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Access to expanded programme on immunization (EPI) in Nigeria: A case study in Lagos State

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ABSTRACT

Objective: This study assessed access to childhood immunization among children aged 12-23 months in Lagos metropolis, Nigeria.

Methods: In a descriptive cross-sectional survey, data on vaccination coverage among 373 children aged 12-23 months residing in Lagos State, Nigeria were extracted from the Child's Immunization card. Their mothers/caregivers were interviewed regarding vaccination practices, missed or rescheduled appointments, and factors influencing access to immunization services.

Results: Majority (75.9 %) of the children were fully vaccinated, with more than 97 % of the children completing their immunizations with BCG, OPV0, OPV1, OPV2, OPV3 and $Penta_1$, and drop-out rates were highest for $Penta_2$ (18.5 %), $Penta_3$ (22.3 %), measles (24.1 %) and yellow fever (24.1 %). All respondents immunized their children at least thrice before their first birthday. Age ($p = 0.0119$), income ($p < 0.001$), religion, and marital status ($p = 0.0323$) of mother/caregiver of the children and sex of the children were significant to immunization practice ($p = 0.0017$). Reported vaccines availability was significantly associated with maternal/caregiver's age ($p < 0.001$), marital status ($p = 0.0001$), educational qualification ($p = 0.0094$) and income ($p = 0.0001$) of the mothers/caregivers. None of the independent variables was significantly associated with the need to reschedule the vaccination appointment date ($p > 0.05$).

Conclusion: Child immunization coverage in the studied area was below the recommended target with a high dropout rate. A large proportion of respondents rescheduled vaccination appointments mainly due to the unavailability of vaccines and late arrival at vaccination centres. These findings underscore the need to improve vaccine availability, establish more vaccination posts in underserved communities to reduce the long distances caregivers travel to access immunization services, as well as educational interventions to emphasize the importance of completing entire immunization schedule.

Keywords: Immunization, vaccines, preventable diseases, childhood diseases

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Accès au programme élargi de vaccination (PEV) au Nigéria : une étude de cas dans l'État de Lagos

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RÉSUMÉ

Objectif : Cette étude a évalué l'accès à la vaccination infantile chez les enfants âgés de 12 à 23 mois dans la métropole de Lagos, au Nigéria.

Méthodes : Dans le cadre d'une enquête descriptive transversale, les données relatives à la couverture vaccinale de 373 enfants âgés de 12 à 23 mois résidant dans l'État de Lagos, au Nigéria, ont été extraites de leur carnet de vaccination. Leurs mères ou personnes en charge ont été interrogées sur les pratiques de vaccination, les rendez-vous manqués ou reportés et les facteurs influençant l'accès aux services de vaccination.

Résultats : La majorité des enfants (75,9 %) étaient entièrement vaccinés, avec plus de 97 % d'entre eux ayant reçu toutes les doses de BCG, OPV0, OPV1, OPV2, OPV3 et Penta1. Les taux d'abandon les plus élevés concernaient Penta2 (18,5 %), Penta3 (22,3 %), la rougeole (24,1 %) et la fièvre jaune (24,1 %). Tous les répondants ont fait vacciner leurs enfants au moins trois fois avant leur premier anniversaire. L'âge ($p = 0,0119$), le revenu ($p < 0,001$), la religion et la situation matrimoniale ($p = 0,0323$) de la mère ou de la personne s'occupant des enfants, ainsi que le sexe des enfants, ont eu une influence significative sur les pratiques de vaccination ($p = 0,0017$). La disponibilité déclarée des vaccins était significativement associée à l'âge ($p < 0,001$), à l'état civil ($p = 0,0001$), au niveau d'études ($p = 0,0094$) et au revenu ($p = 0,0001$) de la mère/personne s'occupant des enfants. Aucune des variables indépendantes n'était significativement associée à la nécessité de reporter la date du rendez-vous de vaccination ($p > 0,05$).

Conclusion : La couverture vaccinale infantile dans la zone étudiée était inférieure à l'objectif recommandé, avec un taux d'abandon élevé. Une grande partie des répondants ont reporté leurs rendez-vous de vaccination, principalement en raison de l'indisponibilité des vaccins et de l'arrivée tardive aux centres de vaccination. Ces résultats soulignent la nécessité d'améliorer l'accès aux vaccins, de créer davantage de postes de vaccination dans les communautés mal desservies afin de réduire les longs trajets que doivent parcourir les personnes s'occupant d'enfants pour accéder aux services de vaccination, ainsi que de mener des actions de sensibilisation pour souligner l'importance de suivre l'intégralité du calendrier vaccinal.

Mots-clés : Vaccination, vaccins, maladies évitables, maladies infantiles

INTRODUCTION

The Expanded Programme on Immunization (EPI) is a World Health Organization (WHO) programme aimed at providing vaccines to children regardless of their socioeconomic or demographic status.[1] It is a public health strategy to reduce morbidity and mortality caused by infectious diseases. This has led to high vaccination coverages of approximately 80 % for the six major vaccine preventable diseases (VPDs): pertussis, childhood tuberculosis, tetanus, polio, measles and diphtheria.[2] Recent evidence indicates that there are large gaps in childhood immunization across West and Central Africa and in South Asia, especially in countries like Angola, Chad, Nigeria, Guinea, and Afghanistan, where less than 10 % of children are fully immunized. In these countries, four basic vaccines recommended by WHO are often lacking and children from wealthier households are more likely to be fully immunized.[3]

EPI was introduced in Nigeria in 1976 to provide routine immunization services for children younger than two years of age and pregnant women, with a national target coverage of more than 85 %.

Despite the benefits of childhood immunization, routine vaccination coverage for all recommended EPI vaccines has remained poor in Nigeria, with a coverage of 31 %,[4] which is much lower than that in other African countries, such as Tanzania (75 %)[5] and Kenya (78 %).[6] These coverages are still below the targets endorsed by the WHO in the 2012 Global Vaccine Action Plan (GVAP), which aimed to ensure delivery of universal access to immunization with associated targets reaching 90 % of the national vaccination coverage and at least 80% vaccination coverage in every district.[2]

Immunization schedule in Nigeria, prescribes five visits to receive one dose of Bacille Calmette Guerin (BCG), four doses of oral polio vaccine, three doses of diphtheria, pertussis and tetanus vaccine, and one dose of measles vaccine.[7] Hepatitis B and yellow fever vaccines were included to the schedule in 2004, which recommend that three doses of hepatitis B at birth, at six weeks of age, and at 14 weeks of age while yellow fever vaccine be given at nine months of age, along with measles vaccine.[8] A child is said to be fully vaccinated when he or she has received the required doses of BCG, OPV, Penta, measles, and yellow fever vaccine before the age of 12 months.[9,10]

Several studies have reported low immunization coverage in certain parts of Nigeria.[11,12] A study conducted in the Arewa and Dandi Local Government Area of Kebbi by Basheer *et al*. in 2018[13] indicated that 66.4 % of children under 2 years were unvaccinated, 26.1 % were partially vaccinated and only 7.4 % were fully vaccinated. The major determinants of vaccination status identified were mothers' education, knowledge and household income.[13] Due to challenges that affect access to immunization, some infants fail to complete their vaccination process. The drop-out rate was determined by comparing the number of infants who started the immunization schedule with the number who completed it. Two measures of drop-out rate are routinely used: the drop-out rate between infants receiving the first dose of pentavalent vaccine ($Penta_1$) and the third dose ($Penta_3$) or the drop-out rate between infants receiving the first dose of pentavalent vaccine ($Penta_1$) and the single dose of measles vaccine (Immunization Module).

Failure to complete the schedule of three doses of pentavalent vaccine indicate poor continuity of immunization services and suggest that caregivers encounter barriers in accessing subsequent vaccination visits.

Poor supply chains, cold chain equipment, and physical infrastructure; inadequate number of health facilities; lack of capacity and accountability at local government levels; maternal age, maternal educational status, paternal educational status, mother's marital status, maternal occupation, family income, wealth index, and behavioural, religious and ethnicity factors have been reported as major drawbacks to immunization coverage.[14-22]

Lagos State is Nigeria's most populous state and has one of the largest primary healthcare networks in the country. However, disparities in access to routine immunization services may still exist because of socioeconomic inequalities, vaccine sock-outs, long travel distances to health facilities, and other health system challenges. This study sought to determine the proportions of fully vaccinated children, identify factors that influence the vaccination status of children, determine the drop-out rate of $penta_1$ - $penta_3$ vaccines as well as, identify factors that influence the vaccination status of children in Lagos state metropolis.

METHODS

Study design and setting

This study involved a descriptive cross-sectional survey conducted in Lagos State, located in southwestern

Nigeria. Lagos State comprises three senatorial districts and 20 Local Government Areas (LGAs). As of August 2021, the estimated population of the state was approximately 14.8 million.[23] There are 26 registered general hospitals (secondary healthcare facilities) and 256 primary healthcare centres that provided healthcare services to individuals, including childhood immunization.[24] The Lagos State Primary Healthcare Board controls the immunization programme.

Participants

Children aged 12-23 months, and their parents or caregivers attending routine immunization clinics in the selected health facilities were recruited for the study. Variation in the sample size from each centre was based on participants attendance rate at the time of visit to the centre. The overall sample was based on a sample size of 368 participants calculated using sample size formula for a target population of more than 10000 as follows:

$$n_f = z^2 pq / d^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

n_f = estimated sample size

z = standard normal deviate (1.96)

p = proportion of target population to be fully vaccinated (using 68 % of fully vaccinated children in Lagos State as reported by National Immunization coverage survey of 2017

q = 1-p

d = level a precision of 5 %

Inclusion and exclusion criteria

Included in this study were children aged 12-23 months and their mothers or caregivers who visited the health facility on one of the immunization days. They were included if they were willing to participate in the study, had their immunization cards at the time of visit to the healthcare facility where data was collected and had received the EPI vaccines before the age of 12 months. Children and their mothers/caregivers who were not domicile in Lagos State or who were unable to present the child's immunization card were excluded.

Study instrument

Data were collected using a structured, interviewer-administered questionnaire developed following an extensive review of published literature on childhood immunization in Nigeria. The questionnaire consisted of two sections. Section A was used to extract information from the child's immunization card, while section B collected information from the mothers/caregivers on sociodemographic characteristics, parents'/caregivers' practice of child vaccination and COVID-19 impact/rescheduled or missed appointments.

The questionnaire was pilot tested using a sample of five mothers who were not included in the final data reported. Reliability was ascertained using Cronbach's alpha test greater than 0.75.

Data collection

In each care center, data was collected by a trained pharmacist who received standardized training before the commencement of the study to ensure uniformity in data collection procedures. On recruitment, each mother/caregiver was asked to present their child's immunization card. Relevant vaccination information was extracted from the card using the structured questionnaire. Subsequently, face-to-face interviews were conducted to obtain additional information on vaccination practices and factors influencing access to immunization services. On completion, the questionnaire was double checked. To avoid duplication of the practice by the mother or caregiver, only the records of one child was accessed from each mother/caregiver who came to the center with more than a child.

Outcome measures

The main outcomes measured were proportions of fully vaccinated children, vaccine drop-out rates, factors that influence vaccination status of children aged 12-23 months and reasons for rescheduled immunization appointments in Lagos State. Any child who received the first recommended dose of the vaccine and did not miss any of the recommended vaccines was considered to be fully vaccinated. Immunization drop-out implies that the child received the first recommended dose of the vaccine but missed any of the recommended doses.

Data analysis

The data collected were sorted and entered into Microsoft Excel and thereafter transferred to SPSS version 20 for analysis. The analysis was both descriptive and inferential. Descriptive statistics were used to summarize participants' characteristics and vaccination coverage. Categorical variables were presented as frequencies and percentages. Bivariate and multivariate logistic regression analyses were used to assess factors

associated with vaccination practices and rescheduled vaccination of children. The results were considered significant at $P < 0.05$.

Ethical approval

Approval for this study was obtained from the Lagos State University Teaching Hospital (LASUTH) Research and Ethics Committee with reference number LREC/06/10/1879. Written informed consent was obtained from all participating mothers or caregivers before enrolment. Participation was voluntary, and participants were assured of the confidentiality and anonymity of all information collected.

RESULTS

Social demographic of study participants

A total of 373 children aged 12-23 months with mean age 17.5 ± 3.45 months and their mothers/caretakers participated in the study giving a response rate 100 %. Majority (66.0 %) of the children were females, and only a few of them (3.2 %) were delivered at home. Majority of the mothers/caregivers (91.4 %) were 25-38 years old. Most of them were female (98.1 %), married (98.7 %), Christians (82.3 %), and of Yoruba ethnicity (71.6 %). More than four-fifths (84.5 %) had attained a first-degree qualification, while 46.1% earned less than USD 120.5 (1 USD = N910.73) per month (Table 1 and 2).

Table 1: Sociodemographic of children aged 12-23 months surveyed in Lagos State, Nigeria June/July 2022.

Variable	Category	Frequency	Percentage
Age (months)	12-15	177	47.5
	16-19	85	22.8
Sex	Male	127	34.0
	Female	246	66.0
Birth order	1-3	367	98.4
	4-7	6	1.6
	>7	0	0.0
Place of delivery	Home	12	3.2
	Health facility	361	96.8

Table 2: Sociodemographic characteristics of mothers/caregivers of children 12-23 months old surveyed in Lagos State, Nigeria June/July 2022

Variable	Category	Frequency	Percentage
Age	18-24	3	0.8
	25-31	209	56.0
	32-38	132	35.4
	>38	29	7.8
Sex	Male	7	1.9
	Female	366	98 1
Marital status	Married	368	98.6
	Unmarried	5	1.4
Occupation	Health professional (pharmacists, doctors, nurses, physiotherapists)	133	35.7
	Other professional (lawyers, teachers, bankers, caterers)	40	10.7
	Trader	26	6.9
	Business (hair stylists, fashion designers, tailors)	16	4.3
	Civil servant	1	0.3
	Unspecified	157	42.1
Educational qualification	No formal education	0	0.0
	Primary school	1	0.3
	Secondary school	57	15.3
	First degree	315	84.4
	Postgraduate degree	0	0.0
Ethnicity	Yoruba	267	71.6
	Hausa	30	8.0
	Igbo	26	7.0
	Others	50	13.4
Religion	Christianity	307	82.3
	Islam	66	17.7
	Traditional	0	0.0
	Others	0	0.0
Monthly income	<USD120.5	172	46.1
	USD120.5- 241	74	19.8
	USD 241- 482	127	34.1
	>USD 482	0	0.0

Vaccines received before 12 months of age by children aged 12-23 months

All 373 respondents presented their children's immunization card. Overall, 75.9 % of the children completed all the recommended vaccines before 12 months of age. Immunization coverage was 100.0 % for both BCG and OPV0 vaccines, 99.7 % for OPV1 and OPV2, 99.5 % for OPV3, and 98.4 % for $Penta_1$. Coverage declined for subsequent vaccines, with 81.5 % receiving $Penta_2$, 77.7 % receiving $Penta_3$, and 75.9 % receiving both measles and yellow fever vaccines (Table 3).

The highest drop-out rates were observed for $Penta_2$ (18.5 %), $Penta_3$ (22.3 %), measles (24.1 %), and yellow fever (24.1 %) respectively.

Table 3: Vaccines received before 12 months of age by children aged 12-23 months

Variable	Frequency	Percentage
BCG	373	100.0
OPV0	373	100.0
OPV1	372	99.7
OPV2	372	99.7
OPV3	371	99.5
Penta1	367	98.4
Penta2	304	81.5
Penta3	290	77.7
Measles	283	75.9
Yellow fever	283	75.9

Mothers/caregivers practices towards vaccination of children aged 12-23 months

Almost all mothers/caregivers (99.7 %) attended both antenatal and postnatal clinics, while 96.2 % reported that their children received vaccination at birth. Nearly all respondents (99.7 %) stated that healthcare workers informed them about the next immunization schedule. Most children (96.8 %) received immunization on five or more occasions before their first birthday, whereas only 3.2 % received immunization two to four times.

Following vaccination, 61.9 % of caregivers reported that their children developed fever. Approximately 60.3 % of respondents spent between 30 and 60 minutes travelling to vaccination centres, while 31.1 % travelled for more than one hour. Only 3.5 % reported that vaccines were available at every clinic visit. Nearly half (48.0 %) reported making payments for vaccination services despite routine immunization being expected to be free (Table 4).

Table 4: Mothers/caregivers practices towards vaccination of children aged 12-23 months

Variable	Category	Frequency	Percentage
Visit antenatal clinic		372	99.7
Visit postnatal clinic		372	99.7
Child vaccinated at birth		359	96.2
Health facility provided information on next immunization schedule		372	99.7
Number of times child immunized before first birthday	Once	0	0.0
	2–4 times	12	3.2
	=5 times	361	96.8
Child developed problem after vaccination	Fever	231	61.9
Problems experienced by child	Others	0	0.0
Time to reach vaccination centre from home	<15 min	11	2.9
	15-30 min	19	5.1
	30-60 min	225	59.8
	>60 min	116	31.0
Vaccine available at every visit to clinic		13	3.5
Number of times vaccine was not available	Once	110	29.5
	Twice	250	67.0
Payment made for the vaccine		179	47.9
Number of times payment was made	Once	116	31.1
	Twice	48	12.9
	More than twice	15	4.0

Factors relating to the practice of mothers/caregivers towards vaccination

Age ($p = 0.0119$), income ($p < 0.001$), religion, and marital status ($p = 0.0323$) of mother/caregiver of the children and sex ($p = 0.0017$) of the children ($p < 0.05$) were all found to be significantly associated with practices towards vaccination. Availability of vaccines as reported appears to be associated with age ($p < 0.001$), marital status ($p = 0.0001$), educational qualification ($p = 0.0094$) and income ($p = 0.0001$) (Table 5).

Table 5. Factors relating to the practice of mothers/caregivers towards vaccination

Variables	Odds Ratio	95% CI	p-value
Did your child get vaccination at birth			
Age of caregiver/parent	0.8514	0.751-0.9651	0.0119*
Birth order	0.5773	0.2879-1.1576	0.1217
Sex child	28.2623	3.5214-226.8274	0.0017*
Sex caregiver/parent	0	0 - >1.0E12	0.9798
Marital status	9.0212	1.2043-67.5751	0.0323
Ethnicity	0.9499	0.5606-1.6094	0.8483
Religion	0.0348	0.0071-0.1704	<0.001*
Did you visit antenatal clinics			
Age caregiver/parent	96930.87	0->1.0E12	0.9315
Birth order	234572.7	0->1.0E12	0.9751
Sex caregiver/parent	0.0009	0->1.0E12	0.9804
Marital status	2052883	0->1.0E12	0.9709
Ethnicity	0.7651	0.165-3.5481	0.7323
Religion	0	0->1.0E12	0.9642
Did you visit postnatal clinic			
Age caregiver/parent	96930.87	0->1.0E12	0.9315
Birth order	234572.7	0->1.0E12	0.9751
Sex child	0	0->1.0E12	0.9673
Sex caregiver/parent	0.0009	0->1.0E12	0.9804
Marital status	2052883	0->1.0E12	0.9709
Ethnicity	0.7651	0.165-3.5481	0.7323
Religion	0	0->1.0E12	0.9642
Did the healthcare worker tell you about immunization schedule			
Age caregiver/parent	96930.87	0->1.0E12	0.9315
Birth order	234572.7	0->1.0E12	0.9751
Sex child	0	0->1.0E12	0.9673
Sex caregiver/parent	0.0009	0->1.0E12	0.9804
Marital status	2052883	0->1.0E12	0.9709
Ethnicity	0.7651	0.165-3.5481	0.7323
Religion	0	0->1.0E12	0.9642
Was vaccine available at every visit to the vaccination clinic			
Age caregiver/parent	1.1301	1.0717-1.1917	<0.001*
Marital status	2.3391	1.5294-3.5776	0.0001*
Birth order	0.8096	0.5793-1.1314	0.216
Educational qualification	2.5713	1.2609-5.2434	0.0094*
Sex child	1.2386	0.7779-1.9721	0.3672
Ethnicity	1.0357	0.8494-1.2628	0.7291
Religion	0.7537	0.4172-1.3617	0.3488
Monthly income	0.2163	0.1023 0.4572	0.0001*

3.4 Reasons for rescheduled vaccination for children, N = 367

Almost all respondents (98.4 %) had reason to reschedule vaccination appointments, mainly due to the unavailability of vaccines (55.3 %) and late arrival at the vaccination centre due to a long distance from home (34.3 %). (Figure 1)

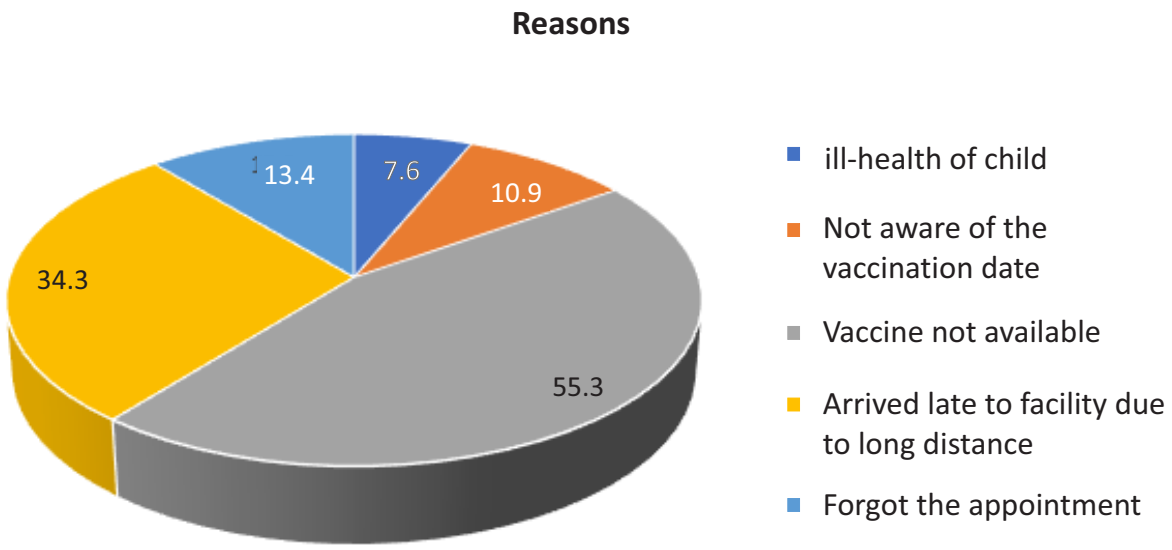


Figure 1: Reasons for rescheduled vaccination for children

DISCUSSION

From our study, children immunization coverage for BCG (100 %), OPV0 (100 %), OPV1 (99.7 %), OPV2 (99.7 %), OPV3 (99.5 %) and $Penta_1$ (98.4 %) was very high. However, vaccine coverage progressively declined for subsequent doses, with 81.5 % receiving $Penta_2$, 77.7 % receiving $Penta_3$, and 75.9 % receiving both measles and yellow fever vaccines. These findings correspond to drop-out rates of 18.5 %, 22.3 %, and 24.1 %, respectively, indicating considerable attrition as children progressed through the immunization schedule. These finding is higher than previous study in Enugu 2020, which reported 78.9 % coverage,[26] and much higher than the figure for Enugu (35.4 %) in 2018[4] and Osun 58 %.[27] The percentage of children fully immunized was 75.9 %, and this is 13.5 % higher than the 2018 NDHS report of 62.4 %, though in the same NDHS report, measles vaccine coverage was higher (89.5 %) than that of our study by 13.6 %.[4] The immunization coverage for each vaccine in this study is higher than that reported in a study conducted in Niger, where coverage for BCG, OPV1, OPV3, $Penta_1$, $Penta_3$ and measles/yellow fever were 91 %, 84 %, 77 %, 90 %, 83 % and 63 %, respectively,[28] but lower than the immunization coverage in a survey in Ghana.[29] The coverage of all the first doses of multidose vaccines was higher than that of the subsequent doses, and this improvement in vaccination coverage could be attributed in part to the increased healthcare centres within Lagos metropolis and to increased awareness and knowledge of vaccination among mothers/caregivers. The $Penta_1$ to $Penta_3$ drop-out rate in this study is higher than those in a 2015 and 2016 survey in Ghana, which were 6.9 % and 5.1 %, respectively.[29] The high drop-out rate noticed in this study may be attributed to forgetting the appointment date, lack of awareness by mothers/caretakers, unavailability of vaccines as well as associated side effects experienced by the babies.

Child-related factors, such as the number of children in the household, the place of delivery, the childbirth order, and the presence or absence of a child health card, have previously been reported to affect immunization coverage; however, only place of birth and childbirth order were considered in this study. Although the sex of the child was found not to be significant in determining immunization coverage in Nigeria,[30] this study showed a significant association of the sex of the child with vaccination at birth.

Although not all the variables were studied in this work, maternal factors such as maternal age, education, and occupation were clearly shown to affect the commencement, continuation, and completion of the required number of immunizations. A previous study reported that maternal age, region, religion, education status/literacy level, wealth index, marital status, and occupation all directly affected the continuation and completion of immunization.[30] The older the care giver, the more likelihood of getting the child vaccinated. Multivariate analysis showed that high literacy and better monthly income were significantly related to better vaccination rates. The findings of Kitamura *et al*. (2013) and Danis *et al*. (2010) support that continuation and completion of the required number of vaccinations in children depends on the mother´s educational level,

socioeconomic status, employment status, immigration status, race, experience with vaccination services, health insurance, parental beliefs, attitudes towards immunization, and adequate schedule information.[21,31] The place of delivery had previously been found to affect immunization coverage in Lao People´s Democratic Republic.[21] A similar finding was also documented in a previous Nigerian study.[32] The place of delivery was significantly associated with immunization status in some studies in North Central Nigeria, Niger Delta area of Nigeria and others.[33-35] A child delivered at a health facility has better access to vaccines received at birth, such as BCG, OPV and HBV, which informs the mother of other routine immunizations for the child we need thereafter.

The main reasons for rescheduled vaccine appointments were vaccines unavailability (55.3 %) and late arrival at the vaccination centres due to the long distance from home (34.3 %). Studies have repeatedly documented that stockouts and unavailability of vaccines at health facilities lead to children being turned away and the need for rescheduling. Some caregivers report making multiple trips-three to four times-to a clinic only to find vaccines are not available, discouraging continued attendance and contributing to missed appointments and drop-outs.[33] In a study in Ibadan, unavailability of vaccines at the time of visit was highlighted as a major reason why mothers missed due doses - undermining trust and future attendance.[34]

Travel time to health facilities has been observed to be a barrier to access to immunization.[35] Incomplete immunization can result from nonadherence to the immunization schedule. Geographical access is a well-established determinant of vaccination coverage. Although specific Nigerian studies might not always quantify "distance" alone, barriers linked to access (such as long travel time, cost of transport, and rural location) are consistently associated with vaccination delay or rescheduling. [34]

Multiple Nigerian studies report caregivers forgetting vaccination appointments as a common reason for missing or rescheduling visits. Qualitative work notes that caregivers sometimes simply do not recall the correct date or misplace the immunization card, leading to appointment lapses.[36] A qualitative synthesis across African settings indicates that lost or forgotten vaccination cards and forgetfulness contribute to rescheduled or missed vaccination visits. In Ethiopia and Burkina Faso, parents have missed appointments because they forgot the date or did not have the vaccination booklet when they visited the clinic.[34]

Most participants (55.3 %) rescheduled vaccination appointments due to the unavailability of the vaccine, which prompted some to pay for vaccines where it was not available for free and those unable to procure, resulting in incomplete vaccination of the ward. Information was obtained that the oral polio vaccine was not available in August 2022 in some health facilities in Lagos State. Nigeria has historically experienced difficulties with vaccine availability, mostly as a result of insufficient and delayed funding. Although there is much to be proud of in Nigeria's push for finance for vaccinations, it is important to emphasize the need to provide women a voice and place in the campaigning and advocacy world.

The high immunization coverage recorded in this study, implies that a large proportion of children in the study are protected against most of the vaccine-preventable diseases, reducing the incidence of falling sick and consequently reducing the disease burden on the caregiver and the government. The high drop-out rate is an indicator of the health system's capacity to deliver services that require multiple visits by clients and health service providers. In routine expanded program on immunization (EPI) programs, a drop-out rate greater than 10% usually indicates shortfalls in the program and needs to be addressed (immunization module).[37] The unavailability of vaccines and late arrival at vaccination centres may be related to socioeconomic factors and the cost of transportation for each immunization session, especially if health care facilities are not in close proximity.[38]

The study is however not without limitations. The study's participants were chosen based on the availability of vaccination cards, which may have resulted in selection bias because infants whose parents did not keep their immunization cards were excluded. Information given by the care givers were self-reported, it is possible that the responses were affected by recall and social responsibility bias, Furthermore, the participants' survey is cross-sectional, so causal relationships between variables of interest cannot be assessed. In addition, the study was conducted only in selected health centres in Lagos state, so results obtained cannot be generalized.

CONCLUSION

The findings from this study revealed that child

immunization coverage in the studied area is below the recommended target with a high drop-out rate. Age and sex of mother/caregiver, sex of the child, religion, marital status, income, birth order and educational qualification are factors with significant influence on vaccine uptake and ultimately vaccination coverage in this study. A large proportion of respondents rescheduled vaccination appointments mainly due to the unavailability of vaccines and late arrival at vaccination centres due to the long distance from home. These findings highlight the need for Government and health authorities to improve vaccine forecasting, procurement, storage, and distribution to ensure the continuous availability of vaccines at all immunization centres. Eliminating vaccine stock-outs will reduce missed opportunities and appointment rescheduling. More vaccination post in underserved communities should be established to reduce the long distances caregivers travel to access immunization services, as well as educational interventions to emphasize the importance of completing entire immunization schedule.

INFORMED CONSENT STATEMENT

Informed consent was obtained from all subjects who involved in the study.

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