

Socio-demographic predictors of full immunization coverage in suburban Nigeria: A retrospective review of community-based data.

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Abstract

Background: Despite the many interventions to improve immunization coverage, Nigeria remains one of the countries with the highest concentration of zero-dose children. A look back at previous determinants may provide important information on trends while serving as the baseline for current and future interventions. This study presents retrospective data on the immunisation coverage and socio-demographic factors associated with immunisation uptake among children aged 12-23 months in the Esan Central local government area of Edo state, Nigeria. Methods: A descriptive, cross-sectional, community-based study was conducted using a multi-stage cluster sampling method. Data was collected using standardised WHO questionnaires and analysed using statistical software. Results: The results showed that 32.6% of children were fully immunised by card, while 81.6% were fully immunised by card and history. Factors significantly associated with immunisation status included maternal education, paternal education, maternal religion, birth order, and socio-economic status. The main reasons for non-vaccination were the presence of obstacles, mothers being too busy, unavailability of vaccines, and lack of information. Conclusion: The findings emphasise the importance of implementing policies to ensure an uninterrupted vaccine supply and continuous health education for mothers to improve immunisation coverage and reduce vaccine-preventable diseases in children.

Keywords: Immunisation, children, socio-demographic, predictors, community, suburban.

Introduction

Immunisation is one of the most beneficial and cost-effective measures of disease prevention.¹ It is one of the greatest landmarks that has been achieved in scientific history, but the full impact of its discovery is yet to achieve the maximum effect on under-five mortality in developing countries, including Nigeria.

Despite the many interventions to improve immunization coverage, Nigeria remains one of the countries with the highest concentration of zero-dose children. A staggering 21 million children remain unvaccinated or under vaccinated globally in 2023².

The number of zero dose children globally increased from 12.8 million in 2019 to 14.5 million in 2023². A look back at previous determinants may provide

important information on trends while serving as the baseline for current and future interventions.

Globally, more than half of zero-dose children are concentrated in just seven countries Nigeria inclusive³. The percentage of zero-dose children by country 2023 in Nigeria is 15%, Europe and Central Asia had the highest DTP₃ with coverage rates of 95%, while West and Central Africa had the lowest coverage of 69%³.

Factors identified to be associated with full immunization coverage vary from place to place. Factors associated with immunization include health service variables, personal variables and socio-demographic variables.^{7,8,9,10} The retrospective data in this index write up which is a community-based survey utilized socio demographic variables

The recent outbreak of diphtheria in the country in which 20,684 cases were recorded across 33 states in Nigeria of which 12,086 cases were confirmed and 554

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dead, calls for urgent action.^{7,8}This recent outbreak has therefore provided a platform to launch a strategic roadmap for accelerating child survival by carrying out surveys exploring coverage and reasons for under-vaccination in different parts of the country and looking back at previous determinants and utilizing the information obtained as an auditing tool for comparison with recent data for current and future practice.^{27,28} The identified factors can also be used to implement low-cost, high- impact strategies that will help improve and reinforce existing immunisation services.

Sociodemographic factors play a vital role in immunisation coverage, as they are often the most recognisable factors that can be readily assessed. Some of the socio-demographic factors known to influence immunization uptake are parents or caregivers' educational level and occupation, birth order, ethnicity and family structure.^{7,8,9,10,11,12,13}

Despite ongoing efforts towards the recovery and strengthening of immunisation strategies, a Nigeria has one of the highest mortality rates of 110/1000 live births⁴. In the Esan central local government area, the infant mortality rate was 189/1000 live births in 2006⁵which is much higher than the national rate.^{2,4} This high infant mortality rate may be attributed to the high rate of vaccine-preventable diseases. Thus, it is important to assess the determinants and factors that affect the level of immunisation coverage which may partially explain the high infant mortality rate, because low immunisation coverage is associated with high levels of vaccine-preventable diseases.^{6,7,9,10}

National averages of immunisation coverage can hide inequalities, and the determinants of immunisation uptake vary from place to place within the country. This reinforces the need for immunisation coverage and determinants to be determined in locales of this country and continuous scrutiny of valid retrospective data²⁷ to enable the spread of scientific knowledge which has an impact on epidemiological surveillance and can also be a stimulus to design prospective studies.

Materials and Methods

The study was carried out in the Esan Central local government area, located in the lowland rainforest zone. This area occupies the non-riverine or upland flood plains of Edo state⁴.

The Local government is located at latitude 06⁰14' east and longitude 06⁰48' north, and the local government area is divided into ten political wards for political and administrative purposes. The total population was divided into 30 equal parts, based on the cumulative population of the villages. Each of the thirty parts was regarded as a cluster based on the recommendation of the WHO cluster survey manual.⁷

The study was descriptive, cross-sectional, and community-based and was conducted over a two- month period in 2014. Study population included Children aged 12-23 months and their primary caregivers/parents

Ethical Clearance

Ethical clearance was obtained from the Ethics Committee of Irrua Specialist Teaching Hospital (ISTH). Permission to conduct this study was obtained from the Esan Central Local Government Council. Permission to enter the villages was sought from community leaders and village heads before conducting the study. Written informed consent was obtained from parents or guardians of the children.

Inclusion Criteria

Children aged 12 -23 months whose parents gave consent and who had been living in the study area for at least 23 months, were participants in this study. The earliest acceptable birthday was determined by subtracting exactly 24 months from the interview date, while the latest acceptable birthday was determined by subtracting exactly 12 months from the interview date.

Exclusion Criteria

Children whose parents were not immediately available or who were still not available on revisit were excluded from the study.

A child whose parents were not resident in the Local Government Area in the last twenty-three months. In a household with twins the older eligible twin was excluded, only the younger twin was recruited.

Sample Size Estimation

Using the formula for estimation of the minimum sample size⁵ $n_{min} = DE \times Z_{1-\alpha/2} \times p \times (1-p)/d^2$

n_{min} = minimum sample size

DE = Design effect = 2

$Z_{1-\alpha/2}$ = Standard normal deviate corresponding to 95% confidence level is 1.96

P = Expected coverage or prevalence of outcome of interest =67% (Immunization coverage estimate of DTP3 in children aged 0-11months in 2011 in Esan Central Local Government area.) d = desired width of the confidence interval = 5% = 0.05

Therefore, the minimum sample size is $2 \times 1.96^2 \times 0.67 \times (1-0.67)/0.05^2 = 679$

A multi-stage cluster sampling method survey was employed according to the WHO recommendations.⁵In selecting clusters for the survey, the most recent population data were used to select clusters for the survey. The number of study subjects drawn from each cluster was calculated based on the sample size (679).

Selecting Clusters for the Survey

A list of localities which formed the sampling frame and population of each locality was obtained from the local government.

The Local government area 2006 population census figure which was 105,340⁵ on applying the national population growth rate of 2.83%, estimated that the population for 2013 was 126,207. This information was used for the survey. A cluster identification form was used to list all the villages in Esan Central Local Government Area.

The Cumulative population of each village was then calculated and written by adding the population of the index village to the combined total population of the preceding villages.

The sampling interval was calculated by dividing the total population surveyed by the number of clusters which was 30. A random number less than or equal to the sampling interval was selected from a table of random numbers with the same number of digits as the sampling interval.

The village in which Cluster 1 was located was identified by locating the first village in which the cumulative population equals or exceeds the random number.

The locality in which cluster 2 was located was identified by adding the sampling interval to the random number. The cumulative population listed for that locality was equal to or exceeded the calculated number. This process continued until the localities corresponding to all 30 clusters were selected.

Selection of enumeration units:For each locality, a number of enumeration units equal to the number of clusters required from that locality was randomly selected.

The selected enumeration units were located with use of maps from National Population Commission and local guide

Selection for starting House

An approximate geographic centre of the selected enumeration unit was located, and direction was randomly chosen from the geographic centre. All houses from the geographic centre to the edge of the area were counted, and a number was randomly selected between one and the number of houses counted; this was the first house visited.

Selection of subsequent Houses: The second house visited was the one nearest on foot, and subsequent houses were visited in a similar manner.

Data Collection Methods

Data collection was performed using standardised WHO questionnaires.⁵ Infant immunisation cluster form, and reasons for immunisation failure cluster form. In addition to these forms, a questionnaire for Socio – demographic information was used. This was pretested in the Esan West local government area before the commencement of the study.

The phrase by history means that the child's caretaker reported that the child had received immunisation, but the immunisation card was not available for the researcher to review. A child was judged to be fully immunised if there were three doses of pentavalent, three doses of polio vaccine, one dose of BCG, Yellow fever, and one dose of measles vaccine. Receipt of one or more but fewer than required to be fully immunised was considered partial immunisation.⁵ Non-non-immunisation status was determined if there was no receipt of any immunisation.

Socioeconomic class was awarded to each child based on the occupation and educational attainment of the primary caregivers. This was done according to the Oyediji classification.⁹⁴ The mean of the four scores (two for the father and two for the mother) to the nearest whole number was the social class assigned to the child. Social classes I –III was considered as higher socio-economic class while IV and V was considered lower socio-economic status.⁹⁴

Data Analysis

The immunisation and sociodemographic data were entered into the WHO Microsoft Excel spreadsheet designed to have multiple checks for accuracy.

Microsoft Excel was used for simple statistical analyses. Immunisation coverage was recorded as a percentage. Frequency tables/charts were generated for categorical variables, such as Occupation, Educational level, Religion, Parity. Simple frequency tables were generated for the population characteristics, immunisation rates, and reasons for under vaccination. WINPEPI and INSTAT statistical packages were used for statistical analyses. When appropriate, Fisher’s exact test or chi-square test with Yates corrections as appropriate were used to explore the association between reasons for immunisation failure and population characteristics. Student’s t-test was used to compare means. Multivariate logistic regression was used to determine the predictors of immunisation status. The level of significance was set at P <0.05.

Results

Socio-demographic characteristics of the study population

Six hundred and ninety children aged 12-23months were recruited. Among them 355 (51%) were males and 335(49%) females, giving a male to female ratio of 1.1:1. The mean age± standard deviation (SD) of the children was 18.0 ± 3.7 months. The modal age of the children was 23months. One hundred and forty-seven children (21.3%) were of the first birth order and 191(27.7%) of birth order 5 and above. The total number of children per family ranged from 1 to 9 with a mean of

3.4±2.0 and a mode of 2. The deliveries were in the hospital in 677 (98.12%), the church in 1 (0.14%) and other deliveries were at home.

Table I: Socio-demographic characteristics of children aged 12-23months Socio-demographic factor N Percentage Gender

Gender	N	Percentage
Male	355	51.4
Female	335	48.6
Birth order		
1	147	21.3
2-4	352	51.0
2-4	352	51.0
Socioeconomic class		
1	9	1.3
2	62	9.0
3	234	33.9
4	357	51.7
7	28	4.1

Table II shows socio-demographic characteristics of both parents.

The mean ± SD ages of the mothers and fathers were 28.8±5.8years and 36.4±8.22 respectively. Most parents were of Christian faith 94.9% of the mothers and 92.3% of the fathers. Majority of the parents were Esan by tribe and the majority were married 95.1 of mothers and 95.4% of fathers. Fathers who attained post-secondary level of education 146 (21.2%) were more than mothers with post-secondary level of education 79 (11.4%). Majority of the parents had secondary level of education 411(59.6%) of the mothers and 417 (60.4%) of the fathers.

Table 2: Socio-demographic characteristics of father and mother

Socio Demographic Variables	Mother (N=690)	%	Father (N=690)	%
Age(years)				
15-19	12	1.7	0	0
20-24	151	21.9	18	2.6
25-29	219	31.7	100	14.5
30-34	170	24.6	151	21.9
35-39	111	16.1	174	25.2
≥40	27	3.9	247	35.7
Religion				
Christianity	655	94.9	637	92.3
Islam	24	3.5	33	4.8
African tradition	11	1.6	20	2.9
Marital status				
Married	656	95.1	658	95.4
Single	16	2.3	17	2.5
Widowed	8	1.2	7	1.0
Ethnicity				
Esan	641	92.9	633	91.7
Etsako	19	2.8	17	2.5
Others	30	4.3	40	5.8
Level of education				
No formal education	10	1.4	3	0.4
Primary	190	27.5	124	18.0
Secondary	411	59.6	417	60.4
Post secondary	79	11.4	146	21.2
Mother occupation				
Hairdresser	102	14.8		
Petty trading	352	51.0		
Farmer	38	5.5		
Unemployed/ Student/ Housewife	61	8.8		
Others	137	19.9		
Father occupation				
Highly skilled professional			55	8.1
Skilled manual labour			179	26.3
Skilled non manual labour			193	28.3
Skilled professional			22	3.2
Student /unemployed			36	5.3
Unskilled labour			197	28.9

Immunization coverage

Immunization status of children assessed by card alone and card and history

Two hundred and twenty-five children (32.6%, CI: 0.29-0.36) were fully immunized

(Immunization coverage by card) and 457(66.20%, CI: 0.63-0.70) partially immunized by card. Five hundred and sixty-three children (81.60%, CI: 0.79-0.84) were fully immunized by card and history and 119(17.20%, CI: 0.14-0.20) partially immunized. Eight children (1.2% CI: 0.00-0.02) had no history or card records of being immunized. Figure 2 shows the immunization status of children by card with and without history. Only 320 (46.40%) had immunization cards available, giving a card retention rate of 46.40%. Those fully immunized by one year of age were 526(76.23%, CI: 0.73-0.79).

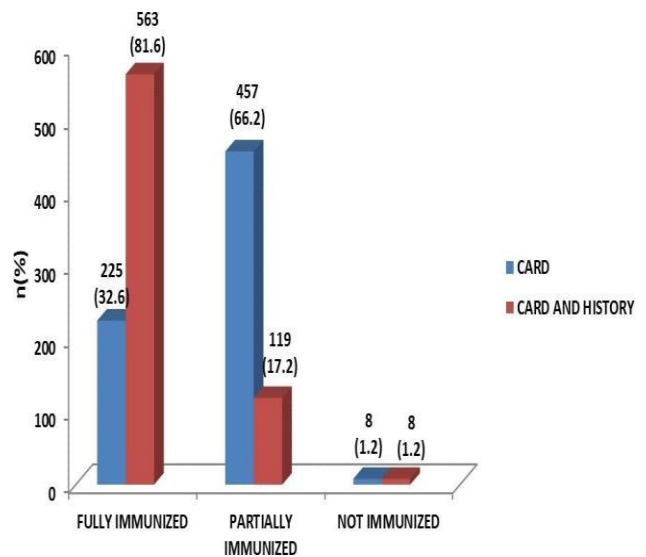


Figure 1: Immunization status of index children by card and card and history

Immunization coverage by individual vaccines

Table III shows the immunization coverage by individual vaccine as adjudged by card and by card and history. There is a consecutive drop in the coverage rate for individual vaccine from those scheduled for earlier part of infancy to those scheduled for later. BCG had the highest coverage rate of 323 (46.8%) and 677 (98.1%) by card and card and history respectively. Yellow fever had the lowest coverage rate of 251 (36.4%) by card and 587 (85.1%) by card and history.

Table 3: NPI schedule immunization coverage by card and card and history

Vaccine*	Immunization by card		Immunization by card and history			
	No	(%)	95% CI	No	(%)	95% CI
BCG	323	(46.8)	0.43-0.51	677	(98.1)	0.47-0.55
OPV0	303	(43.9)	0.40-0.48	665	(96.4)	0.49-0.56
HBV0	304	(44.1)	0.40-0.48	664	(96.3)	0.48-0.56
OPV1	304	(44.1)	0.40-0.48	658	(95.4)	0.47-0.55
PENTA1	317	(45.9)	0.42-0.50	671	(97.2)	0.47-0.55
OPV2	298	(43.2)	0.39-0.47	651	(94.4)	0.47-0.55
PENTA2	308	(44.6)	0.41-0.48	661	(95.8)	0.47-0.55
OPV3	287	(41.6)	0.38-0.45	640	(92.8)	0.47-0.55
PENTA3	294	(42.6)	0.39-0.46	646	(93.6)	0.47-0.55
MEASLES	255	(37.0)	0.37-0.41	592	(85.8)	0.47-0.53
YELLOW FEVER	251	(36.4)	0.33-0.40	587	(85.1)	0.45-0.53

Relationship between immunization status and mothers’

Sociodemographic characteristics

There was significant association between maternal education and immunization status of the children assessed ($\chi^2=0.00$, $p<0.05$), as shown in Table IV. Of the 79 mothers who had post- secondary education 74(93.7%) had children who were fully immunized compared to 85.6%, 68.9% and 60% of the children of mothers who had secondary, primary and no formal education respectively. All the children of the 7 highly skilled professionals were fully immunized, while 71.1% of the 27 farmers’ children were fully immunized (Fisher’s exact test $p=0.03$). There was also significant association between the immunization status of the children and maternal religion. The proportion of children of Islamic faith who were not fully immunized 58.3% was significantly higher than that of children of the Christian faith 17.6% and African traditional religion 18.2%.

The difference was statistically significant.

Table IV: Relationship between mother’s religion, occupation and educational level and child’s immunization status

Maternal	Fully immunized	Not fully immunized	Total	Significance
Socio-demographics	n(%)	n(%)	n (%)	test
Maternal Education				
No formal education	6(60.0)	4(40.0)	10(100)	$\chi^2=35.50$ df=3 P<0.01
Primary	131(68.9)	59(31.1)	190(100)	
Secondary	352(85.6)	59(14.4)	411(100)	
Post secondary	74(93.7)	5(6.3)	79(100)	
Maternal Occupation				
Hairdresser	82(75.9)	20(18.5)	102(100)	$\chi^2=12.05$ df=5 P=0.03
Petty trader	286(81.3)	66(18.8)	352(100)	
Highly skilled professional	7(100)	0(0)	7(100)	
Farmer	27(71.1)	11(28.9)	38(100)	
Unemployed/ student/ Housewife	45(73.8)	16(26.2)	61(100)	
Others	116(89.2)	14(10.8)	130(100)	
Maternal Religion				
African traditional religion	9(81.8)	2(18.2)	11(100)	$\chi^2=25.03$ df=2 P<0.01
Christianity	540(82.4)	115(17.6)	655(100)	
Islam	10(41.7)	14(58.3)	24(100)	

Relationship between immunization status and the fathers’

Sociodemographic factors

Significant association was found between the fathers’ education and immunisation status (χ^2 test $P= 0.00$, $p<0.05$) with full immunisation being significantly higher among children with fathers who had secondary (83.69%) and post-secondary (90.41%) education than among children whose fathers had no formal education (33.33%) and primary education (65.32%). Of the fathers were of the Christian faith 637 majority had children who were not fully immunized 432 (67.82%) while those whose fathers practised African traditional religion had the least number of partially immunized children 11 (57.89%). Paternal occupation and religion were not significantly associated with the immunization status of the children assessed (Table VIII).

Table V: Relationship between father’s religion, occupation and educational level and child’s immunization status

Paternal Socio-Demographics	Fully immunized n (%)	Not fully Immunized n(%)	Total n(%)	Significance test
Paternal Occupation				
Highly skilled professional	49 (89.09)	6 (10.91)	55 (100)	$\chi^2=0.27$
Skilled manual labour	145(81.01)	34(18.99)	179 (100)	
Skilled non manual labour	160 (82.90)	33 (17.10)	193 (100)	p>0.05
Skilled professional	17(77.27)	5(22.73)	22 (100)	
Student/unemployed	33 (91.67)	3(8.33)	36 (100)	
Unskilled labour	153 (77.66)	44 (22.34)	197 (100)	
None (dead)	6(75)	2 (25)	8(100)	
Paternal Education				
No formal education	1 (33.33)	2(66.67)	3 (100)	$\chi^2=35.29$
Completed primary	81 (65.32)	43(34.68)	124 (100)	df=3
Completed secondary	349(83.69)	68(16.31)	417 (100)	P= 0.00
Post-secondary	132 (90.41)	14 (9.59)	146 (100)	
Paternal Religion				
African traditional religion	8 (42.11)	11 (57.89)	19 (100)	$\chi^2=2.152$
Christianity	205 (32.18)	432 (67.82)	637 (100)	Df=3
Islam	12 (36.36)	21 (63.64)	33 (100)	P=0.5415
Others	0 (0)	1 (100)	1(100)	

Relationship between immunization status and child’s birth order,

Socio economic class and gender

A significant association was found between socio-economic class and immunization status as depicted in table VI (Fisher’s Exact test p=0.00, p<0.05).

The rate of full immunization increased as the social class increased from social class 5 to 1. Significant association was also found between child’s birth order and immunization status ($\chi^2=9.31$, p=0.01) those of high birth order 5 and above had the highest proportion of children that were not fully immunized compared to those of birth order 1, 24 (16.3%) and 2-4 54 (15.3%). However, child’s gender was not significantly associated with immunization status.

No association was found between the source of immunization and immunization status as shown in table X ($\chi^2=0.4577$ p> 0.05). Eighty seven percent of those who had immunization in tertiary hospitals were fully immunized compared with 86.2% and 81.7% of those immunized in private hospitals and health centres respectively.

Table VI: Relationship between immunization status birth order, socio economic class and gender

Child’s Socio-demographics	Immunization status			Significance test
	Fully immunized n(%)	Not fully immunized n(%)	Total n(%)	
Birth order				
1	123(83.7)	24(16.3)	147 (100)	$\chi^2=9.31$ df=2
2-4	298 (84.7)	54(15.3)	352 (100)	
5 and above	142(74.3)	49(25.7)	191 (100)	P=0.01
Socio Economic Class				
1	9(100)	0(0)	9(100)	$\chi^2=33.76$ df=4
2	58 (92.1)	5(7.9)	63 (100)	
3	200 (85.8)	33 (14.2)	233 (100)	P=0.00
4	283 (79.3)	74 (20.7)	357 (100)	
5	13 (46.4)	15(53.6)	28 (100)	
Gender				
Male	290 (81.7)	65 (18.3)	355 (100)	Fisher’s Exact test P=0.51
Female	273 (81.5)	62 (18.5)	335 (100)	

Table VII: Relationship between sources of immunization, ownership of immunization card and immunization status

Source Immunization	IMMUNIZATION STATUS			Significance test
	Fully Immunized no (%)	Not Fully Immunized no (%)	Total no (%)	
Health centre	474 (81.7)	10(18.3)	580 (100)	Fisher's Exact test
Private hospital	25(86.2)	4 (13.8)	29 (100)	P= 0.46
Tertiary hospital	64(87.7)	9(12.3)	73 (100)	

TABLE VIII: Multivariate analysis of Socio-demographic predictors of fully immunized status.

Variable	Or	96% for ratio	C.I odds	P
Maternal Religion				
Christianity	0.88	0.17 - 4.62		0.88
Islam	0.48	0.07 - 3.16		0.44
African Tradition	1.00			
Maternal Education				
No Formal Education	1.00			
Completed Primary	0.96	0.15 - 6.06		0.96
Completed secondary	2.15	0.34 - 13.81		0.42
Post-Secondary	5.02	0.54 - 46.86		0.16
Maternal Occupation				
Hairdresser	0.57	0.26 - 1.28		0.17
Petty Trader	0.78	0.40 - 1.54		0.48
Farmer	0.57	0.21 - 1.52		0.26
Unemployed/Students /housewife	0.34	0.14 - 0.84		0.02
Others	1.00			
Paternal Education				
No Formal Education	1.00			
Completed Primary	2.14	0.08 - 56.46		0.65
Completed secondary	4.19	0.16 - 110.24		0.39
Post-Secondary	4.40	0.16 - 124.64		0.39
Birth order				
1	1.12	0.57 - 2.20		0.74
2-4	1.60	0.98 - 2.62		0.06
5 and above	1.00			
SEC				
Upper	0.98	0.27 - 3.57		0.97
Lower	1.00			

Table VIII shows the predictors of complete immunization status on multivariate analysis. Variables analysed in the logistic regression model were ownership of immunization card, maternal religion, maternal education, maternal occupation, paternal education, birth order and socioeconomic class. After adjusting for confounders, ownership of immunization card as well as maternal and/ paternal education were found to be significant predictors of being fully immunized.

Sociodemographic determinant	P	OR	95% C.I. for OR
Religion			
Maternal Religion	0.862	0.474-1.566	0.625
Education			
Maternal Education	2.172	1.453-3.247	0.000
Occupation			
Paternal education	0.994	0.878-1.125	0.923
Paternal education	1.613	1.087-2.394	0.018
Birth Order			
Sec	0.94	0.682-1.297	0.708
Sec	1.347	0.456-3.982	0.590

Sociodemographic characteristics of unimmunized children

Eight children were unimmunized. Their ages ranged from 12 to 23 months with a modal age of 12months and the mean of 16.25 months. The children were of social classes 3 to 5. Seven of the mothers were married while one was single. Majority of mothers (5) had primary education, while two had secondary education and one was without any formal education. Most of the mothers were petty traders (4), two were farmers and the others a hairdresser and a housewife. Four of the fathers had secondary education, two had primary education, one had no formal education, and one had post-secondary education.

Reasons for under vaccination

The major reasons for under-vaccination are shown in Table IX. The proportion of reasons of under-vaccination due to Lack of information, Lack of motivation and Obstacles were 23 (18.3%), 7 (5.6%) and 96 (76.2%) respectively. Obstacles accounted for most of the reasons 96(76.2%). The most common reason proffered for under-vaccination of the children was “mother too busy” 42 (33.3%), followed by non-

availability of vaccines 20 (15.9%). Child ill /not brought 18 (14.3%), unawareness to return for second and third dose 13 (10.3%) also had a significant proportion of reason for under-vaccination.

Table 9: Reasons for under vaccination of children aged 12-23 months

Reasons for under-vaccination	Percentage of under-vaccination		
	SU category total		all children
Unaware of need for immunization	2	8.7	1.6
Unaware of need to return for 2 nd and 3 rd dose	13	56.5	10.3
Fear of side reactions	5	21.7	4.0
Unaware of the place and time of immunization	2	8.7	1.6
Wrong idea about contraindications	1	4.3	0.8
Total	23	100	18.3
Lack of motivation			
Postponed	7	100	5.6
Obstacles			
Mother too busy	42	43.8	33.3
Family problems	8	8.3	6.3
Child ill brought not immunized	1	1.0	0.8
Time of immunization inconvenient	1	1.0	0.8
Vaccinator absent	1	1.0	0.8
Vaccine not available	20	20.8	15.9
Place of immunization too far	5	5.2	4.0
Total	96	100	76.2

Relationship between reasons for under vaccination and maternal education, occupation and religion

The relationship between the reasons for under-vaccination and maternal socio-demographic factors is shown in table X. There was no significant association between maternal religion and reasons for under-vaccination (p>0.05) Lack of information (100%) was the commonest reason in those of African traditional religion while obstacles was the commonest reason in those of Christian and Islamic religions. Children whose mothers had secondary education had obstacles 48 (81.4%) as the commonest reason for under-vaccination while there was no lack of motivation in those whose mothers had no formal education 0 (0%) and post-secondary education 0 (0%) . There was no association between reasons for under-vaccination and maternal

education. The commonest reason for under-vaccination proffered in farmers 9 (81.8%) and hairdressers 16(80%) was obstacles. There was no lack of motivation in the parents who were farmers 0 (0%) and hairdressers 0 (0%). The difference was not statistically significant.

Table 10: Relationship between maternal level of education, religion, occupation and reasons for under-vaccination

Maternal Factor	Obstacles	Lack of information	Lack of motivation	Total	Significance
Completed primary	41 (70.7)	12 (20.7)	5 (8.6)	58 (100)	$\chi^2=4.2$ 84
Completed secondary	48 (81.4)	9 (15.3)	2 (3.4)	59 (100)	df = 6
No formal education	3 (75)	1 (25)	0 (0)	4 (100)	P=0.6 383
Post-secondary	5 (100)	0 (0)	0 (0)	5 (100)	
Religion		2 (100)	0 (0)	2 (100)	$\chi^2=$ 9.768
African tradition	0 (0)				
Christianity	88 (77.2)	20 (17.5)	6 (5.3)	114 (100)	df=4
Islam	8 (80)	1 (10)	1 (10)	10 (100)	P=0.0 4451
Maternal Occupation					
Farmer	9 (81.8)	2 (18.2)	0 (0)	11 (100)	$\chi^2=$ 3.345
Hairdresser	16 (80)	4 (20)	0 (0)	20(100)	df=6
Petty trader	50 (75.8)	12 (18.2)	4 (6.0)	66 (100)	P=0.7 645
Others	22 (75.9)	4 (13.8)	3 (10.3)	29 (100)	

Discussion

This study examined immunization coverage rate and its relationship with socio-demographic factors in children aged 12-23 months in Esan Central LGA of Edo state. The Immunization coverage of 81.6% obtained in this study is just above minimum target of 80% in the UNGASS goals.² Though it is higher than reports from most recent Nigerian studies,^{9,10,16} it is still not as high as those reported from United states, United kingdom and Germany which had coverage rates that are persistently greater than 90%.^{2,3} some recent Nigerian

studies had reported rates of 18% in northern part,¹⁶ 78.9% in south-east¹⁰ and 74.4% south-western parts of Nigeria.⁹ A possible explanation for the high level of immunization coverage obtained in this study may be the high educational attainment of mothers in this study where 59.6% had obtained secondary education while the recent Nigerian studies had reported lower levels of maternal education.^{16,17} the dropping rates in immunisation rates calls for concern as the Pandemic of COVID19 has been reported to cause disruptions of vaccinations in more than 68 countries with significant impact on lower middle income countries^{29,30} and this is corroborated by report of Edo state immunisation coverage of 49%²⁵ this shows a 3.2% decrease from 52.2% reported in 2013.³¹ The NDHS 2023-2024⁴ had reported the National immunization coverage rate to still be as low as 39%, even though NDHS 2013³¹ had reported national coverage rate as 25% this shows 14% point increase in the proportion of children fully vaccinated since 2013, however this pace of progress is still far from UNGASS set goals² and suboptimal.

Card coverage showed lower figures compared to card and history figures. The 32.6% immunization coverage obtained by card alone in this study is similar to the 29.5% obtained in a recent study carried out in a rural area of Nigeria which had reported immunization rate based on immunization card only.² Although card coverage provides accurate estimation of coverage,⁵ there is a limitation to use of card alone to estimate coverage as it can lead to underestimation of true coverage levels in developing countries where card retention is often low.^{4,17,25} The reliability of history regarding immunization has been demonstrated in other studies.⁴

Level of education has been observed as a major factor that predicts immunisation coverage, as mothers with secondary and post-secondary levels of education were more likely to immunise their children than those with primary or no formal level of education. The strong link and unsurpassed role of maternal education in the well-being of children has been affirmed in many recent studies,²⁵ as there is an inverse relationship between maternal education and immunization coverage rates in many countries.^{9,16,17,18,19,20} This further affirms that education plays a significant role in health-seeking behaviour which aids in increased child survival. In this study, it was observed that mothers with secondary and post-secondary education were more likely to have fully

immunised their children, 36.3% and 38%, respectively, compared with mothers who had primary education and those without formal education, which is in contrast with what was reported by Warsenaar et al¹³ in Sierra Leone, where the education of the mothers had no association with full immunisation coverage, which might have been attributed to religion as a potent confounder, which was not controlled for in the study. Ayodele et al¹⁶ reported 60% of mothers without formal education in the 2018 subset of the Demographic Health Survey had a resultant immunisation coverage of 18%.

However, paternal education was a significant predictor of full immunisation status in this study, as the proportion of fully immunised children increased with higher paternal educational attainment. More recent study by Warsenaar in Sierra Leone¹³ reported that children whose caretakers were males were more likely to have missed at least one routine immunisation, whereas Alabi et al. stated that 44% of the partners of the women under study had no formal education¹⁶ with resultant low immunisation coverage rates. This proves that fathers' influence on decision making and the provision of resources helps in making lifesaving decisions in the family. However other studies did not report a significant difference on the influence of paternal education on full immunization coverage rates.^{12,20} the latter study had included the Rotar virus vaccine that is not included on NPI schedule, and they had attributed the success of the immunization programme to creation of more immunization outreach sites.²⁰

Maternal age was not found to be significantly associated with immunisation status in the study carried out, which echoes the findings obtained in more recent studies in rural communities of Nigeria^{16,17,18}, Sierra Leone¹³, and India¹². This finding is in contrast to what was obtained by Adesina et al¹⁸ who had reported that mothers aged 35-44 years were more likely to fully immunize their children in a southern district of Nigeria and this is corroborated by Nyaaba and associates in Ghana.²⁰ It is stated that older mothers have more experience in raising children and are believed to have broader perspective than younger mothers when it involves implications of diseases in their children immunization inclusive.¹⁶

Relationship between religion and immunization status has consistently been demonstrated in various more

recent studies.^{12,13,16,19,20} There was a significant relationship between maternal religion and not being fully immunised in this study; 58.3% of the children not fully immunised had mothers who were of the Islamic faith, and 82.4% of those fully immunised had mothers who were of the Christian faith. The paternal religion and immunisation status of the understudied children did not show a significant association, which further reverberates the fact that maternal socio-demographics have a direct influence on child survival. Adesina et al¹⁸ found religion not to be a significant predictor of immunisation status; however, this study was conducted in the southeastern region of Nigeria, where the predominant religion is Christianity and in a semi-urban area which may have its own peculiar characteristics. The association between not fully immunized status and Islamic religion among the mothers agrees with the study from India¹², Sierra Leone¹³, Nigeria.^{7,16,17} It was inferred that a barrier mitigating effect will be the use of Faith leaders in major decision making, immunization inclusive as they wield a notable influence on their followers.¹⁶

The lack of a significant difference in relationship between place of birth and immunisation status in this study agrees with the report from Gambia.²⁶ but contrasts with the results of studies from other places in Nigeria,¹⁶ Kenya,²⁰ and across Africa.¹⁵ They had stated children delivered in health facilities were more likely to be immunized than those delivered outside health facilities. This could reflect good health seeking behavior, immunization inclusive. Many children in the index study were delivered to a health facility (98.1%), the number delivered outside health facilities might be too small to detect a statistical difference.

The reported relationship between immunisation status and sex has not been consistent. Gender was not a significant predictor of immunization status in this study. Oladokun and associates²¹ had reported that males were three times more likely to be fully immunized than females in a study carried out in Southwestern Nigeria, stating that parents fear adverse effects of immunization when their female Children reach childbearing age and because there is a preference of male to female children in African society. A preference for girls was reported by Adokiya et al²⁰ while Gender was not a significant predictor as stated by Warsenaar et al.¹³ The lack of association found in this study may signify high maternal awareness of

immunization and its importance that is unrelated to gender of their offspring.

Birth order was significantly associated with immunisation status in the study population, with the highest percentage of those not fully immunised (72.8%) being children from the high birth order category, that is, those greater than four. Williams and associates reported later birth order as being associated with poor immunization status.¹⁷ This is possibly due to possible due to socioeconomic and domestic pressures associated with a large family with regard to time and possibly transportation to sites of immunization.

There was a significant relationship between Socio-economic status and immunization status as observed in this study as children with higher socio-economic classes had higher rates of full immunization compared with those of lower socio-economic class. However, the influence of socioeconomic status on health varies. There is a positive association between socio-economic status and

Health, as demonstrated by Oyediji²² in a study carried out in Ilesha as families in the higher socioeconomic classes possessed more health knowledge than those from lower socioeconomic classes, implying that people from higher socioeconomic classes are more likely to stay healthier than those from lower socioeconomic classes, which is reflected in the findings from Kenya²³ and Ethiopia²⁴ where children born to rich mothers were found to be twice as likely to be fully immunised compared with children from a poor wealth index group. One can surmise that poverty- and poverty-related factors tend to present barriers to effective vaccinations.

The major reasons for non-vaccination in this study included the presence of obstacles, mother being too busy, unavailability of vaccines, and lack of information. Most of the mothers reported being too busy with their occupation and were not able to present their children for immunisation as and when due, which may be due to a lack of appropriate information by health workers. Lack of information was proposed as the most common reason in India¹² while in Ghana Adokiya²⁰, the time of immunisation was too inconvenient as the most common reason for partial or no immunisation rates. These findings have further reiterated the importance of implementing policies that will ensure an uninterrupted vaccine supply and continuous health education for mothers.

Conclusion

Immunisation coverage in Esan Central Local Government meets the UNGASS goals. Parents who were educated, of Christian background and employed were mostly found to have ensured full immunization for their children, the major reasons for immunization failure lack of information on the need to return for subsequent doses.

Therefore, implementation of policies that favour education and improve access to health facilities will go a long way in improving immunization outcomes and prevent vaccine preventable diseases.

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