Original Article

A Community Survey of the Vaccination Status of Under-Five Children in a Community in Southern Nigeria

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Abstract

Regarding vaccine coverage, Nigeria is currently making slow progress despite the previous achievements in immunisation coverage. This is contrary to the World Health Organisation's goal of achieving health equity for all people globally. Operational research to determine the immunisation status of children should be unrelenting. Thus, this study sought to assess the proportion of under-five children who had completed vaccination as well as parental variables associated with the vaccination in a South-southern community in Nigeria. **Materials and Methods:** A cross-sectional study and a multi-stage sampling technique were used to select respondents from the community. Respondents were interviewed using a pretested semi-structured questionnaire. Information related to parents' sociodemographic characteristics, mother's knowledge of immunisation, their children's vaccination status, and the reasons for vaccination were collected and entered into SPSS software. The percentage of children who had received all the required number of vaccines in the routine immunisation schedule was calculated. The proportion of children who had each of the vaccines was also calculated. Mother's knowledge of vaccination was scored based on some questions asked and was further graded into good and poor knowledge. Chi-square test was used to determine the association between parents' sociodemographic characteristics and children's vaccination status. **Results:** One hundred and seventy (68%) children completed their vaccination. There was a marked difference when the dropout rates from pentavalent 1/pentavalent 3 vaccine (2.7%) and Bacille Calmette–Guerin/measles vaccines (17.9%) were compared. Maternal knowledge ($P = 0.00001$), maternal parity ($P = 0.006$), mother's education ($P < 0.00001$), father's education ($P < 0.00001$), and father's age ($P = 0.0002$) were associated with vaccine uptake within the community. **Conclusion:** Mothers' knowledge and parity, parents' educational status, and the father's age significantly influenced vaccine uptake.

Keywords: Immunisation, parent education, South-southern Nigeria, under-five children, vaccination coverage

Introduction

Adequate nutrition, access to potable water, and good environmental hygiene remain essential for a child's physical well-being, mental health, and excellent school performance. These measures together with vaccination against major childhood infections may optimize health.[1] Vaccination is expected to enhance a child's ability to mount responses against many infectious diseases. It is a scientific technique of introducing a weakened or killed infectious agent or a fragment of the infectious agent or its toxin or a recombinant mRNA or a viral vector into an individual to activate the body's immune cascade to produce humoral and cellular antibodies needed to fight the specific infectious agent, while immunisation is the ability of the body to promptly recognize and provide protection against infection on exposure to the infectious agent.[2]

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The artificial immunisation of a child against an infectious agent helps strengthen the body's ability to resist infection on exposure rather than allowing nature to take its course. When most of the population is immunised against a particular infectious agent, herd immunity is built, interrupting the spread of the infection in the population.[3] It also gives lifelong protection to families and individuals in the community, saves

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spending on treatment, and limits hospital visits and extended hospital admissions. The reduced hospital stay significantly improves productivity. Although vaccination does not always protect against the disease, it most often protects against serious forms of the disease. As reported in a study, the odds of vaccinated children dying from vaccine-related diseases compared to unvaccinated children was lower with a relative risk of 0.73 (95% confidence interval of 0.63–0.77).[4]

Childhood vaccination has been on for over a century.[5] It is said to be one important means of preventing millions of deaths and outbreaks of communicable diseases in a cluster of vaccinated children. Globally, it averts about 2–3 million deaths annually.[6] It is considered by the World Health Organisation (WHO) and United Nations Children's Emergency Fund as the most cost-effective investment and one of the greatest phenomena ever discovered in medicine. The National Programme of Immunisation (NPI) in Nigeria presently vaccinates children against tuberculosis, poliomyelitis, diphtheria, pertussis, tetanus, *Haemophilus influenzae* type b, pneumococcal infection, hepatitis B, measles, yellow fever, and meningococcal disease.[7] This is comprised of a dose of Bacille Calmette–Guerin (BCG) vaccine, three doses of pentavalent vaccine, four doses of oral polio vaccine, a dose of inactivated polio vaccine, two doses of measles vaccine, a dose of yellow fever, and a dose of meningococcal vaccine.

In 2019, the WHO estimates of global childhood vaccine coverage were 75%; still, 14 million children had not had any vaccination.[8] Globally, the proportion of children who received the diphtheria–tetanus–pertussis 3 (DPT3) vaccine in 2019 was 85%, while in sub-Saharan Africa, vaccine uptake was 50% and 5% in hard-to-reach communities.[8] According to the 2018 National Demographic and Health Survey (NDHS), the percentage of children aged 12–23 months who had all vaccines stood at 31% and those with no vaccination was 19%. In the same document, the proportion of children who received all doses of polio vaccine was <50%, DPT1 (49.8%), DPT3 (38%), and measles (41.8%).[9] The bottom line is that Nigeria has made some progress in vaccine coverage, implementation of innovative ideas, and improved techniques in national immunisation program.[7] However, the country is yet to achieve the WHO's equity in health for all people in the world. Low vaccine coverage, especially in hard-to-reach communities, may pose threat to vaccine-preventable diseases in children.[10] This may lead to many hospitalised, which in turn impinges on already dwindling health systems in developing countries.

A diversity of factors has been recognised to interfere with vaccine coverage, uptake, and the refusal to vaccinate in Nigeria. Factors cited include but are not limited to civil unrest, attacks on vaccination teams, the far distance of houses to the health facilities, low socioeconomic status of women, erratic supply of vaccines, low public acceptability of immunisation programs, late release of funds by the government, fear of its use as a weapon of bioterrorism, rumors of complications or harms, and fear of death from vaccination.[11] There are few disconcerting publications that may prevent parents from vaccinating their children. These researchers found an increased odds rate of neurodevelopmental delays, allergies, and ear infections in vaccinated children compared with the unvaccinated.[12,13] There are also increasing misconceptions about the dangers of childhood vaccination among parents. Thousands of parents linked vaccines with autism in their children after an article was published in Lancet in 1998 which was retracted 10 years after.[14] Furthermore, in May 2009, the *New England Journal of Medicine* published some frightening statistics on vaccine refusal.[15]

To reach the WHO vision for this decade: "a world where everyone, everywhere, at every age, fully benefits from vaccines for good health and well-being," all people and nations need to respond, act, and support immunisation to advance a concrete rise in immunisation uptake and coverage.[8] By this vision, operational research to identify and scale up immunisation uptake and coverage in developing countries is needed. Although studies have been conducted in the past on the vaccination status of children, there is a need for continuous assessment of the prevalence of immunisation among children and the determinants of immunisation uptake as this will give a good understanding of trends that can be used for monitoring and evaluation and decision-making by policymakers.

Therefore, this study aimed to determine the proportion of children immunised in a community and the parental variables associated with immunisation in this community. The reasons for immunisation were also determined.

Materials and Methods

The study was conducted at Oghara, Delta State, Nigeria. Oghara is a semi-urban community in Delta State of Nigeria. It occupies an area of 1175 km^2 within the tropical rainforest belt in the South-South geographical zone of Nigeria and lies approximately on longitude 5.7° West and latitude 5.916° South. It comprises five wards, including Ogharefe-one with a population of 178,455, Ogharefe-two with a population of 30,583, Oghara-three with a population of 22,923, Oghareki-one with a population of 27,017, and Ogharaeki-two with a population of 29,923. Oghara has primary health-care facilities, a secondary health-care facility at Ogharefe, and the Delta State University Teaching Hospital.

The study population included children aged 12–59 months and their parents who should have completed their routine immunisation in an Oghara community, Delta State. A cross-sectional study design was employed and a minimal sample size of 250 was estimated using the formula for a cross-sectional study.[16] The percentage of children who had completed their immunisation in Delta State was 34%–48%.[9] A multi-stage sampling technique was used at different stages to select respondents. In the first stage, each of the wards was divided into clusters based on natural landmarks, and

thereafter, a cluster was then selected from each ward by balloting (there are five wards, thus five clusters were selected). In the second stage of the sampling, the sample size was divided uniformly among the five selected clusters, thus fifty households under-five were selected per cluster. In the third stage of the sampling, cluster sampling technique was used to select the fifty households for the study. All households with under-five children in the selected clusters were identified; in a household with more than one eligible child, balloting was used to select the child, and the selected child's parent was then interviewed. This process continues until the desired sample size was reached. A semi-structured questionnaire was used to obtain and document the following information: child's age, sex, birth order, sociodemographic data of parents/caregivers, awareness of vaccination, what is vaccination, its importance, current vaccination schedule in Nigeria, location of the immunisation centre and activities carried out at the vaccination centre, vaccines received by the child (this was accessed verbally and by sighting the child's vaccination card), the age the child received the vaccines, the interval between vaccines, completion of vaccines, and reasons for and against immunisation. This information was obtained from their mother or both mother and father. Data were analysed using IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0 (Armonk, NY: IBM Corp). The percentage of children who had received all the required number of vaccines was computed irrespective of the age at which he/she received the vaccines. A child was considered to have completed immunisation if he/she had all vaccines in the NPI. Furthermore, the proportion of children who had BCG, OPV0, OPV1, OPV2, OPV3, IPV, PENTA 1, PENTA 2, PENTA 3, PCV1, PCV2, PCV3, VITAMIN A 1st DOSE, VITAMIN A 2nd DOSE, MEASLES 1st DOSE, MEASLES 2nd DOSE, YELLOW FEVER, and MENINGITIS were calculated.

Mother's knowledge was assessed from the following questions: what is vaccination, its importance, the current vaccination schedule in Nigeria, the location of the immunisation centre, and activities carried out at the vaccination centre. Eighteen questions were used to assess knowledge, each correct response attracted one point, and the maximum points were 18. A mother with nine points and above was said to have good knowledge and a mother with <9 points was said to have poor knowledge.

The dropout rates were also calculated. The dropout rate is usually calculated using the formula provided by the National Primary Health Care Development Agency in the basic guide for routine immunisation for a service provider in Nigeria.[7] The dropout rate for PENTAVALENT vaccine was calculated by subtracting the number of children who had PENTA 3 from PENTA 1 divided by PENTA 1 multiplied by 100%. The dropout rate for BCG/measles was calculated by subtracting the number of children who had measles vaccine second dose from the BCG vaccine divided by BCG multiplied by 100%. Chi-square test was used to determine the association between parents' sociodemographic characteristics and children's vaccination status.

Results

Table 1 shows the sociodemographic characteristics of the parents of the children sampled. They were more mothers with tertiary education 125 (50%), 216 (86.4%) mothers were ever married, 227 (90.8%) mothers were working, and about 175 (70%) were multiparous. They were more fathers with tertiary education 149 (59.6%), while 222 (88.8%) fathers were ever married [Table 1].

Table 2 shows the immunisation status of children in the study population. Of the 250 children under five years who participated in the study, 170 (68%) had all the vaccines; 44 (17.6%) did not complete their vaccines and 36 (14.4%) had no vaccine. About 207 (82.8%) had BCG vaccine, 199 (79.6%) had OPV0, 191 (76.4%) had OPV 1, 172 (68.8%) had OPV 2, and 177 (70.8%) had OPV 3. The number of children who had HBV0 was 196 (78.4%); pentavalent 1, 187 (74.8%); pentavalent 2, 188 (75.2%); pentavalent 3, 182 (72.8%); and IPV, 172 (68.8%). About 193 (77.2%) had PCV 1, 177 (70.8%)

Table 1: Sociodemographic characteristics of parents of the children

Variables	Frequency (*n*=250; 100%), *n* (%)
Mother's age	
15-24	81 (32.4)
25-34	125 (50.0)
35 +	44 (19.6)
Mother's education	
None/primary	52 (20.8)
Secondary	73 (29.2)
Tertiary	125 (50.0)
Mother's marital status	
Never married	34 (13.6)
Ever married	216 (86.4)
Mother's occupational status	
Working	227 (90.8)
Not working	23 (9.2)
Mother's parity	
Primiparous	45 (18.0)
Multiparous	175 (70.0)
Grand multiparous	30 (12.0)
Mothers' knowledge of immunisation	
Good	206 (82.4)
Poor	44 (17.6)
Father's age	
15-24	21 (8.4)
25-34	96 (38.4)
35 +	133 (53.2)
Father's education	
None/primary	34 (13.6)
Secondary	67 (26.8)
Tertiary	149 (59.6)
Father's marital status	
Never married	28 (11.2)
Ever married	222 (88.8)

Table 2: Vaccination status of under-five children at Oghara

Vaccines	*n* (%)
BCG	207 (82.8)
OPV0	199 (79.6)
HBV0	196 (78.4)
Pentavalent 1	187 (74.8)
Pneumococcal conjugated virus 1	193 (77.2)
OPV1	191 (76.4)
Pentavalent 2	188 (75.2)
Pneumococcal conjugated virus 2	177 (70.8)
OPV2	172 (68.8)
Pentavalent 3	182 (72.8)
Pneumococcal conjugated virus 3	174 (69.6)
OPV 3	177 (70.8)
IPV	172 (68.8)
Vitamin A first dose	177 (70.8)
Measles first dose	174 (69.6)
Yellow fever	174 (69.6)
Meningitis	172 (68.8)
Vitamin A second dose	171 (68.4)
Measles second dose	170 (68.0)
Complete vaccination	170 (68.0)
Incomplete	44 (17.6)
None	36 (14.4)
Dropout rate	
PENTA 1 minus PENTA 3/PENTA 1×100 (%)	2.7
BCG minus measles second dose/BCG×100 (%)	17.9
Had vaccination card	178 (71.2)

BCG: Bacille Calmette–Guerin, OPV: Oral polio vaccine, HBV: Hepatitis B virus, IPV: Inactivated polio vaccine

had PCV 2, and 174 (69.6%) had PCV 3. The number of children who took Vitamin A first dose was 177 (70.8%), and Vitamin A second dose was 171 (68.4%). Measles first and second doses were 174 (69.6%) and 170 (68%), respectively. About 174 (69.6%) took the yellow fever vaccine. The dropout rate for pentavalent vaccines was 2.7% and for BCG and measles 17.9% [Table 2].

Table 3 shows the association between sociodemographic characteristics of parents and immunisation status of their children. About 82.4% of mothers had good knowledge and 17.6% had poor knowledge, of which 74.8% of mothers' with good knowledge completed their children's immunisation schedule, while 36.4% of mothers with poor knowledge of immunisation completed their children's immunisation. Seventy-six percent (76%) of children whose mothers had tertiary education had complete vaccines compared to 40.4% whose mothers had primary education. Mothers who are grand multiparous (80%) had their children completely vaccinated when compared with mothers who are primiparous (53.3%). About 76.7% of fathers whose ages are >35 years of age completed their children's immunisation schedule, compared to 47.6% of those <24 years. Seventy-six percent (76.5%) of children whose fathers had tertiary education had complete vaccines compared to 32.4% whose fathers had primary education. Maternal knowledge (P = 0.00001), maternal parity (P = 0.006), mother's education (P = 0.00001), father's education (P = 0.00001), and father's age (P = 0.0002) were identified as variables associated with vaccine uptake within the community [Table 3].

Table 4 shows the reasons for/against immunisation. About 48.8% of the mother's said that vaccination protect their children against diseases, and 10% of the mother's said it reduces severe forms of diseases. For reasons against immunisation, 3.2% of the mothers said that the vaccines had no effect on their children, and that the vaccines cause fever (10.8%) [Table 4].

Discussion

We assessed the proportion of children immunised in the community, the parental factors associated with immunisation, and the reasons for and against immunisation. In our study, the proportion of children that completed their vaccination was 68%. This was similar to a survey carried out in Imala, Ogun State, Nigeria, but was higher than the value (31%) obtained from the Nigeria National Demographic Health Survey.[9,17] This finding was also higher than reports obtained from a large-scale rural survey in Ethiopia, a rural setting in Western Nigeria, and a community-based study in Northwest Ethiopia.[18-20] This may be linked to the result that a greater number of mothers had good knowledge about immunisation and most parents in this study attained a tertiary level of education. The rate of complete vaccination of children is an important metric to assess progress toward attaining the United Nations Sustainable Development Goal 3.[21]

The coverage rates of the vaccines administered at birth (BCG and OPV0) were relatively higher than those administered at later periods of life (measles, yellow fever, and meningitis). A comparable pattern has been reported in other studies.[18,20,22,23] This variance has been associated with the duration between the first doses of vaccine and that of taking subsequent vaccines. In Nigeria, children require five contacts with health providers to complete the childhood vaccines.[7] Furthermore, in this study, the antigen with the highest rate of uptake was BCG. A likely reason is that this vaccine is usually given at birth in the health facility where the child is born and the hospital policy ensures that this vaccine is administered before the child is discharged from the hospital.

Comparing the two dropout rates from pentavalent 1/pentavalent 3 and BCG/measles vaccines, there was a marked difference between the two indices. This large difference may be attributable to the longer time between BCG and measles vaccination (about eight months), compared with the three-month time interval between the first and third doses of the pentavalent vaccine. The large time interval between BCG and measles vaccination may result in caregivers forgetting the measles vaccination date, hence a high dropout rate. This calls for the need to institute recalling mechanisms for mothers such as phone calls to remind them of the date for vaccination.

Table 3: Association between parent characteristics and child's vaccination status

Variables	Vaccination status				χ^2 (*P*)
	Completed (*n*=170; 68%), *n* (%)	Incomplete (*n*=44; 17.6%), *n* (%)	None (*n*=36; (144%), *n* (%)	Total (*n*=250; 100.0%), *n* (%)	
Mother's knowledge of immunisation					
Good	154 (74.8)	34 (16.5)	18 (8.7)	206 (100.0)	34.72 (0.00001)
Poor	16 (36.4)	10 (22.7)	18 (40.9)	44 (100.0)	
Mother's age					
15-24	45 (55.6)	17 (21.0)	19 (23.5)	81 (100.0)	12.32 (0.15)
25-34	89 (71.2)	21 (16.8)	15 (12.0)	125 (100.0)	
35 +	36 (81.8)	6 (13.6)	2 (4.5)	44 (100.0)	
Mother's education					28.43 (0.00001)
None/primary	21 (40.4)	13 (25.0)	18 (34.6)	52 (100.0)	
Secondary	54 (74.0)	13 (17.8)	6 (8.2)	73 (100.0)	
Tertiary	95 (76.0)	18 (14.4)	12 (9.6)	125 (100.0)	
Mother's marital status					1.56 (0.46)
Never married	20 (58.8)	8 (23.5)	6 (17.6)	34 (100.0)	
Ever married	150 (69.4)	36 (16.7)	30 (13.9)	216 (100.0)	
Mother's occupational status					1.57 (0.46)
Working	152 (67.0)	42 (18.5)	33 (14.5)	227 (100.0)	
Not working	18 (78.3)	2 (8.6)	3 (13.1)	23 (100.0)	
Mother's parity					14.28 (0.006)
Primiparous	24 (53.3)	7 (15.6)	14 (31.2)	45 (100.0)	
Multiparous	122 (69.7)	32 (18.3)	21 (12.0)	175 (100.0)	
Grand multiparous	24 (80.0)	5 (16.7)	1 (3.3)	30 (100.0)	
Father's age					22.01 (0.0002)
15-24	10 (47.6)	6 (28.6)	5 (23.8)	21 (100.0)	
25-34	58 (60.4)	14 (14.6)	24 (25.0)	96 (100.0)	
35 +	102 (76.7)	24 (18.0)	7 (5.3)	133 (100.0)	
Father's education					28.86 (0.00001)
None/primary	11 (32.4)	10 (29.4)	13 (38.2)	34 (100.0)	
Secondary	45 (67.2)	11 (16.4)	11 (16.4)	67 (100.0)	
Tertiary	114 (76.5)	23 (15.4)	12 (8.1)	149 (100.0)	
Father's marital status					1.33 (0.52)
Never married	17 (60.7)	5 (17.9)	6 (21.4)	28 (100.0)	
Ever married	153 (68.9)	39 (17.6)	30 (14.9)	222 (100.0)	

Table 4: Mother's reason for/against immunisation

Variables	*n*=250, *n* (%)
Immunisation important to children	
Yes	213 (85.2)
No	37 (14.8)
Reasons for immunisation	
Protect the child from illness	122 (48.8)
Make the child healthy	47 (18.8)
Reduce the severity of illness	25 (10.0)
No response	56 (22.4)
Reasons against immunisation*	
Cultural belief	6 (2.4)
No effect on child health	8 (3.2)
Inability to move leg after vaccination	9 (3.6)
Developed fever after vaccination	27 (10.8)
Developed diarrhea after a vaccination	1 (0.4)

*Indicates multiple response

Unlike our study which showed a marked difference in the two metrics used for dropout rates, another study in a rural setting in East Africa showed very close similarity in the different metrics used for assessing dropout rates.[23] East Africa computed dropout rates using three metrics: OPV1 to OPV3, Penta1 to Penta3, and BCG to Measles. The reason that may have accounted for the disparity is that our study compared the dropout rate using BCG and the second dose of measles, while the East Africa study compared dropout rate using BCG and the first dose of measles.

There was a gradual and consistent reduction in the proportion of children who took the oral polio vaccine from OPV0 to OPV3. This may be related to the forgetfulness of vaccination dates by their caregivers due to the successive four weeks' interval between the vaccine administrations. This draws attention to the need to include in the immunisation programs a means of reminding parents of the expected days for

vaccination of their children. Some investigators have also suggested nursing mothers remind their husbands of their appointments, as a way of reducing forgetfulness during subsequent visits.[24]

There was a little above a four-fifths increase in the rate of BCG vaccination compared to the finding from NDHS 2018.[9] This may be an indication of improvement in BCG coverage which is highly commendable. High BCG vaccination is a key strategy for the prevention of tuberculosis infection. In this study, the coverage rate for BCG was more than eight in ten children, which was as high as nine in ten children who took the BCG vaccine in a similar study.[23]

Regarding uptake rate, the second dose of the measles vaccine had the lowest uptake rate. This is, in contrast, to a report by Hailu *et al* 2019, where the lowest uptake rate was in the administration of the oral polio vaccine at birth.[18] In this study, children without any vaccine were lower, almost three in twenty compared to the report of less than one in five from NDHS.[6] Abysmally low coverage rates were also documented in the North-west region of Nigeria.[25] This group of children without vaccination is significant and should be traced in the community as they may hinder the attainment of herd immunity.

About four-fifth of the mothers had good knowledge about immunisation. Conversely, less than a quarter of respondents were reported to have had good knowledge about immunisation in Mangalore, India.[26] A statistically significant association was found between mothers' knowledge of immunisation and their children's vaccination status. This corroborates findings from related studies showing a significant association between mothers' knowledge about vaccination schedules and a child's vaccination coverage.[19,20,27,28] This highlights the importance that educating mothers might have on childhood vaccination coverage. Messages related to the role of mothers as regards vaccination during antenatal care sessions and even in other fora which pertain to mothers of under-fives and those preparing for marriage will be beneficial.

There was a statistically significant association between immunisation status of children and educational level of mothers. In a related study, a similar observation was made.[23] This might reflect the importance of mothers' education in achieving positive health outcomes in their children and within their families by extension. However, a study that was done in Al-Beida, Libya reported findings of a higher proportion of illiterate mothers whose children were fully immunised.[29] Our study portrayed that mothers' knowledge about immunisation, educational status of mothers, maternal parity, and fathers' age and educational level, were significantly associated with an increased uptake of immunisation.

Although there was no statistically significant association between child's vaccination coverage and mother's occupational status. Three-quarters of mothers not working completed their children's vaccination when compared to two-thirds of those working. This may be because mothers who have no jobs have more flexible times to take their children for vaccination, whereas mothers who have jobs may be time-constrained due to busy work schedules, in addition to other reasons which could result in missing children's vaccination dates. A contrary observation showed that a mother's job did not affect the immunisation of their children.[29]

Most of the reasons given by respondents in this study for being against immunisation were factors associated with mothers' experience at health facilities after vaccinating their children, such as fever and the inability of a child to move the leg after vaccination. This may imply that health-care providers may not be properly educating clients on the side effects of vaccines. Strengthening awareness about the side effects of vaccines needs to be embedded into the health education programs which should be done consistently before vaccine administration to prevent dropout rates during vaccinations.

Conclusion

Our study revealed that majority of the children in the community were fully vaccinated, but this coverage was below the expected national target. This signals a need to scale up attempts at creating awareness in the community as regards vaccination campaigns all year round. Furthermore, majority of the mothers had good knowledge of immunisation. Incentives should also be given to mothers who provide evidence of completed child health cards to further motivate other mothers within a community.

Mothers' knowledge of immunisation, educational status of mothers, maternal parity, and fathers' age and educational level were associated with uptake of immunisation. This discovery further reiterates the importance of improving the access to education and promoting gender equality for the achievement of sustained development within the society, with efforts geared toward reducing child morbidity and mortality.

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Conflicts of interest

There are no conflicts of interest.

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