

Original Research Article

Full childhood immunization coverage and incidence of vaccine preventable disease in Nigeria: a regression analysis

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ABSTRACT

Background: Childhood immunization contributes significantly in the reduction of cases of vaccine preventable diseases in children. DHIS2 data showed that only 60.59% of children under one were fully immunized in 2020. This implies that 39.41% did not receive all recommended vaccinations therefore at risk of contracting vaccine preventable diseases. This study therefore examined the effect of full immunization coverage on incidence of vaccine preventable diseases.

Methods: Full childhood immunization coverage and incidence of vaccine preventable disease was examined using simple linear regression model at 5% level of significance and 95% confidence interval. Measles new case for children under five was the dependent variable while children under one fully immunized was the independent variable. Data was retrieved from DHIS2 for the period 2017-2020.

Results: The study showed a negative relationship between full immunization coverage and incidence of under-five measles new cases. The study found that any unit increase in full immunization coverage would lead to decrease in measles cases by 6%.

Conclusions: Full immunization coverage is still low (below WHO target of 80%) despite effort by government and partners. This implies that a lot of children are at risk of contracting vaccine preventable diseases. In order to avert this risk, health authorities and partners should devise appropriate means of educating the populace on the importance of childhood immunization.

Keywords: Immunization, Full immunization, Vaccine preventable diseases

INTRODUCTION

Immunization is highly effective in preventing vaccine preventable diseases such as polio, measles, diphtheria, tetanus, and pertussis which are responsible for a

significant number of child mortality. Every year, approximately 1.5 million children under the age of five die as a result of these diseases globally.¹ In Nigeria, vaccine preventable diseases accounts for a significant percent of child mortality every year. According to

Adedire et al vaccine preventable diseases accounts for approximately 22% of child mortality in Nigeria every year. In order to avert this ugly trend, the National Programme on Immunization (NPI) was established with the aim that every child should have access to routine immunization thereby eradicating vaccine preventable diseases in the country. Development partners through their numerous interventions in child immunization (measles and polio campaigns, and other immunization outreaches) have also increased access to routine immunization. Despite these efforts towards increasing the Nigerian child access to routine immunization thereby improving coverage, full immunization coverage is still very low (23%) and below Global Vaccine Action Plan (GVAP) goals, putting a substantial number of children at risk of vaccine preventable diseases.² In 2014, 18.7 million children were not fully immunized; over 60% of these children were from ten countries-Nigeria inclusive.¹

According to World Health Organization (WHO) Measles Fact sheet in 2018, about 86% of the world's children received one dose of measles vaccine by their first birthday through routine health services. Overall, global measles mortality decreased by 60% between 1999 and 2005. In Africa, the result of the increased measles vaccination coverage was a decline by nearly 75% of measles cases and deaths.

In Nigeria, efforts by government and partners towards immunization coverage have yielded different results over the years. The optimum level was recorded in the early 1990s when a universal childhood immunization coverage of 81.5% was achieved, in 1996 however, the national data showed less than 30% coverage for all antigens, and this decreased to 12.9% in 2003.³ The NICS (2017) report showed 23% coverage for fully immunized children. This immunization coverage has not been examined in relation to incidence of Vaccine Preventable Diseases VPDs. This paper therefore seeks to examine the relationship between full immunization coverage and incidence of vaccine preventable diseases (9-59 months) in Nigeria. VPD cause significant morbidity and mortality in children under the age of five years. In Nigeria only 23% of children received all recommended vaccines, according to the 2018 Nigeria Demographic and Health Survey (NDHS), 31.0% of children aged 12 to 23 months had received all basic immunization.⁴

Immunization is the process of giving a vaccine to a person with the aim of protecting such a person against diseases. In Nigeria, immunization is provided either at fixed or outreach sessions. Fixed sessions are done in health facilities while outreach sessions are done in communities, mostly the ones far from any health facility that provides routine immunization. Immunization began in Nigeria in 1956 when smallpox was severe nationwide the national immunization tagged Expanded Programme on Immunization (EPI) started in 1979 to combat deadly

childhood diseases, which were regarded as the cause of high infant morbidity and mortality in Nigeria.

This study aims to show the relationship between full childhood immunization coverage and incidence in cases of vaccine preventable diseases and consequently mortalities from such diseases.

Vaccine coverage in Nigeria

Vaccine coverage refers to the number of children who received age specific vaccines over a period and specified location. UNICEF estimate of coverage per antigen provides information on only four antigens in Nigeria. These are BCG (TB), DPT (diphtheria, pertussis and tetanus), polio and measles. According to UNICEF data between 1995 and 2005, BCG coverage in Nigeria witnessed a decline from 80% in 1990 to 42% in 1995 and fluctuated between 43% in 1996 and 60% in 2003. In 1997, BCG recorded 53%. This means that the target of at least 80% coverage as indicated in EPI policy in Nigeria was not met, just as it was still not met in 2005. The BCG coverage shows over 35% increase from the 40.50% coverage recorded in 2006 against the 76.41% coverage for 2010 and over 53% from the 23% coverage in 2003. The highest BCG coverage was reported in Enugu State with 99.55%, while the lowest was reported in Kano State with 35.23%.³

EPI policy in Nigeria stipulated that by 2004 no community in the country should have or report cases of diphtheria. The results show that this vision is not yet realized. In 1990, DPT vaccine had coverage of 56%. This dropped to 31% in 1995 and to 26% in 1996 and ranged between 25% and 45% between 1997 and 2005. Apart from 56% in 1990, the peak between 1995 and 2005 was 45% recorded in 1997. Although the national DPT3 coverage stands at 67.73%, there was an almost 95% increase in coverage in 2010 as against the 36.3% coverage recorded in 2006. This figure is applicable not only to the national figure but also across all the zones. The southeast zone with a coverage of 91.18% presents the highest figure, while the northeast zone with 46.16% presents the lowest. The DPT3 coverage by States shows that Enugu state had the highest DPT3 coverage of 98.21%, while Taraba State showed the lowest DPT3 coverage with 15.63%.³

In 1990, polio coverage was 55%. This dropped to 31.5% in 1995 and, between 1996 and 1999 it dropped to between 26% and 19%. In 2000, it increased and then peaked to 26% and continued to rise to 45% in 2005. These results show that the country's target of eradicating polio in Nigeria by the year 2004, through 95% coverage was not met. Oral polio vaccine (OPV3) coverage shows a national figure of 73.95% coverage with the southeast zone at 86.63% as the highest and the northeast zone with 60.2 as the lowest rate. The trend shows a drop from 38.60% in 2003 to 36.70% in 2006 and an increase to 73.95% in 2010. The OPV3 coverage by states shows that

Enugu state recorded the highest coverage with 99.11%, while Taraba State recorded the lowest with 18.75%.³

Measles' coverage was 54% in 1990 and dropped to 44% in 1995 with further drop to 38% in 1996. The peak coverage was 69% in 1997, which later dropped to 40% in 1998 and to 35% in 1999. Since 1999, there was no significant change over the years, except in 2004 and 2005 when the coverage dropped to 32%. The downward trend in the coverage of all the antigens appears to be associated with political problems.³ These political problems included low government commitment to ensure the fulfilment of EPI policy. It also included over-centralization in the administration of EPI at the federal level of governance in Nigeria. Also, the poor coverage of measles between 1998 and 2005 was blamed on vaccine shortages and administrative problems, as it applied to Polio coverage between in 1996, 1999 and 2000 when Polio recorded 26%, 19% and 26% respectively.⁵

However, the coverage for measles also showed a rise from 25.30% in 2003 to 32.70% in 2006 and 63.55% in 2010. Looking at the zones, the data show 82.35% coverage in the southeast, 74.40% in the south-south and 47.15% in the northeast as the lowest. The measles

coverage by state shows that Enugu state had measles coverage of 97.77%, Zamfara had a coverage of 65.48%, while Kano recorded the lowest coverage of 16.48%.³ According to the Federal Ministry of Health, a child is considered fully immunized if he or she has received a BCG vaccination against tuberculosis; three doses of DPT to prevent diphtheria, pertussis (whooping cough), and tetanus; at least three doses of polio vaccine; and one dose of measles vaccine.⁵

All these vaccinations should be received during the first year of life, over the course of five visits, including the doses delivered at birth.

Immunization schedule in Nigeria

Note: OPV0 must be given before the age of two weeks, HepB at birth should be given preferably within 24 hours of birth but can be given up to 14 days of birth, BCG should be given within two weeks of birth but can be given up till 11 months, Rota vaccine has not yet been introduced in Nigeria.

Table 1: Nigeria's expanded programme on immunization schedule.

Minimum Target age of child	Type of vaccine	Dosage	Route of administration	Site
At birth	BCG	0.05 ml	Intra-dermal	Left upper arm
	OPV0	2 drops	Oral	Mouth
	Hep B birth	0.5 ml	Intra-muscular	Antero-lateral aspect of right thigh
6 weeks	Pentavalent (DPT, HepB, and Hib) 1	0.5 ml	Intra-muscular	Antero-lateral aspect of left thigh
	Pneumococcal Conjugate vaccine 1	0.5 ml	Intra-muscular	Antero-lateral aspect of right thigh
	OPV1	2 drops	Oral	Mouth
	Rota1	1 ml	Oral	Mouth
10 weeks	Pentavalent (DPT, HepB, & Hib) 2	0.5 ml	Intra-muscular	Antero-lateral aspect of left thigh
	Pneumococcal Conjugate vaccine 2	0.5 ml	Intra-muscular	Antero-lateral aspect of right thigh
	OPV2	2 drops	Oral	Mouth
	Rota2	1 ml	Oral	Mouth
14 weeks	Pentavalent (DPT, HepB, & Hib) 3	0.5 ml	Intra-muscular	Antero-lateral aspect of left thigh
	Pneumococcal Conjugate vaccine 3	0.5 ml	Intra-muscular	Antero-lateral aspect of right thigh
	OPV3	2 drops	Oral	Mouth
	IPV	0.5 ml	Intra-muscular	Antero-lateral aspect of right thigh (2.5cm apart from PCV)
6 months	Vitamin A 1st dose	100,000 IU	Oral	Mouth
9 months	Measles 1st dose	0.5 ml	Subcutaneous	Left upper arm
	Yellow fever	0.5 ml	Subcutaneous	Right upper arm
	Meningitis vaccine	0.5 ml	Subcutaneous	Antero-lateral aspect of left thigh
15 months	Vitamin A 2nd dose	200,000 IU	Oral	Mouth
	Measles 2nd dose (MCV2)	0.5 ml	Subcutaneous	Left upper arm

Source: National Primary Health Care Development Agency.

Table 2: Coverage by geo-political zones for both survey.

Geo-political Zone	Fully immunized coverage (%) NICS/MICS 2017	Fully immunized coverage (%) NDHS 2018
North West	8	19.9
North East	20	22.9
North Central	26	31.0
South South	43	41.8
South West	50	43.0
South East	44	57.0

Source: NICS 2017 and NDHS 2018 Report.

Immunization coverage in Nigeria

According to the NICS (2017) and NDHS 2018 report, coverage for fully immunized children was 23%, while

the NDHS 2018 reported 31% of children age 12-23 months had received all basic vaccination at the time of the survey.

Factors influencing Immunization Coverage in Nigeria

Education level of parents/caregivers

Education level of parents/caregivers has been found to have a positive influence on child immunization.⁶ In a study conducted in peri-urban area of Kenya on immunization coverage and its determinants among children aged 12-23 months, maternal education was found to be one of the factors that was significantly associated with immunization coverage, this finding agreed with a study conducted in Bungudu Local Government Area of Zamfara State Nigeria.^{7,8} In Uganda, one of the significant factors influencing completion of childhood immunization is possession of at least a secondary education by parents/caregivers.⁹ This assertion is same in Angola.¹⁰

Table 3: Summary of nature of vaccine preventable childhood diseases.

Disease	Mode of spread	Complication(s)	Treatment
Poliomyelitis	Faecal-oral route. Through intake of contaminated food or water.	Flaccid paralysis	No cure. Use of antibiotics (for infection), analgesics (for pain), as well as physical therapy
Diphtheria	Air borne. Through physical contact with infected person	Severe sore throat, fever, obstruction of breathing, damage to the eye (paralysis), heart and kidney	Diphtheria antitoxin, antibiotics (for infections) such as metronidazole, erythromycin, procaine penicillin
Measles	Air borne. Contact with fluids from an infected person’s nose or mouth either directly or through aerosol transmission	Diarrhoea, pneumonia, otitis media, and acute encephalitis	No specific treatment regimen. Use of drugs to take care of the complications
Tetanus	Wound contamination	Painful skeletal muscle spasms in the jaw, back, chest, and abdomen	Tetanus immunoglobulin, metronidazole (for infection), diazepam (as a skeletal muscle relaxant)
Tuberculosis	Air borne	Chronic cough, weight loss, chest pain, fever, blood-stinged sputum	Use of combination of antibiotics such as isoniazid and rifampicin
Pertussis	Air borne	Pneumonia, earache, encephalopathy, seizures	Erythromycin, trimethoprim-sulphamethoxazole

Source: National Programme on Immunization (NPI), 2011.²²

Income level of parents/caregivers

Family income has been found to influence coverage.⁶ In a study on the factors influencing compliance with immunization regimen among mothers in Moniya Community Ibadan, Nigeria, and in a similar study on the reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children, findings indicates that children of parents of lower socioeconomic background have reported poor completion of their immunization regimen than children of parents of higher

socioeconomic background.^{11,12} This is consistent and in line with the findings in a study on the factors influencing full immunization coverage among 12-13 months in Ethiopia, which shows that children of the wealthy families are more likely to complete their immunization regimen than their counterpart from the poor families.¹³

Health facility delivery

According to a study by, in Ethiopia, health facility delivery has a positive and significant influence on child

immunization completion.¹⁴ Findings from their study showed that children delivered at health facilities were more likely to complete their immunization schedule than children delivered at home. This finding is consistent with findings of studies conducted in East African countries, which revealed an increased likelihood of complete vaccination status associated with getting a check-up within 2 months of birth in Burundi, Kenya, and Uganda.¹³

Knowledge of parents/caregivers on routine immunization services

In Nigeria and other African countries, studies have shown that parents/care givers knowledge on routine immunization services has a significant influence on immunization coverage. According to a study by Gidado, et al maternal knowledge of the benefit and schedule of routine immunization services has a positive influence on the mother's decision to get her child fully immunized. This finding agrees with the finding of a study by Etana and Deressa conducted in Ethiopia which found that lack of awareness about immunization contributes to low coverage, and children of mothers that knew the age at which vaccination starts and finished are more likely to complete immunization compare to their counterparts whose mothers have no knowledge of the schedule of routine immunization services.

Distance of parents/caregivers from RI-providing facilities

Distance from a health facility is an important predictor of full immunization; this is because it has an implication in accessing the health facilities where the services are offered.⁶ According to, mothers that are resident near health facilities that provide routine immunization services are more likely to fully immunize their children than those living in areas where there are no health facilities providing routine immunization close to them.¹⁵ In a study conducted by,⁸ in Awe local government area of Nasarawa state Nigeria, long walking distances, as well as long waiting time at the facility, are key factors associated with poor completion of routine immunization schedules.

Influence of religious/ethnic affiliation of parents/caregivers

Religious/ethnic affiliation of parents/caregivers plays a significant role in ensuring complete routine immunization schedule of children. According to, in addition to other personal characteristics of women, religious affiliation, and ethnic background were statistically associated with full immunization status of their children.¹⁶

Women autonomy

Women autonomy is the ability of women to take an independent decision about the family that either affects

them or their children without any interference from the family. Women autonomy increases their use of emergency care or preventive health care services including children's immunization.¹⁷

Maternal age and parity, child's sex, and birth order

Maternal age and parity of mother were some of the factors influencing completion of child immunization.¹⁸ These studies revealed that mothers with lower parity were more likely to have fully immunized children than mothers with higher parity. The study by Rahman found that middle age mothers are more likely to get their children fully immunized than older women, the study also found that sex discrimination plays a role in immunization coverage, with male children more likely to be fully immunized than females.

Insecurity and population displacement

The on-going insecurity situation across most region of the country; the arm conflict in the north east by the non-state actors' group (NSAG), the bandits' crises in most of the North Western and central states, and recently the occurrence of kidnapping in some southern states with it resultant effect on the fluidity of any given population. These have greatly affected the coverage of routine immunization in Nigeria in recent time.

Rejection of routine immunization

Another problem and challenge facing immunization programmes in Nigeria is rejection. Parents and caregivers in some parts of the country reject immunization for their children/wards. The reasons for such rejection are outlined below:

Fear and confusion

Many decision-makers and caregivers reject routine immunization due to rumor, incorrect information, and fear of adverse effects following immunization. Fears regarding routine immunization are expressed in many parts of Nigeria. Fathers of partially immunized children in Muslim rural communities in Lagos State see hidden motives linked with attempts by nongovernmental organizations (NGOs) sponsored by unknown enemies in developed countries to reduce the local population and increase mortality rates among Nigerians. Belief in a secret immunization agenda is prevalent in Jigawa, Kano and Yobe States, where many believe activities are fuelled by Western countries determined to impose population control on local Muslim communities.¹⁹

Low confidence and lack of trust

The widespread misconception that immunization can prevent all childhood illnesses reduces trust and confidence because when it fails to give such protection,

trust and confidence is lost in immunization as an intervention, for any and all diseases.

Attitudes, motivation, performance, and competence of health staff

Parents/caregivers sometimes refuse to present their children/wards for immunization because of the rude and abusive attitude of health workers (Sule, 2018). In Nigeria and other African countries such as Kenya, Ethiopia, Niger, Zimbabwe, and Uganda, parent's/caregiver's refusal for bringing children for vaccination or refusal to return to complete vaccination schedules even when they had already begun the schedule was a result of rude and abusive attitude of health care providers.²⁰

Vaccine preventable childhood diseases

The Table 2.4 below presents a summary of vaccine preventable diseases, mode of spread, complication(s) and treatment.

METHODS

Data type and source

Secondary data sourced from the Nigeria Health Management Information System (NHMIS) database-the District Health Information System (DHIS2) was used for the study. Data retrieved was between the period of 2017 to 2020.

Study variables

The dependent variable for the study is incidence of Measles among children under five while the independent variable is the completion of child immunization schedule (fully immunized children). The choice of only one dependent variable was informed by its high case reporting unlike the others which seems to be under-reported.

Model specification

The regression model used in the study is specified as:

$$MS_i = f(FI) \dots \dots (3.1)$$

$$MS_i = \beta_0 + \beta_1 FI + \varepsilon \dots \dots (3.2)$$

MS_i =incidence of measles in children under five

β_0 =regression intercept of the dependent variable

β_1 =slope of the regression line

FI=fully immunized children

ε =error term

RESULTS

Data presentation

Table 4: Number children fully immunized and measles new cases.

ng Federal Government		
Period name	Fully Immunized <1 year	Measles new cases <5 years
2020	5216384	67507
2019	5507659	83319
2018	4918529	45783
2017	5062689	58668

Source: retrieved from DHIS2 (10th June, 2021, 11:26 am)

Table 5: Percentage under one fully immunized and under five measles new cases.

ng Federal Government		
Period name	%Fully Immunized < 1 year	%Measles new cases < 5 years
2020	60.59	0.16
2019	65.99	0.20
2018	60.72	0.11
2017	64.52	0.15

Source: Author's Computation using data from DHIS2

Table 6: Variable and coefficient.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	257564	26969	-9.5500	0.0107
FI	-0.06208	0.0052	11.9270	0.0069

Table 7: Proportion of variance for dependent variables.

R-squared	0.986135	Mean dependent var	63819.25
Adjusted R-squared	0.979203	S.D. dependent var	15765.80
S.E. of regression	2273.594	Akaike info criterion	1.274876
Sum squared resid	7456887	Schwarz criterion	1.518652
Source: E-views 9.0			

Data analysis

Dependent Variable: MSi

Method: Least Squares

Sample: 2017 - 2020

Included observations: 4

DISCUSSION

The analysis found an inverse relationship between the study variables as expressed in the fitted regression model.

$$MS_i = 257564 - 2273.594 \dots - (4.1)$$

This implies that when no child is fully immunized, incidence of new under five measles will be 257,564. The coefficient of FI implies that a unit increase in the number of fully immunized under one children will lead to a reduction in the incidence of under-five measles cases by about 6%. This finding is consistent with the WHO measles Fact sheet which asserted that increased immunization coverage leads to reduction in cases of vaccine preventable diseases and consequently mortalities from such diseases.²¹ According to the fact sheet, when more than 360 million children globally received measles vaccine through supplementary immunization activities from 2000 to 2005, there was a significant reduction in measles cases. The error term showed that even after completion of immunization schedule (being fully immunized) 2273 cases of measles were reported in children. This could be as a result of several factors such as; administration of vaccines which are not vial and wrong timing of vaccine administration.

A limitation of this study was that the most recent Survey data that contains the immunization coverage in Children is the 2018 version. Also, the routine immunization data on the district health information system are sometimes not accurate and complete, this may have somewhat overestimated the actual vaccine coverage in children as indicated.

CONCLUSION

Despite several efforts by Nigerian government and partners towards full immunization of children, the coverage has remained below 70 per cent over the years which is below the WHO target of 80 per cent. This implies that a substantial number of children are still at risk of contracting vaccine preventable disease. Vaccine preventable diseases remains a challenge across the sub-Saharan African region, hence the findings from this study will provide evidence from available routine program data to health managers and stakeholders for the need to prioritize a wider vaccine coverage across the region. And in order to increase full immunization coverage thereby bringing to a minimal the number of children at risk of these diseases.

Recommendations

Nigerian health authorities (Federal and State Ministries of Health, National and State Primary Health Care

Development Agencies) should produce and publicize messages on schedule and importance of childhood immunization using local dialects.

Local Government Health Authorities through their Health Educators should be supported to conduct compound meetings where community members would be sensitized on immunization schedule and importance of immunization to the health of their children.

Federal and State Ministries of Health should review and encourage case reporting for vaccine preventable diseases. The reviewed reporting format should disaggregate case reporting by age group (under five and above five years).

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