Immunization Coverage in A Rural Community in Southwestern Nigeria

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Abstract

Background and aim: Poor immunization coverage especially in rural areas has led to a high burden of vaccine preventable diseases in children. The study assessed routine immunization coverage and its determinants in a rural community in South Western Nigeria.

Methods: A descriptive cross-sectional survey using the WHO cluster survey design was conducted among children aged 12 to 23 months. Coverage was assessed by immunization cards.

Results: A total of 440 mothers were interviewed with a mean age of 27.9 ± 5.7 years. The mean age of the children was 17.3 ± 3.7 months. Full immunization was recorded among 130(29.5%) children and of these only 53.8% completed their immunization by 12 months. The highest and lowest vaccine coverage was observed for DPT1 (90.2%) and Yellow fever (55%) respectively. The commonest reasons for failure to immunize were; non availability of vaccines (40%) and the mother being too busy (24.2%). Predictors of immunization status included maternal education (p=0.002), place of delivery (p<0.001), family type (p=0.04) and child's birth order (p=0.03).

Conclusion: The immunization coverage rate among children in this rural community was sub-optimal and lower dropout rates may be achieved by making vaccines readily available. High female literacy levels and delivery in health facilities need to be promoted.

Keywords: Routine; Immunization; Coverage; Rural; Children

Abbreviations: HF: Health Facility; LGA: Local Government Area; PHC: Primary Health Centre

Introduction

Vaccine preventable diseases (VPDs) such as Measles, Tetanus, Tuberculosis, Poliomyelitis, Pertussis, Diphteria, Yellow fever and Hepatitis B contribute substantially to morbidity and mortality among children less than five years in developing countries [1]. It is estimated that about 2 million deaths occur globally each year from VPDs with approximately 1.5 million occurring in children under five years of age and constituting 15% of under five deaths [2]. In Nigeria, they account for 22% and 17% of under five mortality and morbidity respectively [3].

The World Health Organization (WHO), United Nations Children's Fund (UNICEF), and National Programme on Immunization (NPI) guidelines stipulate that a child should receive four doses of Oral Polio Vaccine (OPV), three doses of Hepatitis B Vaccine, three doses of Diphtheria, Pertussis and Tetanus (DPT) vaccine and one dose each of *Bacille Calmette – Guerin* (BCG), measles and yellow fever vaccines [4]. Routine immunization with these vaccines is a cost effective way of reducing childhood morbidity and mortality in developing countries [5]. The prevention of these diseases in one child also has a positive ripple effect on the population as the immunized child will not transmit the disease to another child (herd immunity).

In 2008, the World Health Organization estimated that 1.5 million of deaths among children under five years were due to diseases that could have been prevented by routine vaccination, representing 17% of global total mortality in children under 5 years of age [6]. In the United States immunization has reduced the incidence of childhood vaccine preventable diseases by 98 – 100% [7]. The effective control of vaccine preventable diseases depend on the extent of immunization coverage achieved hence the estimation of the success of routine immunization by assessing the coverage rate. In Nigeria, the findings of the National Demographic Health Survey along with UNICEF showed a decline in the immunization coverage between 1990 and 1999 from about 30% to 17%

and a further gradual decline to 13% in 2003 [8,9]. The reasons adduced for this included poor coordination and planning, political instability, and continuing economic recession [10,11]. Effective monitoring and evaluation of childhood immunization programmes are necessary as in their absence, vaccination rates may dwindle unnoticed for some time before increased incidence of target diseases are observed.

Countries with low under five mortality figures have an inverse relationship with their immunization coverage rates. Sweden with immunization coverage of 98% has an under-five mortality rate of 4/1000; this is similar to that of Japan, France and the United States of America all with immunization coverage rates greater than 90% [12]. Developing countries like Nigeria with immunization coverage rates below 80% have under five mortality rates above 100/1000 [12]. Although high under five mortality rates may be understandable in war torn countries like Angola and Liberia, this is not the situation in Nigeria and thus it is imperative for health care delivery systems to identify why there is poor immunization coverage in that country.

There is paucity of published data on the immunization coverage in the communities in developing countries [13]. Some of the reports on immunization coverage surveys included both urban and rural data while some were carried out in rural communities. The need for the precise and accurate documentation of immunization rates and the possible causes of the poor coverage in specific regions to enable well directed (or targeted) interventions should help reduce under-five

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mortality rates in these communities. This study was carried out to determine the immunization coverage of children in a rural community.

Materials and Methods

Study area

The study was conducted in Ogo-Oluwa Local Government Area (LGA) one of the rural communities in Oyo State, Southwestern Nigeria. According to the 2006 National Population Commission [14], the population of Oyo State was 5,580,894 with about 65% of the population living and working in rural areas. The main occupation in the rural areas is agriculture. Ogo-Oluwa LGA measures 451,951 sq km and has 10 political wards. The total population of Ogo-Oluwa is 65,198 and the target population for routine immunization is 2,608 (4% of total population). There are 10 fixed posts for routine immunization (1 in each ward). Routine immunization services is held once a month in the Primary Health Care centres of eight of the wards, once forth nightly in one ward and once weekly in only one ward.

Study population

The study involved mothers of children aged 12-23 months in Ogo-Oluwa LGA of Oyo State. In the case of a mother with more than one child within the age range, the younger child was recruited into the study as this gave a better reflection of the current practice of the mother [15].

Study design

A descriptive cross sectional survey of mothers of children aged 12-23 months in Ogo-Oluwa LGA of Oyo State.

Sampling technique

The minimum sample size of four hundred and thirty four children was determined using the WHO formula for cluster survey sampling [15].

In the cluster sampling method used, in the first stage, Ogo-Oluwa, was randomly selected from the rural local government areas by balloting. A list of all the wards in Ogo-Oluwa LGA was obtained from the LGA secretariat and every ward was included in the study. In the second stage, a list of the settlements in each of the wards was also obtained with the total number of settlements varying between seven and twelve in each ward. Half of the total number of settlements was selected randomly from each ward by balloting (each settlement was taken as a cluster). Sample size was estimated following the standard procedure for using cluster sampling for assessment of immunization coverage [15]. Having adjusted for a target population of less than 10,000 the estimated sample size was 434. A total of 75 clusters were studied and the number of children selected per cluster was seven.

The third stage involved the selection of households; the approximate geographic centre of the settlement cluster was located with the assistance of elderly members of the settlement. One of the four cardinal directions (North, South, East and West) from the centre was randomly selected by balloting. The household nearest to the centre in the selected direction was the first household visited. After visiting the first household, the second and subsequent households visited were the ones nearest to the first until the desired sample size from that cluster was obtained.

The nearest household was defined as the household reachable in the shortest time on foot from the household just visited. When there were two or more households equally near to the one just visited, the one on the immediate right while standing in the doorway of the index house and looking out was selected. The youngest eligible child was selected in each household for the survey.

Study instrument

Data were collected by means of a semi-structured pretested questionnaire, which was interviewer administered. The questions were specific, as well as the required answers; hence there was very limited room for inter-observer errors. The information included age, sex, immunization data and reasons for non-immunization where necessary. Thirty three (33) children were excluded as a result of lack of verified immunization cards. The immunization status of the children obtained from the mothers was crosschecked with immunization records and only children whose immunization was verified with immunization cards were included in the study. The questionnaire was translated to Yoruba, the local language and was back translated to English with the translated versions matching well with the original version.

Ethical issues

Permission was obtained from the Primary Health Care coordinator of Ogo Oluwa LGA. Ethical approval was obtained from the ethical research committee of Oyo State Ministry of Health. Informed consent was obtained from mothers who participated in the study after a detailed explanation of the purpose of the study and the required assistance. Confidentiality was maintained during the course of the study by ensuring face to face interviews by each interviewer without a third party and information obtained during the study was kept confidential. All mothers with children who were not completely immunized were properly counseled and referred to the primary health care centre for immunization.

Characteristics	n (440)	%
Age group (years)		
15-19	18	4.1
20-24	98	22.3
25-29	152	34.5
30-34	99	22.5
≥35	73	16.6
Family type		
Monogamy	335	76.1
Polygamy	102	23.2
Single parent	3	0.7
Level of education		
None	66	15.0
Primary	130	29.5
Junior secondary	107	24.3
Senior secondary	131	29.8
Post secondary	6	1.4
Occupation		
Farming	178	40.5
Petty trading	192	43.6
Housewife	35	8.0
Others*	35	7.9
Religion		
Christianity	341	77.5
Islam	99	22.5

*Teachers, patent medicine dealers, hairdressers and tailors

Table 1: Socio-demographic characteristics of the respondents (mothers).

Characteristics	N=440	%
Sex		
Male	212	48.2
Female	228	51.8
Birth order		
1	81	18.4
2	94	21.4
3	122	27.7
≥4	143	32.5
Place of delivery		
Health facility	**232**	**52.7**
Primary Health Care (PHC)	149	64.2
Other government hospitals	8	3.4
Private hospital	73	31.5
Missionary hospital	2	0.9
Outside health facility	**208**	**47.3**
Church	23	11.1
Home	185	88.9

Table 2: Characteristics of the index children.

Antigen	n	%
BCG	324	73.6
DPT1	397	90.2
DPT2	339	77.0
DPT3	337	76.6
OPV0	293	66.6
OPV1	385	87.5
OPV2	334	75.9
OPV3	338	76.8
HBV1	376	85.5
HBV2	371	84.3
HBV3	314	71.4
Measles	286	65.0
Yellow fever	242	55.0

Table 3: Distribution of immunization coverage of children aged 12-23 by vaccine type (N =440).

Data management

The data obtained were entered into a computer and analyzed with SPSS version 11.0. Tables, graphs and charts have been used to report descriptive statistics. In testing for associations, cross tabulation was done and chi- squared statistics has been used for qualitative variables. The level of significance was established at p-value < 0.05. Multivariate analysis was used to determine the sociodemographic factors associated with immunization coverage.

Results

Socio-demographic characteristics of mothers and index children

The mean age of the mothers was 27.9 ± 5.7 years. Table 1 shows the socio-demographic characteristics of mothers. Majority, 152(34.5%) were in the 25-29 years age group while the least represented age group was 15-19 years accounting for 18(4.1%) mothers. Over half, 238(54.1%) had secondary education, 130(29.5%) primary and 66(15.0%) had no formal education. Only six (1.4%) mothers had post secondary education.

The characteristics of the index children and their places of delivery are shown in table 2. Two hundred and twenty-eight (51.8%) were females while 212(48.2%) were males giving a female: male ratio of

1.1:1. About half, 232(52.7%) of the children were delivered at a health facility. Among those that were delivered at a health facility, 149(64.2%) were delivered at Primary Health Centres (PHC) and among those delivered outside a health facility, 185(88.9%) were delivered at home.

Immunization coverage of index children

Table 3 shows the immunization coverage of children aged 12-23 months by vaccine type. Only DPT1, OPV1, HBV1 and HBV2 had 80% coverage and above. The antigen with the highest coverage was DPT1, (90.2%) while the lowest was yellow fever (55.0%).

Dropout rate by vaccine type

Figure 1 shows dropout rate of children of 12-23 months by vaccine types. DPT3/Yellow fever had the highest dropout rate of 39.0%, followed by BCG/yellow fever, 25.3% and the least was BCG/measles, 11.7%.

Immunization status of index children

One hundred and thirty (29.5%) children were fully immunized, 289(65.7%) were partially immunized and 21(4.8%) were not immunized. Among the 130 children who were fully immunized at the time of the study, 54% completed their immunization before 12 months.

Timeliness for immunization

Figure 2 shows the proportions of children who received each vaccine at recommended ages according to the national immunization
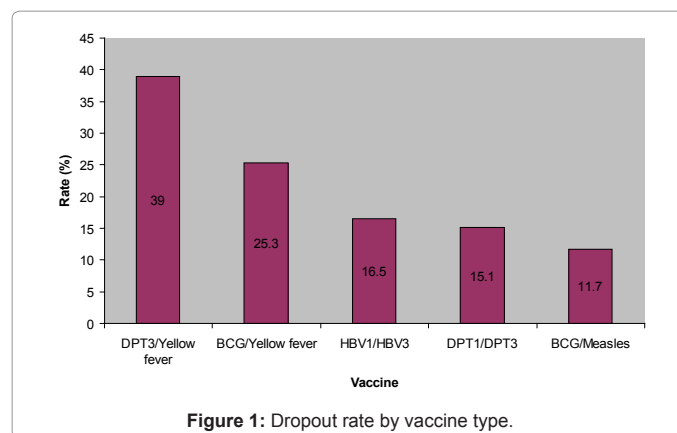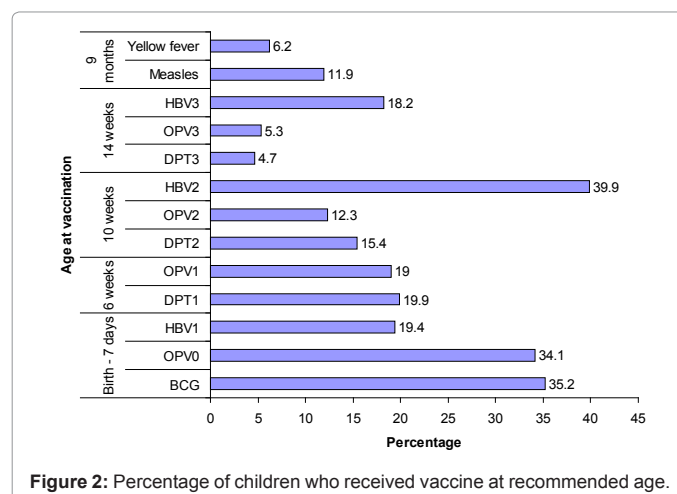

Figure 1: Dropout rate by vaccine type.

Figure 2: Percentage of children who received vaccine at recommended age.

Reason	No (%)
Obstacles	
Vaccine not available	124 (40.0)
Mother too busy	75 (24.2)
Place of immunization too far	68 (21.9)
Travelled	25 (8.1)
Family problem, including illness of mothers	17 (5.5)
Vaccinator absent	16 (5.2)
Time of immunization not convenient	14 (4.5)
Child ill-not brought	13 (4.2)
Child ill-brought not given immunization	3 (1.0)
Long waiting time	1 (0.3)
Lack of information	
Unaware of need for immunization	47 (15.2)
Unaware of need to return for 2nd or 3rd dose	23 (7.4)
Fear of side reactions	17 (5.5)
Place and/or time of immunization unknown	16 (5.2)
Wrong ideas about contraindications	4 (1.3)
Lack of motivation	
Postponed until another time	35 (11.3)
No faith in immunization	1 (0.3)
Rumours	0

Table 4: Stated reasons for incomplete or no immunization (N=310).

programme schedule. The timeliness for receiving HBV2 was the highest, recorded at 39.9% while the lowest was recorded for DPT3, OPV3 and Yellow fever at 4.7%, 5.3% and 6.2% respectively.

Reasons for failure to immunize

The major reasons for failure to immunize children were categorized into obstacles, lack of information and lack of motivation and are shown in table 4. Obstacles in all accounted for most of the reasons (72.3%) for failure to immunize children while lack of information and motivation accounted for 23.5% and 4.2% respectively.

Association between socio-demographic variables and immunization status of children

Table 5 shows the bivariate analysis of socio-demographic variables and immunization status of children. A significant association was found between immunization status and child's birth order and age; place of birth, family type, mother's level of education, immunization centre at settlement as well as distance of health centre from settlement. 92(39.7%) of the children who were delivered at health facilities were fully immunized compared with 38(18.3%) of those that delivered outside of health facilities (church and home) (p<0.001). Also, 33.4% of mothers with some education had their children fully immunized compared with 7.6% of those without formal education (p<0.001). Mothers' age, marital status, occupation and religion and child's gender were not significantly associated with immunization status (p>0.05).

Socio-demographic predictors of complete immunization status on multivariate analysis

Table 6 shows the predictors of complete immunization status on multivariate analysis. Variables in the logistic regression model included the age of index children, mothers' level of education, birth order, family type, place of delivery, availability and distance of health facility offering immunization. After adjusting for confounders, child's birth order, mothers' level of education, family type and place of delivery were found to be statistically significant predictors of being fully immunized. Mothers without formal education were less likely (95% CI=0.085-0.586; p=0.002) to have fully immunized children compared with those with some education (primary education and

above). Children delivered at health facilities were 2.3 times more likely (95% CI=1.431-3.759; p<0.001) to complete immunization compared with those delivered outside health facilities (churches and homes). However, the age of children, availability of immunization centres and distance of health facilities from place of residence were not significant predictors. Children aged 12-15 months were less likely (95% CI=0.338-1.005; p=0.052) to be fully immunized compared to those between 20-23 months old.

Discussion

This study which assessed the immunization coverage in a rural community in Nigeria showed that only 29.5% of the children were fully immunized. There were variations in the coverage rate for individual vaccines, timeliness for vaccines was poor and the drop-out rates were

Characteristics	Fully immunized		X^2	P	OR(95% CI)
	Yes	No			
Child's gender					
Male	64 (30.2)	148(69.8)	0.08	0.78	1.06(0.71-1.60)
Female	66 (28.9)	162(71.1)			
Child's birth order					
<3	65 (37.1)	110(62.9)	8.06	0.005	1.82(1.20-2.75)
≥3	65 (24.5)	200(75.5)			
Child's place of birth					
Health centre	92 (39.7)	140(60.3)	24.10	<0.001	2.94(1.90-4.56)
Outside health centre	38 (18.3)	170(81.7)			
Child's age (months)					
12-15	36 (22.5)	124(77.5)	6.00	0.05	Not done
16-19	45 (33.8)	88(66.2)			
20-23	49 (33.3)	98(66.7)			
Mother's age (years)					
15-19	5 (27.8)	13(72.2)	0.58	0.75	Not done
20-34	106 (30.4)	243(69.6)			
≥35	19 (26.0)	54(74.0)			
Family type					
Monogamous	110 (32.8)	225(67.2)	6.55	0.011	2.00(1.17-3.44)
Polygamous	20 (19.6)	82(80.4)			
Level of education					
No formal	5 (7.6)	61(92.4)	18.00	<0.001	0.16(0.06-0.42)
Some education	125 (33.4)	249(66.6)			
Marital status*					
Never married**	1 (14.3)	6(85.7)	Fisher'	0.68	0.39(0.47-3.30)
Ever married	129 (29.8)	304(70.2)	s Exact		
Occupation					
Unemployed (housewives)	12 (34.3)	23(65.7)	0.41	0.52	1.27(0.61-2.63)
Employed	118(29.1)	287(70.9)			
Religion					
Christianity	101 (29.6)	240(70.4)	0.004	0.95	1.02(0.62-1.66)
Islam	29 (29.3)	70(70.7)			
Immunization centre at settlement					
Available	108 (34.6)	204(65.4)	13.24	<0.001	2.55(1.52-4.27)
Not available	22 (17.2)	106(82.8)			
Distance of health centre from place of residence					
<5	109 (34.5)	207(65.5)	13.19	<0.001	2.58(1.53-4.36)
≥5	21 (16.9)	103(83.1)			

Table 5: Association between socio-demographic characteristics and immunization status of children.

Variables	Odds ratio	95% confidence interval	P-value
Age (Index children)			
12-15	0.583	0.338-1.005	0.052
16-19	1.094	0.642-1.877	0.734
20-23	1.000		
Mothers' level of education			
No formal	0.224	0.085-0.586	0.002*
Primary and above	1.000		
Birth order			
<3	1.646	1.054-2.571	0.029*
≥3	1.000		
Family type			
Monogamous	1.827	1.028-3.247	0.040*
Polygamous	1.000		
Delivery place			
Health facility	2.320	1.431-3.759	<0.001*
Outside HF	1.000		
Availability of HF			
Yes	1.372	0.243-7.738	0.72
No	1.000		
Distance to HF			
<5 km	1.241	0.215-7.166	0.809
≥5 km	1.000		

Table 6: Multivariate analysis of socio-demographic predictors of fully immunized status.

high. The commonest reason for failure to immunize children was non-availability of vaccines and the most important predictor of the immunization status is delivery in a health facility.

The immunization coverage of 29.5% obtained from this study was low. One of the strengths of this study is that the immunization status of each subject was confirmed by immunization cards. The latest national immunization coverage survey which was carried out in 2010, reported that 53.01% of the children were fully immunized using card and history though only 18.38% were verified by card [16]. The use of immunization cards to assess coverage is necessary to verify the immunization status of a child as both overestimation and underestimation are possible depending on the maternal tendencies exhibited with regards to immunizations [17].

Though the target age group (12 to 23 months) and sampling methodology were similar, the national survey had included both urban and rural areas whereas our study was carried out in a purely rural community. It is important then to note that national estimates may not reflect the immunization coverage rates in individual communities and the continued changes in the social and political milieu of different communities requires that regular monitoring and evaluation of the immunization process should be continuous. Regardless of sample locale, immunization rates are abysmally low compared to the acceptable target set by the NPI of 80% [11]. Other rural communities in Nigeria have also reported low immunization rates; for example, a survey carried out in Sokoto, Northern Nigeria reported coverage rates as low as 7% [18].

Reports show that some other developing countries have achieved optimal immunization coverage, while others are making great strides in doing so [12]. Jani et al. [19] reported an immunization coverage rate of as high as 71.7% in a rural area in Mozambique. The consequence of suboptimal immunization coverage is low herd immunity with continued circulation of vaccine preventable diseases in the community. Herd immunity is improved by immunizing eligible children in the community and this subsequently results in lower incidence of vaccine preventable diseases. This has been demonstrated in countries like USA, with greater than 90% coverage in which the mortality and morbidity resulting from these diseases have been significantly reduced and in some cases totally absent [20].

There were variations in the coverage rate for individual vaccines. With regard to individual vaccines, it is noteworthy that four of the antigens (DPT1, HBV1, OPV1 and HBV2) recorded 90%, 86%, 87%, and 84% coverage respectively in the community studied. The coverage for BCG was 75%. The proximity of the time of delivery to the vaccine schedule for obtaining the earlier vaccines may explain the high rates of coverage for these vaccines. The lowest coverage rates were recorded for measles vaccine (65%) and yellow fever vaccine (55%) reflecting poor compliance for vaccines scheduled for administration later in infancy. In the study population, it is customary for a newly delivered mother to spend a mandatory six weeks at home with the exception of visits to health facilities when necessary. That the majority of the mothers delivered in health facilities availed them of the opportunity to immunize their babies in the facilities. In contrast, a low rate of 37% for BCG was reported by Babalola and Lawan [21] in the northern part of Nigeria. Apart from the maternal characteristics associated with the immunization status of a child, they observed that the regularity of vaccine supply also influenced the coverage rate of BCG significantly.

From the study, 65.6% of the children were either partially immunized or did not receive any immunization. However, this absolute number reveals only the completeness of immunization and not the age appropriateness of vaccinated children. The age appropriateness of immunization is of importance in VPDs as children are prone to some infections at certain specific ages during which their attacks could result in fatal outcomes.

Drop-out rates are also measured to determine immunization programme continuity - showing the number of the children who start but fail to complete the immunization process. Among the fully immunized children, only 54% completed their immunization before 12 months. In addition, the timeliness for receiving all vaccines was poor with HBV2 recorded as most timely at 39.9% while the least timely was DPT3, recorded as 4.7%. Furthermore, the drop-out rates between different vaccines groups were all above the accepted 10% [22] as seen in figure 1. The poor timeliness for all vaccines and high and variable drop-out rates between vaccines may be related to the presence of obstacles encountered by 72.3% of the mothers with the commonest obstacle to immunization being unavailability of vaccines (40%) and not a lack of motivation (only 4.2%). Therefore, one major way of achieving higher immunization coverage in Nigeria is for vaccines to be made available at all times in the routine immunization programme. Mothers also need to be educated on the immunization schedule and the need for subsequent doses of vaccines, as 'mother too busy' and 'place of vaccination too far' were also important reasons for incomplete immunization.

Concerning socioeconomic factors that predict immunization coverage, it was observed in this study that mothers with some education were more likely to have fully immunized their children compared with those that had no formal education. Higher immunization coverage was also commoner among children of mothers with higher educational status in the Mozambique study [19]. In Papua New Guinea, higher maternal education was associated with the knowledge of when to start immunizations, the frequency of visits and the diseases prevented by each vaccine [23]. The female literacy level in the study population was low as about one fifth of the mothers had no formal education. The

female literacy level in a community needs to be optimal as educated mothers utilize child health services better (including immunization) and this has been linked positively with child survival practices [24]. Other than the level of education of mothers, exposure to other social and cultural factors may influence the utilization of immunization services.

Children from monogamous families were twice more likely to complete immunization than those from polygamous homes and children of the 1st and 2nd birth order than those of 3rd order and above. Several studies have corroborated findings of a larger family size and later birth order as being associated with poor immunization status of children. This may be related to socioeconomic and domestic pressures of a large family due to time pressures and cost of transportation for each immunization for each child, especially if health care facilities are not in close proximity.

The place of delivery of children in this study was also a significant predictor of immunization, with those delivered in health care facilities being 2.3 times more likely to complete immunization. Similar findings have been reported in previous studies [21,25,26], potentially due to the fact that delivery in health facilities affords mothers the opportunity to receive health education and other preventative health care services including immunization.

The limitations of the study include that with a cluster design, assumptions are made that clusters are similar to one another. However, the large number of clusters of highly dispersed settlements in both near and hard to reach areas studied which should help to reduce this bias.

Conclusion

The immunization coverage rate among children in this rural community was sub-optimal and lower dropout rates may be achieved by making vaccines readily available. High female literacy levels and delivery in health facilities need to be promoted.

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