

IMMUNISATION STATUS AND OCCURRENCE OF VACCINE-PREVENTABLE DISEASES AMONG THOSE UNDER-5 IN A NIGERIAN RURAL COMMUNITY

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Abstract

Background: Immunisation remains the most effective public health intervention to reduce morbidity and mortality associated with infectious diseases. Nigeria is among the ten countries in the world with the lowest immunisation coverage giving room for the resurgence of Vaccine-Preventable Diseases (VPDs) in children.

Objective: The study assessed the immunisation status and occurrence of childhood Vaccine-Preventable Diseases in the Kwandare community of Lafia LGA, of Nasarawa State, Nigeria.

Methods: The study was a community-based cross-sectional study involving 240 mothers with children aged 12-60 months (under-five children). A simple random sampling of households was enumerated to get eligible households for the study. Data were collected from eligible households using structured questionnaires designed to elicit relevant information such as socio-demographics, immunisation history and occurrence of Vaccine-Preventable Diseases. Descriptive analyses, including frequencies and proportions and inferential statistics using Pearson's Chi-square and Multivariate logistic regression, were carried out using SPSS version 20.

Results: The study revealed a total immunisation rate of 82(34%) prevalence of Vaccine-Preventable Diseases was 31(13%), with measles being the most prevalent vaccine-preventable disease. The low uptake of the measles vaccine by only 152(63.3%) children was significantly ($P<0.024$) associated with the prevalence of measles in the community of study.

Conclusion: The study revealed a low (34%) full immunisation rate, which is insufficient to provide herd immunity against vaccine-preventable diseases in the community and a 13% prevalence of VPDs, with measles being the most prevalent. A relationship exists between immunisation status and the occurrence of measles in the community.

Key Words: Immunisation status, Vaccine, Childhood diseases, under-five, Nigeria

Introduction

Immunisation is the process of rendering a subject immune or becoming immune. It is also known as inoculation or vaccination. There are two main types of immunity; active immunity and passive immunity. Active immunity is acquired when an antigen provokes an individual's immune system to produce antibodies with life-long protection against disease. In contrast, passive immunity refers to the process of immunoglobulin G antibodies providing immediate but short-lived protection against infections.

Since 1974, global coverage of vaccines to prevent tuberculosis, diphtheria, tetanus, pertussis, poliomyelitis, and measles has increased from less than 5% to 86% [1]. The world health organisation (WHO) recommends that vaccines be administered during the first year of life within a specified scheduled time and interval. According to the WHO guidelines, complete immunisation status is defined as a child who has received a BCG, three doses of DPT, at least three doses of oral polio, and one dose of the measles vaccine. The recommended immunisation schedule is designed to protect children early in life when they are most vulnerable and before they are exposed to potentially life-threatening diseases. Globally the proportion of the world's children who receive recommended

vaccines has remained the same over the past few years. In 2019, about 85% of infants worldwide (116 million infants) received three doses of the Diphtheria-Pertussis-Tetanus (DPT) vaccine, protecting them against infectious diseases that can cause severe illnesses and disability or be fatal. In 2019, 125-member states of the world health organisation reached at least 90% coverage of the DPT vaccine^[2]. DPT1 to DPT3 dropout rates include populations that are hard to reach and those that are hard to vaccinate. Due to geographic distance or terrain factors, hard-to-reach populations face supply-side barriers to vaccination. In contrast, hard-to-vaccinate populations include those who are reachable but whose distrust, religious beliefs or other factors can lead them to decide against vaccination for their children^[3].

Suboptimal progress has been made in vaccination coverage worldwide since the establishment of the Expanded Program on Immunization (EPI) in 1974. Fewer than two-thirds of all countries globally reached the Global Vaccine Action Plan (GVAP) 2020 target of $\geq 90\%$ national coverage with DPT3 and Measles Containing vaccines^[4].

Though Africa has made tremendous progress in improving access to immunisation, many countries are off track to achieving the GVAP target of $\geq 90\%$ immunisation coverage by 2020. This is because one out of every five African children still lacks access to all the WHO-recommended life-saving vaccines, which is not only a threat to the health of the families but also the strength of the economies and equity in African societies^[5]. Sub-Saharan Africa remains the region with the highest under-5 mortality rates in the world, with one child in thirteen dying before his or her fifth birthday. Two regions, Sub-Saharan Africa and Central and Southern Asia, accounted for more than 80% of the 5.2 million under-five deaths in 2019^[2]. A significant finding from the 2016 Multiple Indicators Cluster Survey/ National Immunization Survey Coverage (MICS/NICS) reveals that 77% of children aged 12-23 months in Nigeria have not received all the vaccines as recommended by the nation's EPI schedule^[6]. Forty per cent (40%) of children in this age group did not receive any vaccine. A Vaccine Preventable Disease (VPD) is an infectious disease for which an effective vaccine exists. The most common and severe VPDs tracked by the WHO are diphtheria, pertussis, tetanus, mumps, and Haemophilus influenzae serotype B infection. According to the WHO, every year, more than thirty million (30M) under five children fall sick due to VPDs, which accounts for 58% of global paediatric deaths. Such diseases can impose an economic burden of thirteen billion U.S. dollars (13B USD) yearly, funding that could be used to fuel the economy and drive development^[7]. Complete immunisation against tuberculosis and poliomyelitis and immunisation documentation are the most cost-effective interventions against VPDs.

Routine immunisation against DPT, polio, measles and tuberculosis (T.B.) is a cost-effective intervention for reducing childhood illness and mortality. However, national coverage in Nigeria for full immunisation is less than 13%, one of the lowest rates in the world even lower than many countries in conflict such as the Democratic Republic of Congo (DRC). Some states in northern Nigeria have coverage rates as low as 1%, and the average for the northwestern zone is just 4%. These coverage figures are much worse than in the neighbouring countries of Benin, Chad and Cameroon^[8]. Moreover, children in urban areas are more than twice likely as rural children to be vaccinated. Despite overwhelming evidence that vaccines prevent childhood disease with resultant significant health and economic benefits, Nigeria remains among the countries with the lowest immunisation coverage globally. This unnecessarily increases the burden of VPDs such that Nigeria and India alone accounted for almost a third of global deaths due to VPDs. Findings from recent studies coupled with the resurgence of VPDs in people supposedly protected by vaccines should interest public health practitioners.

This study assessed the immunisation status of under-five children and related it to the occurrence of vaccine-preventable childhood diseases in the Kwandare community of Lafia, Nasarawa State, Central Nigeria.

Methods

Study location and setting

The study was carried out in the Kwandare community in the Lafia Local Government Area of Nasarawa state, central Nigeria. Lafia is located on latitude 8.48°N and longitude 8.52°E with an estimated land area of 2,733km² and a population of 329,922^[9]. The indigenous people of Kwandare are the Gwandara tribe, and the main languages spoken are Hausa and Gandara. The climate is sub-humid with two distinct seasons; the rainy and dry seasons. Many of the inhabitants are farmers in cash crops like rice and yam. They are also into livestock farming like cattle, goats and sheep, mainly reared for commercial purposes. The women are into farming and petty trading, such as selling fruits and vegetables. There are other minority ethnic groups, mainly the Igbos and Hausas, who settled in the community engaging in diverse kinds of businesses. The community has a Comprehensive Primary Health Centre (CPHC) and government-owned primary and secondary schools.

Study population/Sample size

Inclusion/exclusion criteria: Included were mothers of children aged 12-60 months permanently residing in the community at the time of the study and who have the immunisation cards of their children and gave consent to participation in the study. Excluded in the study were women of eligible children who could not present their children's immunisation cards. A sample size of 240 was calculated for the study using Fisher's formula^[10] for studying proportions when the population is greater than 10,000, assuming proportion in the target population with an estimated 15.8% (0.158) full immunisation coverage^[11].

Study design/Data collection

A cross-sectional community-based descriptive study design was used for the research.

Two weeks before the commencement of data collection, household enumeration was done to identify and label households with children aged 12 – 60 months and to seek the consent of household heads to allow access to their families for the interview. Convenience sampling was used for household enumeration for families with children in the age bracket of the study. To avoid possible bias from one of the authors who worked in the clinic where the community accessed immunisation services for their children, that author was excluded from participation in household enumeration and interview during data collection. A week later, the community head delegated the youth leader/town crier and religious leaders to make announcements in the marketplace, churches and mosques to encourage participation. The community women leader also encouraged women to participate in the study, make their children's vaccination cards available and be as truthful as they could in giving out information during the interview. The preceding 240 respondents in 187 households were interviewed in the study area between August and October 2019. The main instrument for data collection was an interviewer-administered questionnaire. The questionnaire was adapted from two previous studies^[12;13] and modified to meet the study objective. It was divided into three sections; section A: socio-demographic characteristics of respondents, section B: child immunisation history and section C: occurrence of childhood Vaccine-Preventable Diseases. The questionnaires were pre-tested in Randan Sarki 1, a rural community in Shabu/Kwandare ward, analysed and necessary modifications effected. The questionnaire was administered house to house in the cluster households previously labelled for the study. As soon as a household interview was completed, the label was removed or marked as completed.

Ethical consideration

The approval to conduct the study was obtained from the Nasarawa State Health Research Ethics Committee (ref. no. NSHREC18/06/2017). Permission to carry out the study was sought and obtained from the ward head of the Kwandare community. Written informed consent was obtained from the respondents prior to the interview.

Data analysis

Descriptive analyses included frequencies and proportions for categorical variables. In addition, the mother's age was reported as mean±standard deviation (Mean±SD) while the child's age (in months) was reported as median with interquartile range (IQR). To evaluate the immunisation status of children, those who received all of BCG, OPV₁, OPV₂, OPV₃, Penta 1, Penta 2, Penta 3 and measles/yellow fever vaccines were categorised and defined as 'fully immunised' children. Bivariate analysis of factors associated with 'full immunisation' was performed using Pearson's Chi-square of independence and Fisher's Exact Test, respectively. The following variables were conceptualised to independently influence a child's immunisation status: the presence of an immunisation centre in the community, history of side effects following immunisation, availability of vaccines in the immunisation centre and awareness of Vaccine-Preventable Diseases. Statistical tests were two-sided, with alpha defined as $p < 0.05$. All statistical analyses were performed using IBM Statistical Package for Social Science (SPSS) version 20 for windows.

Results

Children aged 12-24 months were 51.7%, 25-36 months (20.4%), while those aged 37-48 months were 15.8%, and those within the range of 49-60 months were 12.1%, in the same vein, 126(52.5%) were males and 144(47.5%) females (Table 1).

Table 1: Demographic characteristics of children (N=240)

Variable	Frequency	Percentage
Sex		
Male	126	52.5
Female	114	47.5
Age (Months)		
12 – 24	124	51.7
25 – 36	49	20.4
37 – 48	38	15.8
49 – 60	29	12.1
Median (IQR)	24(18, 26)	

IQR = interquartile range

Of the 240 respondents interviewed, 93(38.8%) had no formal education, while 9(3.8%) had tertiary education. The rest had primary or secondary education. 221 (92.1%) were Muslims, with 19(7.9%) Christians. 218(90.8%) were married, and 1(0.4%) were single, with widows and divorced/separated making up the rest. Of the 240 respondents, those engaged in farming and petty traders were 182(75.8%), while civil servants were 8(3.3%). One hundred and thirty-one (54.6%) were from polygamous settings, while 109(45.4%) were from monogamous settings (Table 2).

Table 2: Mothers' demographic characteristics (N=240)

Variable	Frequency	Percentage
Age (Years)		
≤ 17	17	7.1
18 – 29	133	55.4
30 – 39	76	31.7
≥ 40	14	5.8
Educational status		
None	93	38.8
Primary	71	29.6
Secondary	67	27.9
Tertiary	9	3.8
Religion		
Christianity	19	7.9
Islam	221	92.1
Marital status		
Married	218	90.8
Single	1	0.4
Widow	18	7.5
Divorced/Separated	2	0.8
Occupation		
House wife	40	16.7
Business woman	182	75.8
Peasant farmer	10	4.2
Civil servant	8	3.3
Place of child delivery		
Home	65	27.1
Traditional birth attendant	8	3.3
Healthcare facility	167	69.6
Family type		
Nuclear	95	39.6
Extended	144	60
Marriage type		
Monogamous	109	45.4
Polygamous	131	54.6

Full immunisation was recorded in 34% of the children, while 66% who skipped antigens were categorised as partially immunised. As a result, the incidence of vaccine-preventable disease occurred in 13% of the children, while 87% were protected (figure 2).

Table 3: Immunization status and occurrence of vaccine preventable diseases (VPDs) in the community

Variable	Frequency	Percentage
Immunization status		
Fully immunized	82	34
Partially immunized	158	66
Occurrence of VPDs		
Yes	31	13
No	209	87

Seventy-seven per cent of respondents had their child immunisation cards, and the availability of the cards significantly influenced immunisation status ($P<0.05$). Availability of vaccine in health facilities on the due date of vaccination was reported by 97.5% of respondents, and taking the children for immunisation on the due date significantly influenced the immunisation status of the children ($P<0.05$). Awareness of vaccine-preventable diseases and history of side effects to vaccines had no significant influence on immunisation status (Table 4).

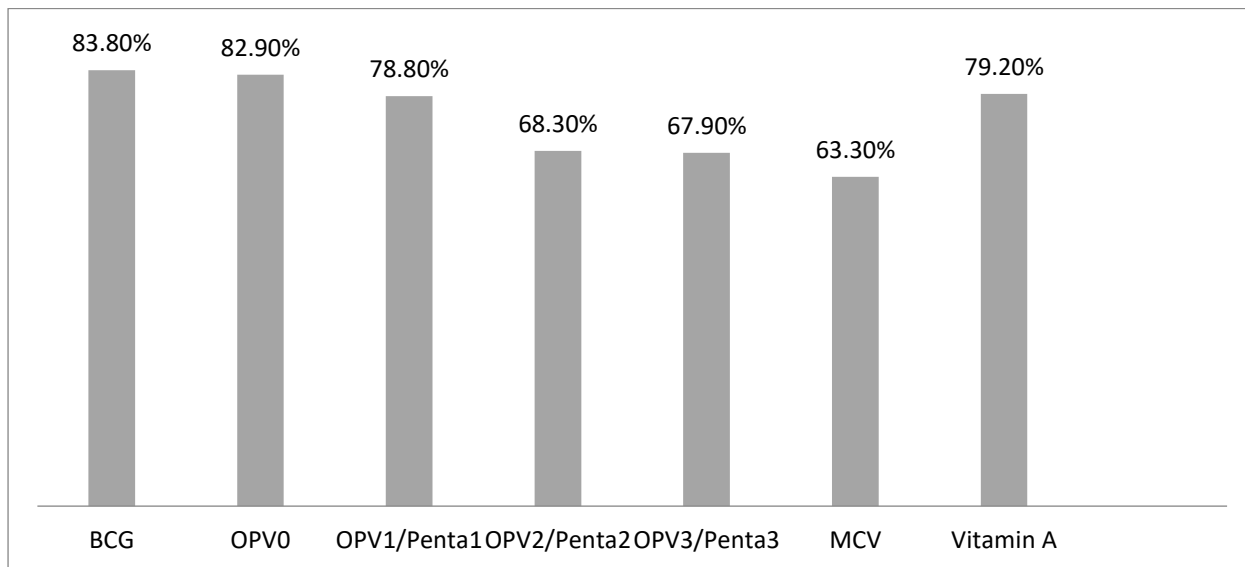
Table 4: Factor influencing childhood immunization status

Variable	Fully immunized		Partially immunized	P-value
	N	n (%)	n (%)	
Availability of immunization card				
Yes	185	74(40.0)	111(60.0)	0.000*
No	55	6(10.9)	49(81.1)	
Presence of immunization center				
Yes	240	80(33.3)	160(66.7)	
No	0	0(0.0)	0(0.0)	
Taking child for immunization on due date				
Yes	190	71(37.4)	119(62.6)	0.010*
No	50	9(18.0)	41(82.0)	
History of side effects of vaccine				
Yes	28	9(32.4)	19(67.9)	0.667
No	212	71(33.5)	141(66.5)	
Availability of vaccine on due of immunization				
Yes	234	77(32.9)	157(67.1)	0.403
No	6	3(50.0)	3(50.0)	
Awareness of vaccine preventable diseases				
Yes	233	77(33.0)	156(67.0)	0.689
No	7	3(42.9)	4(57.1)	
Having children with vaccine preventable diseases				
Yes	31	9(29.0)	22(71.0)	0.586
No	209	71(34.0)	138(66.0)	

* $P<0.05$

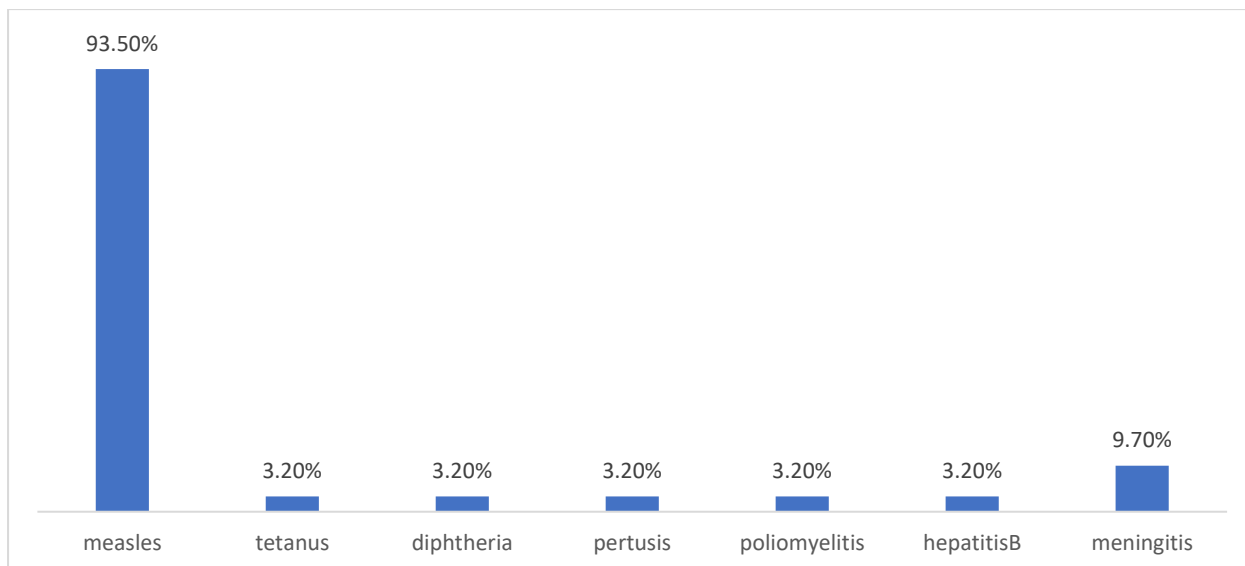
The majority of the mothers revealed that their children received BCG (83.8%) and OPV0 (82.9%), while only 63.3% returned their children for MV/YFV, as depicted in figure 1

Figure 1: Antigen-based immunisation coverage



Measles was recorded as the most prevalent VPD (93.5%), while meningitis was 9.7%, with all others at 3.2% observed in the study (figure 2)

Figure 2: Occurrence of vaccine-preventable diseases in the community



Measles was the most prevalent VPD (93.5%), in which 75.9% of those infected were partially immunised while 24.1% were fully immunised. A statistical significance ($p=0.024$) was observed. Overall, three children had meningitis, of which the majority (66.7%) were fully immunised, with 33.3% partially immunised. Tetanus, diphtheria, pertussis, poliomyelitis and hepatitis B were the least prevalent VPDs, and 100% were partially immunised (table 5).

Table 5: Relationship between immunization status and occurrence of vaccine preventable childhood diseases

Diseases Occurrence	Fully immunized		Partially immunized	P-value
	N	n (%)	n (%)	
Measles	29	7(24.1)	22(75.9)	0.024*
Tetanus	1	0(0.0)	1(100.0)	1
Diphtheria	1	0(0.0)	1(100.0)	1
Pertussis	1	0(0.0)	1(100.0)	1
Poliomyelitis	1	0(0.0)	1(100.0)	1
Hepatitis B	1	0(0.0)	1(100.0)	1
Meningitis	3	2(66.7)	1(33.3)	1

* $P < 0.05$

Discussion

Vaccination is a cost-effective intervention to reduce morbidity and mortality due to vaccine-preventable diseases. Immunisation has become a key component of child survival strategies and an effective public health tool for disease control worldwide. In this study, full immunisation coverage in the community was far below national and global targets. This is despite the availability of vaccines at no cost, the presence of a Health Care Facility in the community and knowledge of the importance/benefits of immunisation. This suggests the underutilisation of immunisation services in the community. This figure is lower than the findings of similar studies conducted in the southern parts of the country^[14;16] in Ogun, Lagos, and Ondo states, respectively.

On the contrary, the coverage in this study setting is better than in studies in the far North, where 4.7% was reported in Sokoto state^[12] and 7.6% in Zamfara state^[17]. Several reasons may contribute to these disparities; the southern region is more economically and educationally advanced than the northern region, where poverty and illiteracy are endemic. Literate couples and mothers will no doubt value the benefit of childhood immunisation, and this will encourage vaccination uptake for their children. However, illiteracy and religious insinuations about the intent of vaccination among the predominantly Muslim communities of the far North play a more significant role in the poor uptake of vaccinations. The central or middle belt of the country where this study was conducted lies between the North and South. Their views on the benefit and otherwise of childhood vaccination are influenced to different extents by the southern and northern communities. Immunisation coverage in this study is abysmally low compared to the acceptable target of 80% set by the National Programme on Immunization (NPI). The consequence of this suboptimal coverage is low herd immunity with the continual transmission of Vaccine-Preventable Diseases in the community.

Herd immunity is improved by immunising eligible children in the community, resulting in a lower incidence of diseases. This has been demonstrated in countries like the USA with greater than 90% coverage, where morbidity and mortality resulting from these diseases are significantly reduced and, in some cases, totally absent^[18]. There were variations in the coverage of individual vaccine antigens, with BCG and OPV₀ being the highest (83.8%/82.9%), respectively, while measles/ yellow fever vaccines had the lowest uptake (63.3%). An observation made from this study is that vaccine antigens administered early in the child's life (BCG and OPV₀) had the highest coverage. However, as time progressed, there was a gradual drop in coverage of antigens given much later, such as OPV₃ and Penta3, measles and yellow fever vaccines.

Previous studies have reported a similar pattern of gradual decline in antigen uptake, with measles and yellow fever vaccines being the lowest^[12;14;17]. This may be due to mothers' forgetfulness regarding the timing of such vaccines as the child ages. Long after delivery, loss of an immunisation card may compound the problem, and women may give up on the immunisation, especially if the child is healthy. This may be why many start but fail to complete the immunisation schedule. The proximity of the place of delivery to the vaccination schedule for obtaining the earlier vaccines may explain the high rates of coverage for these vaccines (BCG/OPV₀). Many mothers may forget to bring their children measles and yellow fever vaccines (administered at nine months). Ayano^[19] also obtained a similar result from an Ethiopian research on the immunisation status of children. Another likely reason for the high uptake of BCG/OPV₀ in this study is that most mothers (69.6%) delivered in

Health Care Facilities, which availed them the opportunity to have their babies immunised in the health facilities before their being discharged to go home. Several factors have been reported to significantly influence complete immunisation status and immunisation coverage in Nassarawa State, such as socio-demographics, antenatal care attendance and the number of children per household^[20]. The overall prevalence of VPDs in the community was 13.0%. This may appear small in the community, but the preventable economic and disease burden on the affected families is enormous. These diseases occurred more in children who were partially immunised. Measles was observed to be the most prevalent (93.5%) VPD, followed by meningitis (9.7%), with tetanus, diphtheria, pertussis, poliomyelitis and hepatitis B all having the same and the lowest prevalence of 3.2% in the current study. A high prevalence of measles has been reported in a similar study^[12].

The likely reason measles was the most prevalent VPD in this study could be due to the decline in the uptake of the measles vaccine (63.3%), which is the lowest among the vaccine antigens. This low coverage of the measles vaccine cannot possibly interrupt the spread of measles in any outbreak. In addition, Adu *et al.*^[21] reported a low seroconversion rate of the measles vaccine among children in Nigeria, which may be a contributing factor among children. It is also known that the cold chain effect and storage system can affect the potency of the vaccines leading to primary failures. Another probable reason is the community's low (34%) vaccination coverage, inappropriate vaccination timing, and poor vaccination potency among vaccinated children. Another likely reason is that clinical manifestation of measles can be elicited early enough while others, such as hepatitis B, run a chronic latent phase^[12]. Since mothers are familiar with the maculopapular rash in measles, it may account for why it was reported mainly by mothers in the community. It was, however, observed that 24.1% of fully immunised children still came down with measles; this could be due to the untimely administration of the vaccine. It has been reported that many of the vaccines are received in an untimely fashion^[22]. This may affect its protective efficacy. In this study, there is a relationship between immunisation status and the occurrence of measles, such that inadequate measles vaccination leads to the occurrence of measles in the study community. The occurrence of diphtheria, tetanus, polio, pertussis and meningitis were low when compared to measles. The probable hypothetical reason for this may be due to the booster doses of pentavalent (3 doses if completed) and OPV (about four doses if completed), which may contribute to the low incidence of these diseases. It shows that vaccinations have helped to reduce or interrupt the transmission of these Vaccine-Preventable Diseases. Despite the low full immunisation status (34%) in the community, the 13% prevalence of VPDs may be attributed to factors other than vaccination, such as good sanitary conditions, good nutrition, exclusive breastfeeding and others, which may strengthen the immunity of the children.

Conclusion

Results from this study revealed that only 34% of children in the Kwandare community were fully immunised. This falls below the Global Vaccine Action Plan (GVAP) target of 80% by 2020. The study also revealed an overall prevalence of 13% of Vaccine-Preventable Childhood Diseases in the community, with measles being the most prevalent. The occurrence of measles is a consequence of inadequate measles vaccine coverage.

Study Limitation

A possible limitation of this type of study is that some vaccinations may not have been done on the due dates. This can affect the potency of immunisation even when immunisation schedules are reported as completed.

Conflict of Interests

The authors have not declared any conflict of interest.

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