] The situation, however, is not different in Edo State and other rural communities in Nigeria.

In the study conducted in Edo State, it was observed that only 26% of children were completely vaccinated in the rural community surveyed.[15] A similar study conducted in the state has similarly shown that the rate was below the GVAP target of 80%.[16] Additionally, the evaluated clinical records of 512 children in a vaccination centre in Benin City found that the vaccination completion rate was low with 18.9–65% of children experiencing a delay in receiving various doses of vaccines with only 44.3% of the children being fully immunised.[17] Therefore, the present study aims to identify the socio-ecological and contextual determinants of childhood vaccination as well as determine the proportion of children aged <5 years who are fully immunised in a rural setting in Nigeria.

Methods

Research setting and recruitment strategy

The study was conducted in Esan-West Local Government Area of Edo State which spans an area of 502 km² with a density of 333.3/

km² and a population size of 127 718.[18, 19] The district has 11 rural communities including Iruekpen, Ujoelen, Ujemen, Idumebo, Ihonmidumun, Eguare, Uhiele, Ukpenun Ne Eka, Emaudo, Uke, Ileh and Ukhun. Politically, these communities are divided into 10 different wards with each of the wards having several villages/clans. Additionally, the district has seven primary healthcare centres, two government-owned hospitals and four registered private clinics that provide immunisation services to the teeming population. These health facilities offer free immunization services to the inhabitants of the district on specific days of the week using the recommended national immunization schedule. Other services provided by the health facilities to the teeming population include health education

and antenatal and postnatal care services. The district also has the presence of alternative medical practitioners such as bonesetters, traditional birth attendants and herbal healers who enjoy patronage from the populace.

The target population is principally caregivers of children aged 12–59 months who were recruited from the community after fulfilling specific inclusion and exclusion criteria. The inclusion criteria include

• Caregivers who are willing to voluntarily participate and give consent for the study. This is because voluntary participation is an important ethical requirement.
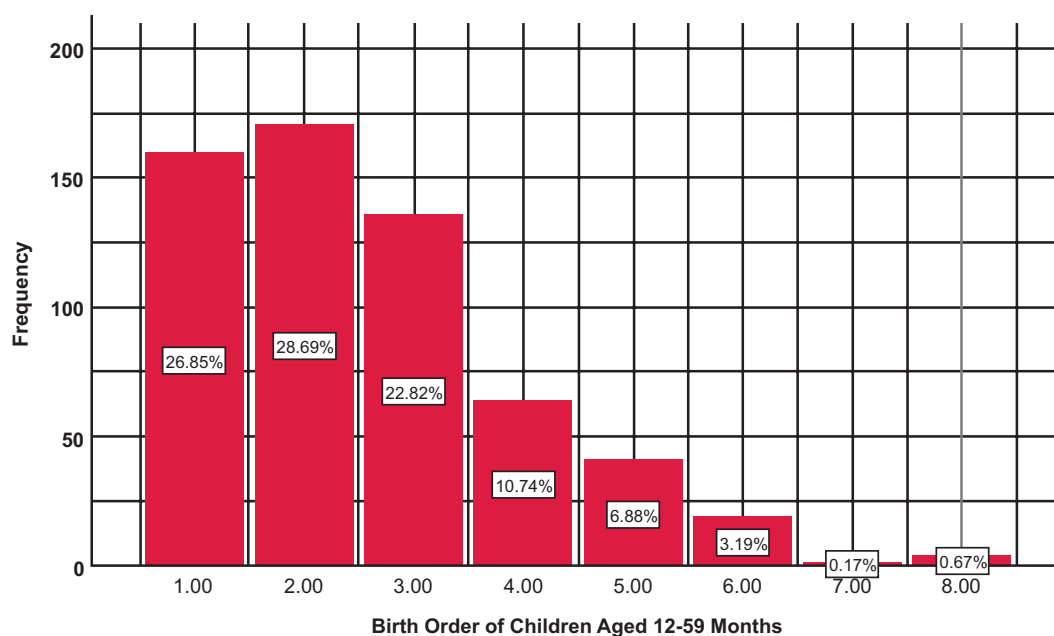

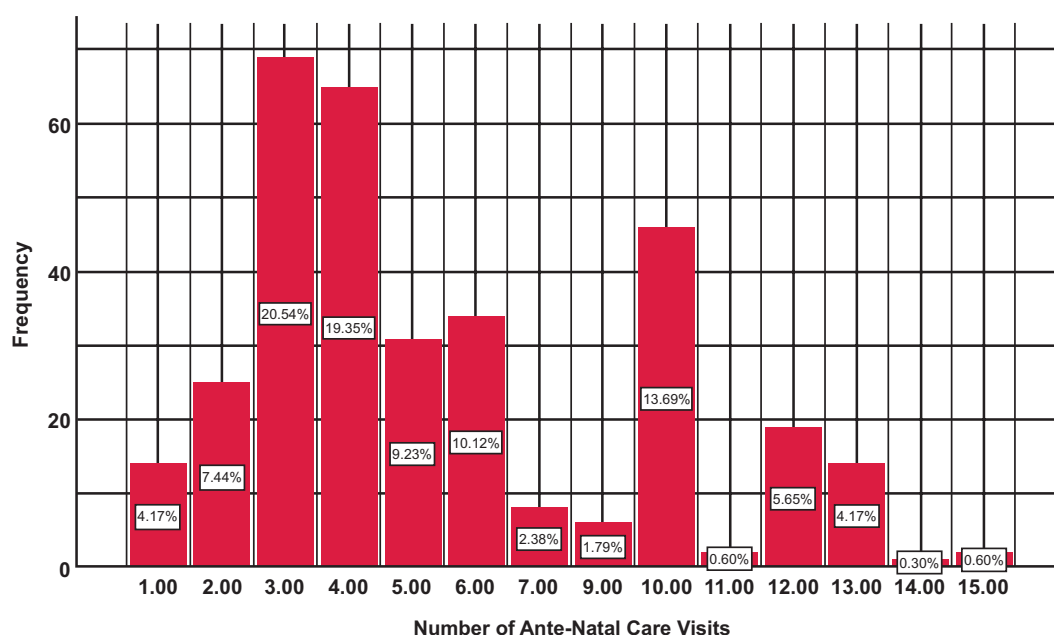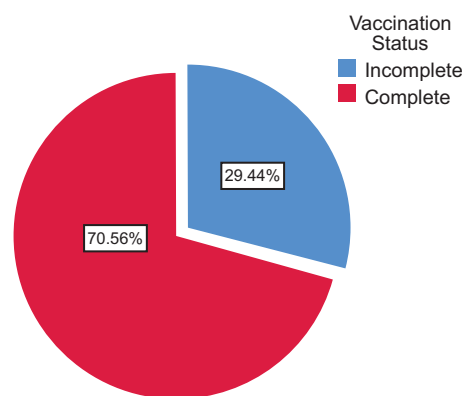**Figure 1** Birth order of children in the study population

Figure 2 Number of maternal ANC visits

- Caregivers who are residents in communities within Esan-West district of Edo State for at least 12 months before the study.
- Caregivers who can recall the vaccination history of their children/wards in the last 24 months and can indicate the health facility where the child was immunised or have a government-issued immunisation card as evidence of vaccination. The timeline of 12 and 24 months was given in the 2nd and 3rd criteria because it is expected that children would have attained complete vaccination status by 12 and 24 months based on the recommended national immunisation schedule.[9, 20]

Exclusion criteria include

- Volunteers whose children are <12 months and >59 months of age.
- Volunteers who are unable to provide information due to ill-health. The justification for their exclusion is that evidence has shown that illness may have a negative effect on memory and cognition,[21] hence such volunteers may not be able to give reliable information about the vaccination of their children/wards.

Vaccination Status of Children Aged 12-59 Months

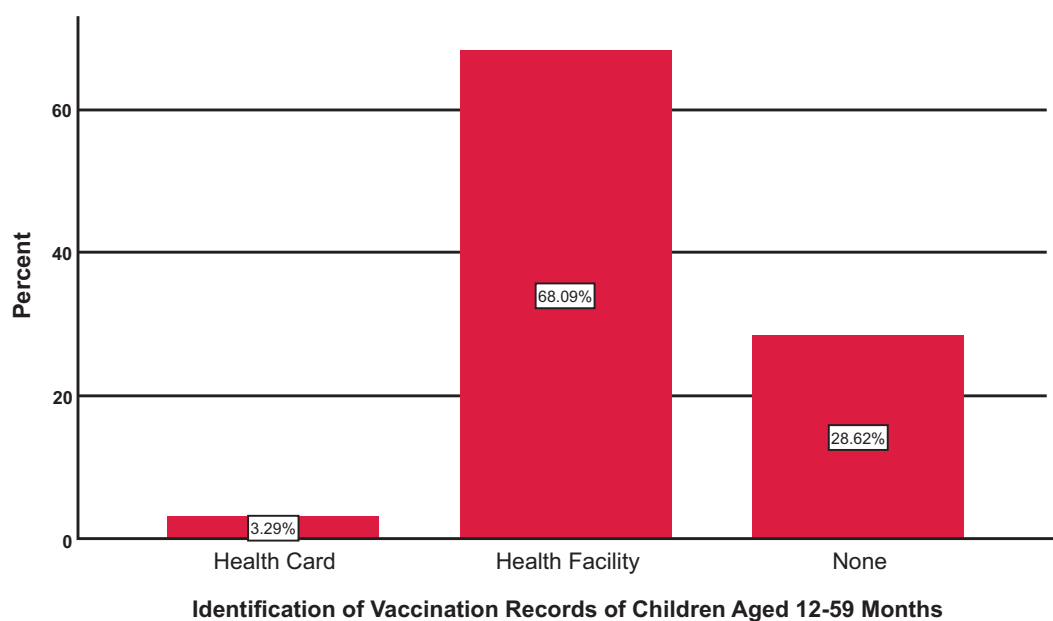**Figure 3** Vaccination status of children in the study population

In this study, complete vaccination status was defined as receiving a dose of Bacille Calmette Guerin (BCG), three doses of diphtheria, pertussis and tetanus (DPT), at least three doses of the oral polio vaccine and one dose of measles vaccine within the first 12 months of age over a period of five visits including doses administered at birth.[10, 22] However, the current immunisation schedule uses a pentavalent vaccine which is made up of DPT, *Haemophilus influenza* type b and hepatitis B antigens, hence children who receive three doses of the pentavalent vaccine were considered to have met the DPT dosing requirement.[12, 22] Additionally, recruitment was done sequentially after obtaining informed consent from caregivers in the selected household. Eligible children were recruited from each household.[23]

Study design, sampling and sample size estimation

The study is a community-based cross-sectional study that entails the use of an interview-structured questionnaire as the instrument of data collection. A two-stage cluster sampling technique was used in the study, and the sample size was calculated using the CDC Epi-Info statistical software which gave an estimated sample size of 600 for a population size of 127 718 in the Esan-West area.[18] The calculation was based on an estimated frequency of 50%, an error margin of 5%, a design effect of 1.5, a cluster size of 20 and a confidence level of 95%. Additionally, based on WHO recommendation, the sampling technique used involves the grouping of the identified communities into clusters followed by a selection of eligible individuals from selected households in each cluster.[23] A total of 30 clusters were randomly selected from an enumeration list of the areas in the district. The first household in each cluster was selected using a simple random technique and subsequently, another household located on the right side was selected consecutively until a total of 20 households were selected in each of the 30 clusters.[24] Also, to avoid selection bias, the last child in households with more than one eligible child was selected for the study.

Data collection methods

An interview-structured questionnaire containing closed and open-ended questions was used for data collection and it contains

Identification of Vaccination Records of Children Aged 12-59 Months

Figure 4 Vaccination status of children aged 12–59 months based on health record

information on socio-demographic characteristics, immunisation history, individual and group factors, socio-cultural factors, healthcare-related factors, knowledge, beliefs and attitude, role of the community, religious and political leaders. Also, pretesting of the questionnaire was done before being administered to the participants. Additionally, data were collected sequentially using a one-on-one interview approach. The elicited information was documented in the structured questionnaire by the interviewer and the completed form for each participant was kept in a folder after cross-checking the information provided. However, to address the problem of recall and information bias that may emanate from relying on the immunisation history alone, immunization cards or confirmation of health facility where vaccination was administered were used to determine the child's vaccination status.

Table 2 Proportion of children immunised with specific vaccines

Vaccines/Vitamin A	*n* (%)
BCG	435 (71.50)
HBV0	430 (70.70)
OPV1	434 (71.40)
OPV2	433 (71.20)
OPV3	433 (71.20)
Pentavalent/DPT1	432 (71.10)
Pentavalent/DPT2	431 (70.90)
Pentavalent/DPT3	431 (70.90)
Rotavirus	5 (0.80)
Measle1	434 (71.40)
Measle2	434 (71.40)
Yellow Fever	434 (71.40)
Meningitis A Conjugate Vaccine (MenVac)	234 (38.50)
Measles, Mumps & Rubella (MMR)	5 (0.80)
Pneumococcal Conjugate Vaccine (PCV1)	419 (68.90)
PCV2	419 (68.90)
PCV3	419 (68.90)
Vitamin A	428 (70.40)

Additionally, children whose immunisation card and history indicate that a dose of BCG, three doses of DPT, at least three doses of OPV and one dose of measles vaccine were administered within the first 12 months of life and over a period of five visits were categorised as being completely vaccinated while children who received at least a dose was classified as being incompletely vaccinated and children who did not receive any dose before the study were regarded as not being vaccinated.[10]

Data analysis methods

Data were entered into Microsoft Excel spreadsheets after thorough cross-checking to identify coding errors and missing information and were analysed using IBM-SPSS, version 25, software. Descriptive statistics were used to determine proportions, frequencies and means, while the χ^2 test was used to establish relationships between complete/incomplete vaccination status and independent variables such as place of birth, antenatal care (ANC) attendance, breastfeeding status, educational status and level of knowledge about vaccination. The categorical variables were presented as frequencies and percentages using tables and charts while numerical variables were presented as mean and standard deviation as well as with tables and charts. After conducting a bivariate analysis using the χ^2 test, a multiple logistic regression analysis was done to establish the association between independent variables and the dependent variable complete/incomplete vaccination status. The odds ratio was determined and used as the measure of association and values were set at 95% confidence interval. $P < 0.05$ was considered significant.

Ethical considerations

The research was conducted after obtaining written ethical permission from Ambrose Alli University Health Research Ethics Committee with an approval number of HREC 006/19 and obtaining written informed consent from the participants. Also, data were collected anonymously using research identification numbers for each participant and generating a master list linking the participant's research ID to their identity. This was securely locked with other survey
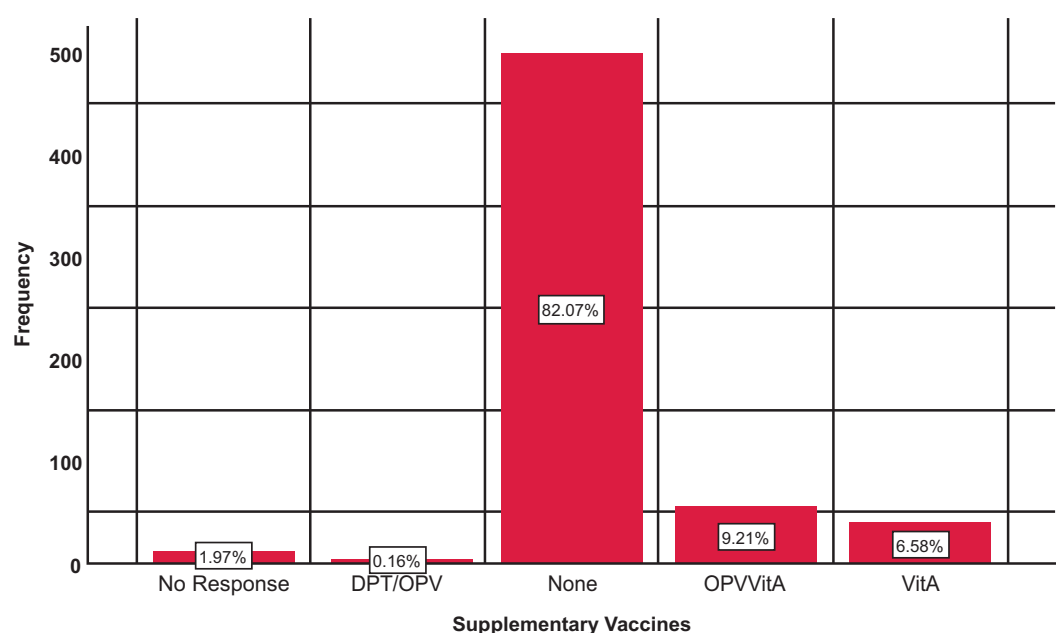

Figure 5 Supplementary vaccines received by children in the study population

materials in a cabinet file. Additionally, all the data elicited from the study were safely and securely stored in a pass-worded computer.

Results and analysis of findings

Descriptive analysis

In the cross-sectional study, 608 caregiver–child pairs were assessed, of which majority (525, 86.35%) were mothers. Also, the majority of the respondents (577, 94.90%) were married and secondary education (249, 41.00%) was the highest level of education attained by the participants. The majority of the participants were employed (453, 74.50%), were from monogamous home (505, 83.10%) and were professing Christians (543, 89.30%). Only 148 (24.30%) of the respondents had previously been residents in urban areas while 318 (52.30%) were mainly rural dwellers with no previous experience of urban life. The majority of the children (Table 1) assessed are females (310, 51.0%), who were born through vaginal delivery (569, 93.60%) and in health facilities (583, 95.90%). Also, the mean age of the children was 32.08 ± 13.4 months and a majority of the children (Figure 1) were in the first (160, 26.85%) and second birth order (171, 28.69%). Only 296 (48.68%) were not exclusively breastfed. Additionally, the majority of their mothers (503, 82.73%) attended antenatal clinics before delivery and a few (69, 20.54%)

recorded at least three ANC visits (Figure 2). Moreover, most of the households evaluated were from a low-income group with a majority (425, 69.90%) having a monthly income of <200 USD.

Assessment of immunisation status (Figure 3) shows that the majority of the children (429, 70.56%) were completely vaccinated while 179 (29.44%) were incompletely vaccinated. In addition to the vaccination history elicited, vaccination status (Figure 4) was assessed by health card inspection (20, 3.29%) and by the health facility records (414, 68.09%) of the participants. However, 174 (28.60%) of the children assessed had no vaccination record and formed part of the 179 participants categorised as being incompletely vaccinated.

Individual vaccine coverage (Table 2) shows BCG coverage of 71.50%, HBV0 (70.70%), OPV3 (71.20%), Pentavalent/DPT3 (70.90%), PCV3 (68.90%), Rotavirus (0.8%), measles 2 (71.40%), yellow fever (71.40%), MenVac (38.50%) and MMR (0.80%). Oral vitamin A coverage was 70.40% while the majority of the children (499, 82.07%) did not receive supplementary vaccines given during immunisation plus days. However, supplementary vaccination with OPV + Vitamin A (56, 9.21%) was more predominant among children resident in the rural community (Figure 5).

Caregiver's past experience with vaccination is a very important determinant of vaccination in children. In the study

Table 3 Responses to questions on individual and group factors associated with vaccination

Variables	Responses n (%) N = 608		
	Yes	No	No Response
Have you ever rejected vaccination for child	33 (5.40)	560 (92.10)	15 (2.50)
Have you or someone known to you have a bad reaction to a vaccine	20 (3.30)	573 (94.20)	15 (2.50)
Know any child with deformity from lack of vaccination	100 (16.40)	491 (80.80)	17 (2.80)
Heard of any child with disability from vaccination	55 (9.00)	536 (88.2)	17 (2.8)
Did you reconsider decision to vaccinate child based on above	9 (1.50)	297 (48.80)	302 (49.7)
Does crying from prevent you from vaccinating child	24 (3.90)	536 (88.20)	48 (7.90)
Can vaccines overload the immune system	10 (1.60)	581 (95.60)	17 (2.80)
Are there better ways to prevent disease	37 (6.10)	554 (91.10)	17 (2.80)
Do you believe it is better to vaccinate child if over 1 year	150 (24.70)	442 (72.70)	16 (2.60)
Do you believe it is better to vaccinate child at birth	531 (87.30)	62 (10.20)	15 (2.50)
D o you know the vaccines to get for yourself and your child	283 (46.50)	300 (49.30)	25 (4.10)
Do you get enough information from vaccinators during mass campaigns	462 (76.00)	129 (21.20)	17 (2.80)
Do you get information about certain vaccines and decide against it	68 (11.80)	526 (86.50)	14 (2.30)
Do you feel you have enough information about vaccines and their safety	405 (66.60)	186 (30.60)	17 (2.80)
Do you think some vaccines are more important than others	35 (5.80)	549 (90.30)	24 (3.90)
Do you think vaccines given to a child is safe	576 (94.70)	12 (2.00)	20 (3.30)
Do you think vaccines are no longer needed when disease prevalence is low	41 (6.70)	553 (91.00)	14 (2.30)
Do you believe vaccines are needed when disease are rare	556 (91.40)	38 (6.30)	14 (2.30)
Do you agree that every parent/caregiver should get recommended vaccine for child	583 (95.90)	11 (1.80)	14 (2.30)
Does your community members have their children vaccinated	572 (94.10)	17 (2.80)	19 (3.10)
Do you have your child vaccinated	572 (94.10)	20 (3.30)	16 (2.60)
Are you worried if refusal of vaccines by caregivers in your community will put your child at risk of disease	305 (50.20)	289 (47.50)	14 (2.30)
Do you believe if you vaccinate child others are protected	174 (28.60)	419 (68.90)	15 (2.50)
Do you refuse a vaccine for child because it has animal protein	37 (6.10)	553 (91.00)	18 (3.00)
Have you ever felt pushed by health authorities & Government towards an immunisation decision you don't support	36 (5.90)	556 (91.40)	16 (2.60)
Are you more likely to accept vaccines from same healthcare provider than a different one	197 (32.40)	389 (64.0)	22 (3.60)
Are you able to openly discuss your concerns about vaccines with your child's doctor	573 (94.20)	18 (3.00)	17 (2.80)
Do you think healthcare providers care about what is best for your child	565 (92.90)	25 (4.10)	18 (3.00)
Does open discussion of side effect by government & health authorities improve your decision about vaccines	561 (92.30)	29 (4.80)	18 (3.00)

conducted, 5.40% of caregivers rejected vaccination (Table 3) based on reasons that include adverse reactions to vaccines (2.80%), inherent dislike for vaccination (1.81%), not recognising vaccinators (0.16%), lack of trust in vaccines (0.16%) and preference for traditional medical practice (0.16%) (Figure 6). Additionally, 20 (3.30%) of the respondents asserted that their children and others in the community have experienced adverse reactions following vaccination while 55 (9.0%) of the participants have seen a child with deformity following vaccination which has resulted in a reconsideration of vaccination (9, 1.50%) for their children. Also, a few respondents (24, 3.90%) claim that seeing their child cry from pain can prevent them from vaccinating their children.

Additionally, of the 608 participants surveyed, 10 (1.60%) believed that vaccination overloads the immune system while 37 (6.10%) have the impression that there are better ways to prevent disease in a child than vaccination. However, a majority of the participants (531, 87.30%) believed that vaccines should be given to children at birth and that vaccines do not overload the immune system (581, 95.60%). Also, 35 (5.80%) of the participants think that some vaccines are more important than others with 0.16% of respondents asserting that the pentavalent vaccine was more important than other vaccines.

In the cross-sectional study, 82.40% of the participants claim that the source of information trusted the most is information from the health centre (Figure 7). However, a majority of the participants (567, 93.30%) do not share information about vaccination in their
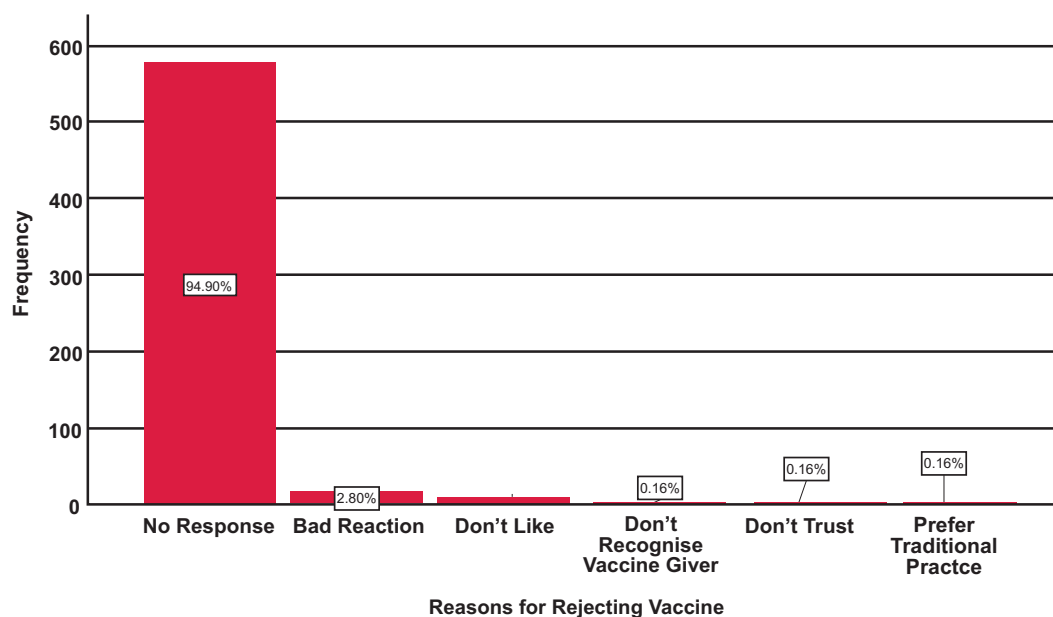

Figure 6 Reasons for rejecting vaccination in the study population
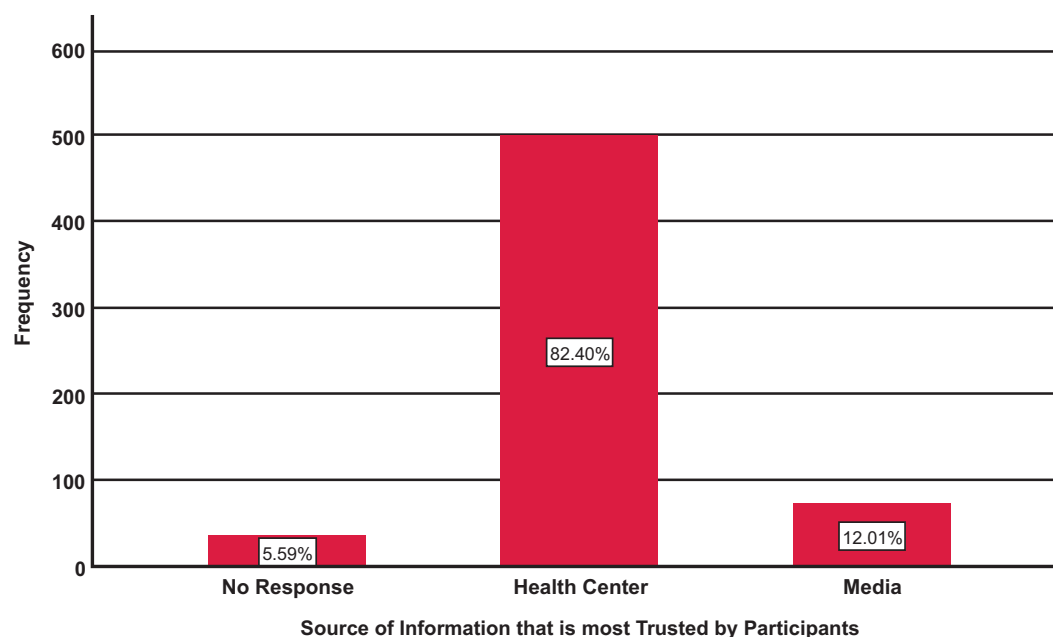

Figure 7 Sources of information trusted most by respondents

social media network neither do reports from social media (566, 93.10%) make them reconsider vaccinating their child (Table 4). Moreover, 49 (8.1%) of the respondent will want a vaccine for their child based on information shared on the social networks with the majority of participants (391, 64.30%) not believing the report on the media about parents losing their children to VPDs. Also, reports from the media (Figure 8) that generally led to a reconsideration of vaccine decision include adverse reactions to vaccines (0.49%), death from vaccination (0.16%), deformity from vaccination (0.33%) and deformity from non-vaccination (0.16%). However, 274 (45.10%) of the respondents claim that they are likely to doubt vaccination if religious leaders fail to support vaccination. Also, a majority of the participants (85.50%) claim that their community welcomed a new vaccine each time it was introduced while 185 (30.40%) of respondents stated they will follow the advice of religious leaders against vaccination. Additionally, the majority of the participants (574, 94.40%) were not influenced by the circle of friends in their community who vaccinate their children.

As shown in Table 5, 36 (5.90%) of the participants could mention past events that reduced their trust in vaccination. Past events that made the respondents lose their trust in vaccination (Figure 9) include swelling of limbs at the injection site (5.20%), deformity (1.97%), rashes (0.82%), fever (0.49%), death (0.66%) and severe pain (0.33%). Moreover, 13 (2.10%) claim that their religion and culture go against certain vaccines while 162 (26.60%) claim they know of individuals in the community who reject vaccination on religious and cultural grounds.

However, 0.49% of the respondents who claim their communities reject vaccines could not specify the vaccine while 0.16% mentioned pentavalent vaccines as the most commonly rejected vaccine in their community. Also, 343 (56.40%) are convinced that individuals who reject vaccination based on religious and cultural disposition put their health and that of their children at risk.

Moreover, the majority of the respondents (582, 95.70%) claimed they would not refuse a vaccine if the vaccinator is from a

Table 4 Responses on media and communication and influence of community and religious leaders on vaccination

Variables	Responses n (%) N = 608		
	Yes	No	No Response
Has report from media/social network made you reconsider vaccination	17 (2.80)	566 (93.10)	25 (4.10)
Do you share information about vaccination in your social media network	22 (3.60)	567 (93.30)	19 (3.10)
Will you want vaccine for child based on information shared	49 (8.10)	34 (15.50)	465 (76.5)
Do you believe report in media of parents claiming loss of child to VPDs	192 (31.60)	391 (64.30)	25 (4.10)
If yes does it affect your decision to get child vaccinated	17 (2.80)	162 (26.60)	429 (70.60)
Do you have child vaccinated because parents in community or your circle vaccinate theirs	18 (3.0)	574 (94.40)	16 (2.60)
Do you agree with religious leaders who don't accept vaccination	34 (5.60)	556 (91.40)	18 (3.00)
Do community and religious leaders in your setting support vaccination	514 (84.50)	77 (12.70)	17 (2.80)
Will there be a doubt to vaccinate child if any of the above leaders disagree with vaccination	274 (45.10)	313 (51.50)	21 (3.50)
Has your community ever welcomed a new vaccine	520 (85.50)	70 (11.50)	18 (3.00)
Has any of the religious leaders ever spoken against vaccines	15 (1.80)	567 (93.30)	30 (4.90)
Do you follow the advice of religious leaders against vaccines	185 (30.40)	116 (19.10)	307 (50.50)
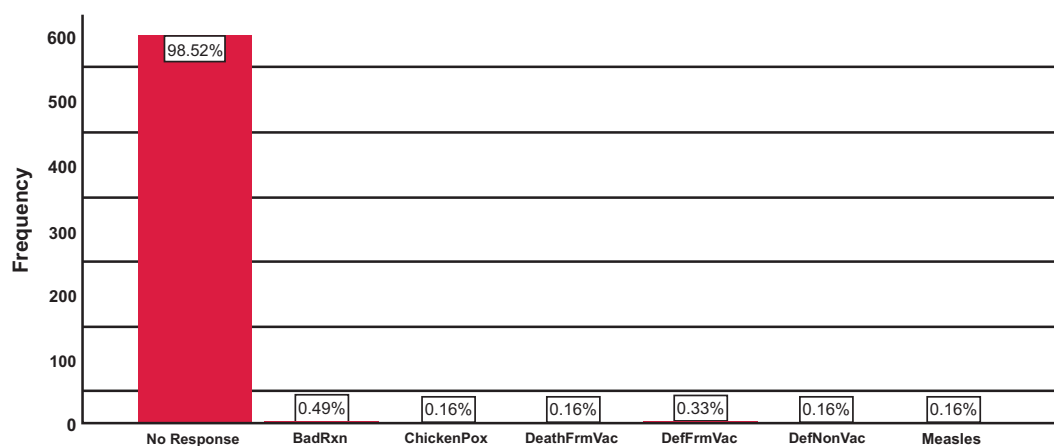
Keys: BadRxn=Bad reaction; DeathFrmVac=Death from Vaccination;
DefFrmVac=Deformity from Vaccination;
DefNonVac=Deformity not related to vaccination

Figure 8 Reports from media that led to reconsideration of vaccination

different religious and ethnic background from theirs and are convinced (90.10%) that the government provides the highest quality of vaccines for their use. While 326 (53.60%) agree with the vaccination policy adopted by their child's daycare or school, 102 (16.80%) claim that distance and long waiting hours in the clinic have hindered them from vaccinating their children even though most of the participants (79.60%) do not pay for vaccination services. However, many of the participants (74.70%) claim they are ready to spend up to 1 h waiting in the clinic for the vaccination of their children. The mean maximum time the caregivers are willing to spend in the clinic for the vaccination of their children is 360 ± 96.07 min.

Table 5 Responses on historical, socio-cultural, religious, gender, political, geographical and pharmaceutical factors

| Variables	Responses n (%) N = 608		
	Yes	No	No Response
Can you mention past event that reduced your trust in vaccination	36 (5.90)	532 (87.50)	40 (6.60)
Have your community ever rejected or refused certain vaccine	7 (1.20)	583 (95.90)	18 (3.00)
Does your religion or culture against certain vaccines	13 (2.10)	580 (95.40)	15 (2.50)
Know anyone who rejects vaccination for religious or cultural reasons	162 (26.60)	427 (70.00)	19 (3.10)
Do you agree with these individuals	15 (2.50)	236 (38.80)	357 (58.70)
Do you think they are risking their health and that of their children if they reject vaccination	343 (56.40)	45 (7.40)	220 (36.20)
Will you refuse to vaccinate child if vaccinator is a male or female	1 (0.20)	583 (95.90)	24 (3.90)
Will you refuse vaccination if the vaccinator is from a different ethnic background and religion from you	5 (0.80)	582 (95.70)	21 (3.50)
Are you convinced government provides the highest quality of vaccines	548 (90.10)	35 (5.80)	25 (4.10)
Do you ever have the impression that government/healthcare authorities don't provide the best vaccines available	56 (9.20)	532 (87.50)	20 (3.30)
Does child's daycare or school require the vaccination of your child	320 (52.60)	255 (41.90)	33 (5.40)
Do you agree with the above policy	326 (53.60)	13 (2.10)	269 (44.20)
Has distance and long waiting hours hindered the vaccination of child	102 (16.80)	484 (79.60)	22 (3.60)
Do you pay for vaccination services	83 (13.70)	491 (80.8)	34 (5.60)
If you pay does it prevent the vaccination of your child	11 (1.80)	102 (16.80)	495 (81.40)
If you spend more than 1 hour waiting in clinic, do you think it is worthwhile	454 (74.70)	132 (21.70)	22 (3.60)
Has mobile lifestyle hindered you from vaccinating child	56 (9.20)	528 (86.80)	24 (3.90)
Do you think that government are pushed by lobbyist to recommend certain vaccines	85 (14.00)	504 (82.90)	19 (3.10)
Do you trust pharmaceutical companies to provide effective and safe vaccines	561 (92.30)	25 (4.10)	22 (3.60)
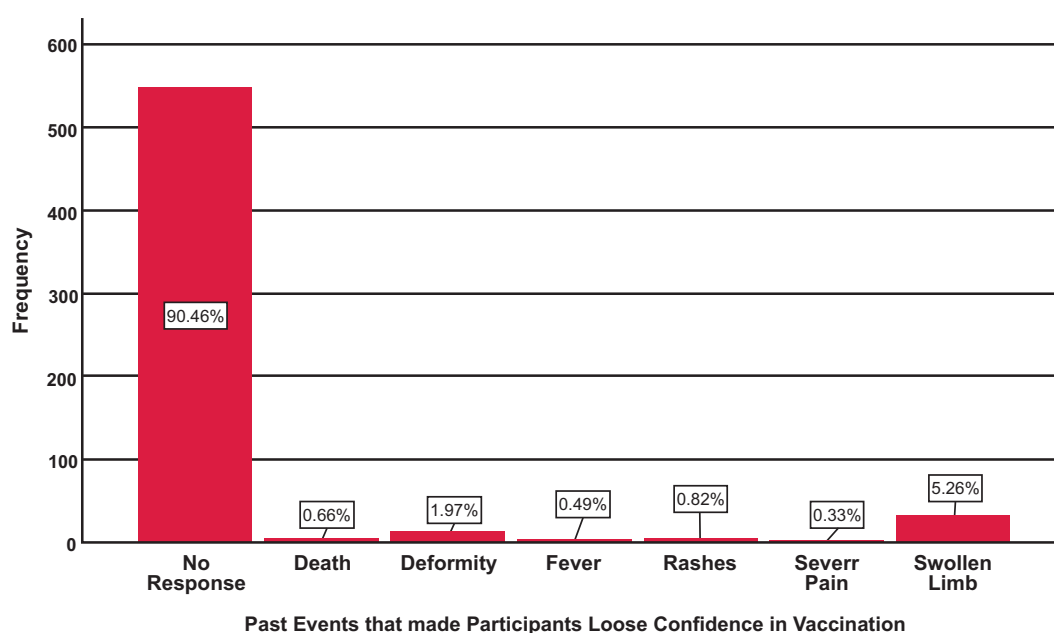
Figure 9 Past events mentioned by participants that hinder vaccination of children

Table 6 Relationship between vaccination status and socio-demographic characteristics of participants

Variables	Vaccination Status		Total n (%)	Pearson Chi-Square Value	Df	P-value
	Complete n (%)	Incomplete n (%)				
Educational Status						
No Response	8 (6.4)	1 (2.6)	9 (100)			
No formal Education	16 (29.1)	39 (70.9)	55 (100)	59.85	4	<0.001
Primary	84 (70.6)	35 (29.4)	119 (100)			
Secondary	201 (80.7)	48 (19.3)	249 (100)			
Tertiary	120 (68.2)	56 (31.8)	176 (100)			
Total	**429**	**179**	**608**			
Occupational Status						
No Response	3 (60)	2 (40)	5 (100)			
Employed	342 (75.5)	111 (24.5)	453 (100)			
Unemployed	84 (56)	66 (44)	150 (100)	20.89	2	<0.001
Total	**429**	**179**	**608**			
Residence						
No Response	81 (57.0)	61 (43.0)	142 (100.0)			
Rural	253 (79.6)	65 (93.6)	318 (100.0)	27.78	3	<0.001
Urban	95 (64.2)	53 (35.8)	148 (100)			
Total	**429**	**179**	**608**			
Marital Status						
No Response	3 (75.0)	1 (25.0)	4 (100)			
Divorced	2 (100.0)	0 (0.0)	2 (100.0)	2.04	5	0.84
Married	407 (70.5)	170 (29.5)	577 (100.0)			
Separated	1 (50.0)	1 (50.0)	2 (100.0)			
Single	12 (75.0)	4 (25.0)	16 (100.0)			
Widowed	4 (57.1)	3 (42.9)	7 (100.0)			
Total	**429**	**179**	**608**			
Family Setting						
No Response	49 (71.0)	20 (29.0)	69 (100.0)			
Monogamy	369 (73.1)	136 (26.9)	505 (100.0)			
Polygamy	10 (30.3)	23(69.7)	33 (100)	27.70	3	<0.001
Single						
Total	**429**	**179**	**608**			
Religion						
No Response	3 (25.0)	9 (75.0)	12 (100.0)			
Christianity	408 (75.1)	135 (24.9)	543 (100)			
Islam	17 (35.3)	33 (14.7)	50 (100)	51.64	3	<0.001
Traditional	1 (33.3)	2 (66.7)	3 (100.0)			
Total	**429**	**179**	**608**			
Place of Birth						
No Response	2 (22.20)	7 (77.80)	9 (100.00)			
Health Facility	424 (72.90)	159 (27.30)	583 (100.00)	32.12	2	<0.001
Home	3 (18.80)	13 (81.30)	16 (100.00)			
Total	**429**	**179**	**608**			
Type of Birth						
No Response	0 (0.00)	3 (0.90)	3 (100.00)			
Caesarean Section	25 (69.40)	11 (30.60)	36 (100.00)			
Vaginal	404 (71.00)	165 (29.00)	569 (100.00)	7.27	2	0.03
Total	**429**	**179**	**608**			
Breast Feeding Status						
No Response	8 (15.70)	43 (84.30)	51 (100.00)			
Exclusively Breast Fed	196 (75.10)	65 (24.90)	261 (100.00)	80.75	2	<0.001
Not Exclusively Breast Fed	225 (76.00)	71 (24.00)	296 (100.00)			
Total	**429**	**179**	**608**			
Antenatal Clinic Status						
No Response	14 (25.00)	42 (75.00)	56 (100.00)	85.37	2	<0.001
Attended	393 (78.10)	110 (21.90)	503 (100.00)			
Not Attended	22 (44.90)	27 (55.10)	49 (100.00)			
Total	**429**	**179**	**608**			

Table 7 Association between vaccination status and confidence in healthcare system and providers

Variables	Vaccination Status		Total *n* (%)	Pearson Chi-Square Value	Df	*P*-value
	Complete *n* (%)	Incomplete *n* (%)				
Felt Pushed by Authorities on Decision to Vaccinate						
No Response	1 (6.30)	15 (93.80)	16 (100.00)			
No	401 (72.10)	155 (27.90)	556 (100.00)	32.85	2	<0.001
Yes	27 (25.00)	9 (25.00)	36 (100.00)			
Total	429	179	608			
Have Same Healthcare Give Vaccine to Child						
No Response	6 (27.30)	16 (72.70)	22 (100.00)			
No	326 (83.80)	63 (16.20)	389 (100.00)	95.81	2	<0.001
Yes	97 (49.20)	100 (50.80)	197 (100.00)			
Total	429	179	608			
Openly Discuss Concerns with Doctor						
No Response	3 (17.60)	14 (82.40)	17 (100.00)			
No	12 (66.70)	6 (33.30)	18 (100.00)	23.83	2	<0.001
Yes	414 (72.30)	159 (27.70)	573 (100.00)			
Total	429	179	608			
Health Provider Care about Child						
No Response	5 (27.80)	13 (72.20)	18 (100.00)			
No	19 (76.00)	6 (24.00)	25 (100.00)	16.56	2	<0.001
Yes	405 (71.70)	160 (28.30)	565 (100.00)			
Total	429	179	608			
Open Discussion of Side Effects Improve Vaccination						
No Response	3 (16.70)	15 (83.30)	18 (100.00)			
No	11 (37.90)	18 (62.10)	29 (100.00)	43.18	2	<0.001
Yes	415 (74.0)	146 (26.0)	561 (100.00)			
Total	429	179	608			

Inferential analysis

As shown in Table 6, there is a statistically significant association between the educational status of participants and the vaccination status of their children (χ^2 = 59.85, df = 4, P < 0.001). Also, there is a significant association (χ^2 = 20.89, df = 2, P < 0.001) between the occupational status of respondents and the vaccination status of their children. Additionally, a significant association also exist between family setting (χ^2 = 27.70, df = 3, P < 0.001), religion (χ^2 = 51.64, df = 3, P < 0.001), place of birth (χ^2 = 32.12, df = 2, P < 0.001), type of birth (χ^2 = 7.27, df = 2, P = 0.03), breastfeeding status (χ^2 = 80.75, df = 2, P < 0.001), maternal antenatal visit (χ^2 = 85.37, df = 2, P < 0.001) and the vaccination status of children.

Additionally, having the same healthcare practitioner administer the vaccine to a child (χ^2 = 95.81, df = 2, P < 0.001) and having the assurance that healthcare providers care about a child's health (χ^2 = 16.56, df = 2, P < 0.001) as well as openly discussing the side effects of vaccines with a health professional (χ^2 = 43.18, df = 2, P < 0.001) was significantly associated with the vaccination status of children in the community (Table 7).

Also, media report (χ^2 = 6.78, df = 2, P = 0.034) and information shared on social media (χ^2 = 4.36, df = 2, P = 0.001) as well as influence of religious (χ^2 = 40.10, df = 2, P < 0.001) and community leaders (χ^2 = 16.09, df = 2, P < 0.001) were significantly associated with the vaccination status of children (Table 8).

Additionally, past adverse experience (χ^2 = 11.21, df = 2, P = 0.004) and events that affect trust in vaccines (χ^2 = 7.05, df = 2, P = 0.029), and past community rejection of vaccines (χ^2 = 24.40, df = 2, P < 0.001) as well as the ethnic background of participants (χ^2 = 28.19, df = 2, P < 0.001), were significantly associated with the vaccination status of children (Table 9).

Moreover, trust in government decision about vaccines (χ^2 = 37.00, df = 2, P < 0.001), agreement with government approved vaccination schedule (χ^2 = 81.05, df = 2, P < 0.001) and confidence that the government provides quality vaccines (χ^2 = 25.92, df = 2, P < 0.001) were significantly associated with vaccination status in children. Also, payment for vaccination (χ^2 = 22.34, df = 2, P < 0.001) and the lifestyle and mobility characteristics of caregivers (χ^2 = 35.55, df = 2, P < 0.001) was also significantly associated with the vaccination status of children resident in the target community (Table 10).

Additionally, the multiple logistic regression model was significant and showed a good fit for the data (χ^2 =170.027, P < 0.001). However, it explains 68.70% (Nagelkerke Pseudo R^2 = 0.687) of the expected variation in the vaccination status of children. The odds of attaining complete vaccination (Table 11) is 2.1 times higher among caregivers with secondary education (OR = 2.069, 95% CI 0.669–6.400, P = 0.207). Also, the odd of not completely vaccinating a child is 8.9% higher with increasing birth order (OR = 0.911, 95% CI 0.662–1.252, P = 0.564). Moreover, an adequate level of knowledge about immunisation is significantly associated with a 4-fold increased odds of attaining complete vaccination status (OR = 3.606, 95% CI 1.305–9.964, P = 0.013). Additionally, the lack of respectful treatment of caregivers by healthcare professionals was associated with a 65.4 % chance of not completing the vaccination of a child (OR = 0.346, 95% CI 0.050–2.407, P = 0.284). Also, for caregivers who accept newly introduced vaccines, the odds of achieving complete vaccination status for their children are 5.9 times higher (OR = 5.899, 95% CI 1.899–18.331, P = 0.002) than those who reject new vaccines.

Table 8 Relationship between vaccination status and information, and influence of community and religious leaders

Variables	Vaccination Status		Total n (%)	Pearson Chi-Square Value	Df	*P*-value
	Complete n (%)	Incomplete n (%)				
Reconsideration following Media Reports						
No Response	12 (48.00)	13 (52.00)	25 (100.00)	6.78	2	0.034
No	406 (71.70)	160 (28.30)	566 (100.00)			
Yes	11 (64.70)	6 (35.30)	17 (100.00)			
Total	**429**	**179**	**608**			
Share Information about Vaccines in Social Media						
No Response	6 (31.60)	13 (68.40)	19 (100.00)			
No	407 (71.80)	160 (28.20)	567 (100.00)	4.36	2	0.001
Yes	16 (72.70)	6 (27.30)	22 (100.00)			
Total	**429**	**179**	**608**			
Believe Media Reports about Children Lost to VPDs						
No Response	12 (48.00)	13 (52.00)	25 (100.00)			
No	317 (81.10)	74 (18.90)	391 (100.00)	88.45	2	<0.001
Yes	100 (52.10)	92 (47.90)	192 (100.00)			
Total	**429**	**179**	**608**			
Have Child Vaccinated Because Others in Community Do						
No Response	2 (12.50)	14 (87.50)	16 (100.00)			
No	415 (72.30)	159 (27.70)	574 (100.00)	26.93	2	<0.001
Yes	12 (66.70)	6 (33.30)	18 (100.00)			
Total	**429**	**179**	**608**			
Agree with Religious Leaders who don't Support Vaccination						
No Response	2 (11.80)	15 (88.20)	17 (100.00)			
No	68 (88.30)	9 (11.70)	77 (100.00)	40.10	2	<0.001
Yes	359 (69.80)	155 (30.20)	514 (100.00)			
Total	**429**	**179**	**608**			
Doubt Vaccination because Leaders are Against it						
No Response	6 (28.60)	15 (71.40)	21 (100.00)			
No	217 (69.30)	96 (30.70)	313 (100.00)	20.87	2	<0.001
Yes	206 (75.20)	68 (24.80)	274 (100.00)			
Total	**429**	**179**	**608**			
Community Welcome New Vaccines						
No Response	3 (16.70)	15 (83.30)	18 (100.00)			
No	64 (91.40)	6 (28.60)	70 (100.00)	40.07	2	<0.001
Yes	362 (69.60)	158 (30.40)	520 (100.00)			
Total	**429**	**179**	**608**			
Community Leaders Speak Against Vaccination						
No Response	12 (40.00)	18 (60.00)	30 (100.00)			
No	407 (71.80)	160 (28.20)	567 (100.00)	16.09	2	<0.001
Yes	10 (90.90)	1 (9.10)	11 (100.00)			
Total	**429**	**179**	**608**			

Discussion

In the present study, 72.90% of children in the target community were completely immunised, which falls below the global vaccine action plan target of 80%.[6, 25] Comparatively, the coverage rate was higher than the rate of 61.90% obtained from Sabongidda-Ora, a rural community in Edo State, and lower than the rate of 80.70% obtained from another study conducted in Edo State Nigeria.[15, 26] The improvement in coverage rate from the earlier report of 61.90% in previous studies may be due to increased access to information, because 76% of respondents claimed that they received sufficient information about vaccination from vaccinators and 84.7% indicated that health centres were their preferred source of information. Moreover, for individual antigens, the study showed that the lowest rates were observed for rotavirus (0.80%), MMR (0.80%) and MenVac (38.50%) antigens. This may be attributed to the underutilisation of the recently introduced vaccines in the national immunisation schedule and logistic issues related to vaccine supply in Nigeria.[9, 27]

Although higher rates were recorded for the individual antigens (BCG, polio, pentavalent/DPT, measles and yellow fever), there is still an unacceptable gap in knowledge with 64.5% of the population having inadequate knowledge about vaccination and 49.3% not knowing the appropriate vaccine for themselves and their children. However, on the basis of national reports, only 18% of children aged 12–23 months are completely immunised in the first year of life, with specific vaccine coverage showing a low rate for BCG (53.1%), polio (34%), pentavalent vaccine (34.4%), measles (41.8%) and yellow fever (39%). There is, however, no available national data for MenVac, MMR and rotavirus vaccines.[27]

Caregivers' educational status and level of knowledge are very important factors determining vaccine uptake in the population.[12] The present study showed that educational status and the adequacy of caregiver's knowledge were significantly associated with the vaccination status of children in the study population. Additionally, there was a 4-fold increased odds of attaining complete immunisation

Table 9 Relationship between vaccination status and historical, socio-cultural, religious and gender-based factors

Variables	Vaccination Status		Total *n* (%)	Pearson Chi-Square Value	Df	*P*-value
	Complete *n* (%)	Incomplete *n* (%)				
Past Experience Against Vaccination						
No Response	8 (38.10)	13 (61.90)	21 (100.00)			
No	397 (71.90)	155 (28.10)	552 (100.00)	11.21	2	0.004
Past Events that Affect Trust						
No Response	22 (55.00)	18 (45.00)	40 (100.00)			
No	385 (72.40)	147 (27.60)	532 (100.00)	7.05	2	0.029
Yes	22 (61.10)	14 (38.90)	36 (100.00)			
Total	**429**	**179**	**608**			
Community Reject Vaccine in the Past						
No Response	5 (27.80)	13 (72.20)	18 (100.00)			
No	422 (72.40)	161 (89.90)	583 (100.00)	24.40	2	<0.001
Yes	2 (28.60)	5 (71.40)	7 (100.00)			
Total	**429**	**179**	**608**			
Refuse Vaccination on Ethnic background						
No Response	4 (19.00)	17 (81.00)	21(100.00)			
No	422 (72.50)	160 (27.50)	582 (100.00)	28.19	2	<0.001
Yes	3 (60.00)	2 (40.00)	5 (100.00)			
Total	**429**	**179**	**608**			

status in children whose caregivers had adequate knowledge compared with children whose caregivers have inadequate knowledge about vaccination. This finding was also observed in children born to mothers with no education and were more likely to be unimmunised compared with children born to educated mothers.[14] Additionally, Malende *et al*.[28] also implicated the level of caregiver's knowledge as one of the barriers to effective uptake of vaccines in a rural community in Uganda. Other factors identified in the study to be significantly associated with the vaccination status of children include the individual and group characteristics of caregivers such as occupational status, family setting, religion, birth order, place of birth and the breastfeeding status of children. This finding is corroborated by other studies that also showed a significant association between these determinants and vaccination status.[4, 29]

Additionally, the significant association of maternal ANC visits with the vaccination status of the child may be a result of the enhanced exposure of caregivers to information about vaccination during their visit to health facilities. Additionally, findings such as the significant association of breastfeeding status with vaccination are corroborated by other studies which suggest that breastfeeding reduces the crying of the child during immunisation, hence, is likely to enhance the vaccination completion rate of children.[30] The present finding shows that the odds of not completely vaccinating a child was 8.9% higher with increasing birth order (OR = 0.911, 95% CI 0.662–1.252, *P* = 0.564). This is supported by the finding of Ijarotimi *et al*.[14] which observed that children of birth orders above four and those born in a polygamous setting were more likely to be incompletely immunised when compared with children from lower birth order and those from a monogamous and single-family setting. This similarity in observation may be related to the similar socio-cultural setting of the study. Moreover, the significant association (χ^2 = 27.78, df =3, *P* < 0.001) of urban–rural exposure of caregivers with the vaccination status of children is also supported by the finding of a study conducted in Nigeria in which it was observed that children in rural areas had a lower likelihood of being completely immunised compared with those from urban areas.[31]

Additionally, the study showed that most participants do not share information about vaccination on the social network with only 8.1% of participants willing to vaccinate their children based on information from a social network. However, media reports and information shared on social media (χ^2 = 6.78, df =2, *P* = 0.034; χ^2 = 4.36, df =2, *P* = 0.001) were significantly associated with the vaccination status of the child. However, a recent study showed that the use of patient-based immunisation campaign websites significantly improved the vaccination coverage rate.[32] Additionally, evidence has shown that providing information through the use of reminders such as text messages and other social platforms has significantly helped to improve immunisation coverage rates.[33] Also, in the study, 4.9% of caregivers claim that their children have experienced severe adverse reactions following vaccination, with the majority (95.60%) believing that some vaccines are safer than the others and that healthcare providers do not give sufficient information (31.1%) about side effects before administering the dose. This finding is corroborated by studies that have shown that vaccine safety scare can negatively impact on vaccine utilization rates by eroding public trust and confidence in vaccination.[34] This appears to be a critical factor with some participants stating they will reject, avoid or delay a child's vaccination with a newly introduced vaccine. This is because of the safety concerns of caregivers since the past experience with vaccines (χ^2 = 11.21, df = 2, *P* = 0.004) and past vaccine-related events (χ^2 = 7.05, df =2, *P* = 0.029) were significantly associated with the vaccination status of children in the present study. An example is the Trovan vaccine trial of 1996 that led to the crippling and death of children in Northern Nigeria which caused a significant drop in immunisation coverage rate in Borno and other Northern States of Nigeria.[35]

The role of religious and community leaders in vaccination coverage cannot be overemphasised. In the study, the influence of religious and community leaders was significantly associated with vaccination status. In a similar study conducted by Ruijs *et al*.,[36] the role of religious leaders in promoting vaccine acceptance was evaluated qualitatively and showed views that ranged from complete acceptance to total rejection which was hinged on doctrinal issues.

Table 10 Relationship between vaccination status and political, geographical and pharmaceutical factors

Variables	Vaccination Status		Total n (%)	Pearson Chi-Square Value	Df	P-value
	Complete n (%)	Incomplete n (%)				
Trust/Distrust Government Decision						
No Response	2 (10.0)	18 (90.00)	20 (100.00)			
Distrust	9 (64.30)	5 (35.70)	14 (100.00)	37.00	2	<0.001
Trust	418 (72.80)	156 (27.20)	574 (100.00)			
Total	**429**	**179**	**608**			
Agree with Government Recommended Schedule						
No Response	2 (10.00)	18 (90.00)	20 (100.00)			
Agree	425 (73.10)	156 (26.90)	581 (100.00)	81.05	2	<0.001
Disagree	2 (28.60)	5 (71.40)	7 (100.00)			
Total	**429**	**179**	**608**			
Confident Government Provide Quality Vaccines						
No Response	7 (28.00)	18 (72.00)	25 (100.00)			
No	30 (85.70)	5 (14.30)	35 (100.00)	25.92	2	<0.001
Yes	392 (71.50)	156 (28.50)	548 (100.00)			
Total	**429**	**179**	**608**			
Have Impression Government don't Provide the best Vaccines						
No Response	5 (25.00)	15 (75.00)	20 (100.00)			
No	380 (71.40)	152 (28.60)	532 (100.00)	21.91	2	<0.001
Yes	44 (78.60)	12 (21.40)	56 (100.00)			
Total	**429**	**179**	**608**			
Distance & Time to Health in Vaccines						
Yes	24 (68.60)	11 (31.40)	25 (100.00)			
Total	**429**	**179**	**608**			
Facility Hindered Vaccination						
No Response	3 (13.60)	19 (86.40)	22 (100.00)			
No	342 (70.70)	142 (29.30)	484 (100.00)	41.15	2	<0.001
Yes	84 (82.40)	30 (17.60)	102 (100.00)			
Total	**429**	**179**	**608**			
Pay for Vaccination						
No Response	16 (47.10)	18 (52.90)	34 (100.00)			
No	367 (74.70)	124 (25.30)	491 (100.00)	22.34	2	<0.001
Yes	46 (55.40)	37 (44.60)	83 (100.00)			
Total	**429**	**179**	**608**			
Lifestyle & Mobility Prevent Vaccination						
No Response	7 (29.20)	17 (70.80)	24 (100.00)	35.55	2	<0.001
No	369 (69.90)	159 (30.10)	528 (100.00)			
Yes	53 (94.60)	3 (5.40)	56 (100.00)			
Total	**429**	**179**	**608**			
Believe Vaccine Producers Interested in Child's Health						
No Response	5 (20.80)	19 (79.20)	24 (100.00)			
Believe	422 (73.00)	156 (27.00)	578 (100.00	34.24	2	<0.001
Don't Believe	2 (33.30)	4 (66.70)	6 (100.00)			
Total	**429**	**179**	**608**			
Government Lobbied by Pharmaceutical Companies						
No Response	4 (21.10)	15 (78.90)	19 (100.00)			
No	367 (72.80)	137 (27.20)	504 (100.00)	23.88	2	<0.001
Yes	58 (68.20)	27 (31.80)	85 (100.00)			
Total	**429**	**179**	**608**			
Trust Pharmaceutical Companies to Provide Safe & Effective Vaccines						
No Response	4 (18.20)	18 (81.80)	22 (100.00)	31.06	2	<0.001
No	16 (64.00)	9 (36.00)	25 (100.00)			
Yes	409 (72.90)	152 (27.10)	561 (100.00)			
Total	**429**	**179**	**608**			

Additionally, other studies have shown that the involvement of religious leaders in vaccination campaigns can enhance the mobilisation of individuals and families within the community towards vaccination.[37, 38] Also, in this vein, UNICEF has recognised the need to gain the support of religious leaders in embarking on vaccination programs because of the great influence they wield at the grass-root level.[39] Government and healthcare professionals also play a major role in improving vaccination coverage. The study shows that trust

Table 11 Multiple logistic regression showing the relationship between vaccination status and multiple independent variables

Variables	Regression Coefficient B	Std. Error	Wald Statistics	*P*-value	Odds Ratio Exp (B)	95% Confidence Interval of Exp (B)	
						Lower Boundary	Upper Boundary
Complete Vaccination Intercept	-27.821	12.976	4.597	0.032			
Educational status							
No formal Education	0.260	1.058	0.060	0.806	1.296	0.163	10.314
Primary Education	0.788	0.609	1.676	0.195	2.199	0.667	7.246
Secondary Education	0.727	0.576	1.592	0.207	2.069	0.669	6.400
Birth Order	-0.094	0.162	0.332	0.564	0.911	0.662	1.252
Occupation	-0.211	0.583	0.131	0.717	0.810	0.258	2.537
Employed							
Sex of Child	-0.833	0.455	3.350	0.067	0.435	0.178	1.061
Female							
Caesarean Section	0.052	1.071	0.002	0.961	1.054	0.129	8.597
Birth at Health Facility	3.374	2.370	2.027	0.154	29.197	0.281	3036.413
No. of ANC Visits	-0.206	0.072	8.192	0.004	0.814	0.707	0.937
Adequate Knowledge	1.282	0.519	6.114	0.013	3.606	1.305	9.964
Accept New Vaccines	1.775	0.578	9.414	0.002	5.899	1.899	18.331
Not Treated with Respect by Health Practitioners	-1.061	0.990	1.150	0.284	0.346	0.050	2.407

in government decisions about vaccination and the confidence that the government provides quality vaccines were significantly associated with vaccination status. Also, ill-treatment of caregivers by healthcare professionals was associated with a 65.4% chance of not completing the vaccination of children in the study population (OR = 0.346, 95% CI 0.050–2.407, *P* = 0.284).

This report was also noted by Mekonnen *et al.*[40] who observed that disrespectful behaviour of health professionals was one of the prime factors that delayed the vaccination of children by their mothers. The study also showed that trust in healthcare professionals was significantly associated with childhood vaccination status. According to Bauingaertner *et al.*[41] respondents who had trust in healthcare professionals as well as government health experts were more likely to embark on vaccination of their children.

Study strengths and limitations

The reliability of the study was enhanced by the use of a standardised questionnaire which was patterned after the model developed by the SAGE vaccine hesitancy working group.[42] Also being a cross-sectional study, it was able to assess the proportion of children fully vaccinated and evaluate the association between various determinants and vaccination status. However, as the questionnaire was not self-administered, the internal validity of the study may be reduced due to the information bias that may occur in the course of the interview. Another potential source of information bias is the non-response to questions by some respondents either due to perceived intricacies in some questions asked or an inherent feeling that confidentiality will not be maintained. Also, other confounding variables may have interfered with the internal validity of the study.

Conclusion

The study has shown a suboptimal vaccine coverage rate in the rural community examined, which typifies what is obtainable in other rural communities in Nigeria. Therefore, to achieve improved immunisation coverage in rural communities, interventional programs that utilise a multidimensional approach will have to be deployed to ensure that appropriate vaccines are supplied, maintained and utilised in every district of the country. This will help to meet the needs of children and reduce childhood mortality from VPDs.

Recommendations

- Immunisation coverage programs should be designed using a comprehensive interventional framework that targets key stakeholders in rural communities. This includes caregivers, community leaders, community-based organisations as well as community healthcare workers.
- Additionally, caregiver's behavioural disposition and ability to make informed decision about immunisation can be enhanced by educating them during clinic visits, before vaccination sessions, during antenatal visits and through the use of information slips and posters which can be distributed within the community. Moreover, mass immunization campaigns and focussed group discussion involving community leaders are required for improved community mobilisation.
- Also, the introduction of effective feedback and performance tracking mechanism is needed for proper monitoring and evaluation of vaccination activities within the community.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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