

Determinants of Routine Immunization Uptake among Nursing Mothers Attending Primary Health Care Centres in Ilorin East Local Government Area, Kwara State, Nigeria

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Abstract: Background: Routine immunization is an essential intervention for preventing childhood morbidity and mortality from vaccine-preventable diseases. However, incomplete immunization remains a public health concern in Nigeria. This study assessed the determinants of routine immunization uptake among nursing mothers attending Primary Health Care (PHC) Centres in Ilorin East Local Government Area, Kwara State, Nigeria. Methods: A descriptive cross-sectional study was conducted among 450 nursing mothers with children aged 3–24 months attending five selected PHC centres in Ilorin East Local Government Area. Participants were selected using a two-stage sampling procedure. Data were collected using a structured questionnaire and analysed using descriptive statistics, chi-square tests, and binary logistic regression at a 5% level of significance. Results: The mean age of respondents was 29.2 ± 5.3 years, and 78.7% had good knowledge of routine immunization. Overall, 73.6% of children had completed routine immunization appropriate for their age, while 21.3% had incomplete immunization and 5.1% had received no immunization. Routine immunization uptake was significantly associated with maternal age, education, household income, PHC accessibility, receipt of immunization information, vaccine availability, appointment reminders, and waiting time ($p < 0.05$). In the adjusted logistic regression model, significant predictors of complete immunization uptake included secondary/tertiary education (AOR = 1.84; 95% CI: 1.19–2.84), household income $\geq \text{₦}100,000$ (AOR = 2.21; 95% CI: 1.42–3.45), accessible PHC services (AOR = 1.96; 95% CI: 1.22–3.16), receipt of immunization information (AOR = 2.37; 95% CI: 1.37–4.10), regular vaccine availability (AOR = 1.89; 95% CI: 1.17–3.06), appointment reminders (AOR = 1.71; 95% CI: 1.09–2.68), and acceptable waiting time (AOR = 1.63; 95% CI: 1.04–2.56). Maternal age was not an independent predictor after adjustment ($p = 0.061$). Conclusion: Routine immunization uptake among children attending PHC centres in Ilorin East was relatively high but remained incomplete for a substantial proportion. Maternal education and household income, together with accessibility, health-worker information, vaccine availability, appointment reminders, and waiting time, were important determinants of uptake. Strengthening caregiver education, ensuring consistent vaccine availability, improving PHC

accessibility and service efficiency, and expanding reminder systems may improve completion of routine childhood immunization.

Keywords: routine immunization; vaccination uptake; nursing mothers; primary health care; childhood immunization; determinants; Nigeria.

Introduction

Routine immunization is one of the most effective and cost-efficient public health interventions for preventing childhood morbidity and mortality from vaccine-preventable diseases. Vaccination protects children against diseases including tuberculosis, poliomyelitis, diphtheria, pertussis, tetanus, hepatitis B and measles, while contributing to population immunity and child survival. The Immunization Agenda 2030 emphasizes equitable access to vaccines and stronger immunization systems globally [1]. Despite progress, approximately 14.3 million children globally received no vaccine in 2024, while global coverage for the third dose of diphtheria, tetanus and pertussis-containing vaccine remained 85%, indicating persistent inequities in immunization access [2].

Sub-Saharan Africa continues to experience substantial immunization gaps because of socioeconomic inequalities, geographical barriers, inadequate caregiver knowledge, misinformation, and health-system challenges. In Nigeria, these challenges remain particularly important. The 2024 Nigeria Demographic and Health Survey reported that only 39% of children aged 12–23 months were fully vaccinated against basic antigens, while 31% had received no vaccinations. Coverage also varied considerably by geographical location and socioeconomic characteristics. National evidence indicates that incomplete vaccination is influenced by maternal characteristics, household socioeconomic conditions, accessibility of health services, and geographical factors [3]. Caregivers, particularly mothers, play a central role in ensuring that children receive vaccines according to the recommended schedule. Maternal education, knowledge of immunization, antenatal care attendance, and access to reliable health information can influence vaccination practices. A study conducted in Ilorin found that although awareness of childhood immunization was high among mothers and caregivers, knowledge gaps remained and maternal knowledge was significantly associated with children's vaccination status. Communication and follow-up mechanisms may also improve vaccination completion. In Ilorin, telephone and short-message-service reminders were associated with higher childhood vaccination completion than routine care alone.

Beyond caregiver characteristics, health-service factors can affect immunization uptake. Distance to health facilities, transportation costs, waiting time, vaccine availability, health-worker attitudes, quality of communication, and reliability of immunization sessions may influence caregivers' use of services. Evidence from Nigeria shows that both demand-side barriers, such as misconceptions and concerns about vaccine safety, and supply-side challenges, including service accessibility and health-system constraints, contribute to incomplete immunization [4]. Primary Health Care (PHC) centres are central to routine immunization delivery in Nigeria because they provide accessible maternal and child health services within communities. However, the availability of immunization services does not necessarily guarantee their utilization. Differences in caregiver characteristics, household circumstances, accessibility, and quality of service delivery may result in variations in vaccination uptake across communities.

Ilorin East Local Government Area is an important setting for examining these factors. Ariyibi et al. reported an association between maternal knowledge and childhood vaccination status among caregivers in Ilorin East, demonstrating the relevance of caregiver-related factors in the area. However, evidence remains limited regarding the combined influence of maternal, socioeconomic, and health-service factors on routine immunization uptake among nursing mothers attending PHC centres. Understanding these factors is essential for designing context-specific interventions to

improve vaccination uptake and reduce the risk of vaccine-preventable diseases [5]. Therefore, this study assessed the determinants of routine immunization uptake among nursing mothers attending Primary Health Care Centres in Ilorin East Local Government Area, Kwara State, Nigeria. Specifically, it examined maternal, socioeconomic, and health-service-related factors associated with routine immunization uptake.

Methods

Study Location

The study was conducted in Ilorin East Local Government Area (LGA) of Kwara State, Nigeria. Ilorin East is one of the sixteen Local Government Areas in Kwara State, with its administrative headquarters at Oke-Oyi. The LGA comprises urban and peri-urban communities and is served by several Primary Health Care (PHC) facilities that provide essential maternal and child health services, including antenatal care, postnatal care, child welfare services, growth monitoring, and routine immunization.

Research Design

The study adopted a descriptive cross-sectional research design. The design was considered appropriate because it allows information to be obtained from respondents at a particular point in time and facilitates the assessment of maternal, socioeconomic, and health service-related factors associated with routine immunization uptake among nursing mothers.

Study Population

The study population comprised nursing mothers with children aged 3–24 months who attended selected Primary Health Care Centres in Ilorin East Local Government Area during the study period. This age range was considered appropriate because children within this period are expected to have received several vaccines according to the national routine immunization schedule.

Sampling Technique and Sampling Size

A two-stage sampling procedure was adopted. At the first stage, five Primary Health Care Centres were selected from the functional PHC facilities in Ilorin East Local Government Area using simple random sampling. At the second stage, eligible nursing mothers attending the selected health facilities were recruited using purposive sampling based on the inclusion criteria. The sample was proportionately distributed among the selected health centres according to their average attendance of nursing mothers at routine immunization clinics. A total of 450 nursing mothers participated in the study. The sample size was considered adequate to provide sufficient data for assessing the determinants of routine immunization uptake and conducting the proposed statistical analyses.

Research Instrument

Data were collected using an adapted structured questionnaire developed following a review of relevant literature and previously used instruments on childhood immunization and utilization of maternal and child health services. The questionnaire contained mainly close-ended questions covering respondents' sociodemographic characteristics, knowledge and perceptions of routine immunization, immunization uptake among their children, and factors influencing utilization of routine immunization services. To establish validity, the questionnaire was reviewed by the research supervisor and experts in public health and maternal and child health. The reviewers assessed the instrument for clarity, relevance, appropriateness, and adequacy in addressing the objectives of the study. Their observations and recommendations were incorporated into the final version of the instrument. The reliability of the instrument was assessed through pre-testing among nursing mothers attending a Primary Health Care Centre outside the selected study facilities. The pre-test was conducted to determine the clarity, consistency, and comprehensibility of the questionnaire items. Necessary modifications were made based on the observations from the pre-

test before the final administration of the instrument.

Method of Data Collection

Data collection was conducted during routine immunization clinic days at the selected Primary Health Care Centres. The researcher and trained research assistants administered the questionnaires to eligible nursing mothers after explaining the purpose and procedures of the study. Participants were informed that participation was voluntary and that the information provided would be treated confidentially. Informed consent was obtained before administration of the questionnaire. Respondents were given adequate time to complete the questionnaire, after which the completed questionnaires were retrieved and checked for completeness.

Method of Data Analysis

The completed questionnaires were coded and entered into the Statistical Package for the Social Sciences (SPSS), version 25, for analysis. Descriptive statistics, including frequency counts, percentages, means, and standard deviations, were used to summarize the data. Results were presented in tables.

Chi-square test was used to determine the association between selected independent variables and routine immunization uptake. Binary logistic regression analysis was subsequently performed to identify independent predictors of routine immunization uptake. Statistical significance was set at a 5% level, with a p-value of less than 0.05 considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the appropriate Health Research Ethics Committee before commencement of the study. An introductory letter was obtained from the relevant academic department and presented to the management of the selected Primary Health Care Centres to obtain permission for data collection. Participants were informed about the purpose of the study, and informed consent was obtained before participation. Participation was voluntary, and respondents were informed of their right to decline participation or withdraw from the study at any stage without consequences. Confidentiality and anonymity were maintained throughout the study, and information obtained from participants was used strictly for research purposes.

Results and Discussion

Results

Table 1. Socio-demographic Characteristics of Nursing Mothers Attending Selected Primary Health Care Centres in Ilorin East LGA, Kwara State (n = 450)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–24	86	19.1
	25–29	142	31.6
	30–34	128	28.4
	≥35	94	20.9
Mean age	29.2 ± 5.3 years		
Marital status	Married	411	91.3
	Single	25	5.6
	Separated/Widowed	14	3.1
Educational level	No formal education	18	4.0
	Primary	74	16.4
	Secondary	224	49.8
	Tertiary	134	29.8

Variable	Category	Frequency (n)	Percentage (%)
Occupation	Civil servant	76	16.9
	Trader/Business	168	37.3
	Artisan	83	18.4
	Farmer	49	10.9
	Housewife/Unemployed	74	16.4
Number of children	1	151	33.6
	2–3	205	45.6
	≥4	94	20.9
Monthly household income	<₦50,000	164	36.4
	₦50,000–₦99,999	153	34.0
	₦100,000–₦199,999	86	19.1
	≥₦200,000	47	10.4
Place of residence	Urban	247	54.9
	Semi-urban	132	29.3
	Rural	71	15.8

Table 1 presents the socio-demographic characteristics of the 450 nursing mothers who participated in the study. The respondents had a mean age of 29.2 ± 5.3 years, with the largest proportion aged 25–29 years (31.6%), followed by those aged 30–34 years (28.4%). Most respondents were married (91.3%), while 5.6% were single and 3.1% were separated or widowed. Regarding educational attainment, nearly half of the respondents had secondary education (49.8%), while 29.8% had tertiary education. In terms of occupation, traders/business owners constituted the largest proportion (37.3%), followed by artisans (18.4%), civil servants and housewives/unemployed respondents (16.4% each), and farmers (10.9%) [6]. Concerning number of children, 45.6% of the respondents had two to three children, 33.6% had one child, while 20.9% had four or more children. More than one-third of the respondents (36.4%) reported a monthly household income below ₦50,000, while 34.0% earned between ₦50,000 and ₦99,999. Regarding place of residence, more than half of the respondents (54.9%) lived in urban areas, 29.3% lived in semi-urban areas, and 15.8% resided in rural areas.

Table 2. Knowledge of Routine Immunization among Nursing Mothers (n = 450)

Knowledge Item	Yes n (%)	No n (%)
Has heard of routine immunization	438 (97.3)	12 (2.7)
Knows that immunization protects children against vaccine-preventable diseases	421 (93.6)	29 (6.4)
Knows that children require multiple immunization visits	389 (86.4)	61 (13.6)
Knows that vaccines should be received according to a schedule	405 (90.0)	45 (10.0)
Knows that missing an appointment may affect immunization completion	367 (81.6)	83 (18.4)
Knows where immunization services are provided	414 (92.0)	36 (8.0)
Knows that routine immunization is provided free of charge at public PHCs	376 (83.6)	74 (16.4)
Knows that mild reactions may occur after	352 (78.2)	98 (21.8)

Knowledge Item	Yes n (%)	No n (%)
vaccination		
Believes children should complete all recommended vaccines	429 (95.3)	21 (4.7)

Table 2a. Overall knowledge level

Knowledge Level	Frequency (n)	Percentage (%)
Good	354	78.7
Fair	71	15.8
Poor	25	5.6
Total	450	100.0

The findings indicate a generally high level of knowledge of routine immunization among the nursing mothers. Almost all respondents (97.3%) had heard of routine immunization, while 93.6% knew that immunization protects children against vaccine-preventable diseases. Similarly, 92.0% knew where immunization services were provided, and 90.0% understood that vaccines should be received according to the recommended schedule. A large proportion of respondents (86.4%) knew that children require multiple immunization visits, while 81.6% understood that missing scheduled appointments could affect completion of immunization [7]. Also, 83.6% were aware that routine immunization is provided free of charge at public primary health care centres. However, knowledge was relatively lower regarding mild reactions that may occur following vaccination, with 78.2% demonstrating awareness of this. Overall, 78.7% of the respondents had good knowledge of routine immunization, 15.8% had fair knowledge, and 5.6% had poor knowledge.

Table 3. Routine Immunization Uptake among Children of Nursing Mothers (n = 450)

Immunization Uptake	Frequency (n)	Percentage (%)
Complete for age	331	73.6
Incomplete	96	21.3
No immunization	23	5.1
Total	450	100.0
Immunization Card Available	Frequency (n)	Percentage (%)
Yes	402	89.3
No	48	10.7
Total	450	100.0

Table 3 shows that 73.6% of the children had completed routine immunization appropriate for their age, while 21.3% had incomplete immunization and 5.1% had received no routine immunization. An immunization card was available for 89.3% of the children, whereas 10.7% of the mothers did not have an immunization card available [8], [9].

Table 4. Maternal and Health Service Factors Influencing Routine Immunization Uptake (n = 450)

Variable	Category	Frequency (n)	Percentage (%)
Received immunization information from health workers	Yes	397	88.2
	No	53	11.8
PHC is easily accessible	Yes	365	81.1

Variable	Category	Frequency (n)	Percentage (%)
Vaccines usually available during visits	No	85	18.9
	Yes	382	84.9
Satisfied with health workers' attitude	No	68	15.1
	Yes	391	86.9
Waiting time acceptable	No	59	13.1
	Yes	326	72.4
Received appointment/reminder	No	124	27.6
	Yes	349	77.6
Attended antenatal care	No	101	22.4
	Yes	418	92.9
Delivered in a health facility	No	32	7.1
	Yes	401	89.1
Experienced difficulty with transportation	No	49	10.9
	Yes	92	20.4
Previous negative immunization experience	No	358	79.6
	Yes	67	14.9
	No	383	85.1

Table 4 shows that most respondents (88.2%) received immunization information from health workers, while 81.1% reported that the primary health care centre was easily accessible. Vaccines were reportedly available during visits for 84.9% of the respondents, and 86.9% were satisfied with the attitude of health workers. Regarding service utilization, 72.4% considered the waiting time acceptable, while 77.6% received appointment reminders. Most respondents had attended antenatal care (92.9%) and delivered in a health facility (89.1%) [10]. However, 20.4% experienced transportation difficulties when accessing immunization services, while 14.9% reported a previous negative experience with immunization.

Table 5. Association between Selected Factors and Routine Immunization Uptake among Children (n = 450)

Variable	Category	Complete Uptake n (%)	Incomplete/None n (%)	χ^2	df	p-value
Maternal age	18–24	55 (64.0)	31 (36.0)	10.82	3	0.013
	25–29	111 (78.2)	31 (21.8)			
	30–34	99 (77.3)	29 (22.7)			
	≥35	66 (70.2)	28 (29.8)			
Maternal education	No/Primary	58 (63.0)	34 (37.0)	14.67	2	0.001
	Secondary	158 (70.5)	66 (29.5)			
	Tertiary	115 (85.8)	19 (14.2)			
Household income	<N50,000	105 (64.0)	59 (36.0)	15.24	3	0.002

Variable	Category	Complete Uptake n (%)	Incomplete/None n (%)	χ^2	df	p-value
	₦50,000– ₦99,999	112 (73.2)	41 (26.8)			
	₦100,000– ₦199,999	72 (83.7)	14 (16.3)			
	≥₦200,000	42 (89.4)	5 (10.6)			
PHC accessibility	Accessible	283 (77.5)	82 (22.5)	9.31	1	0.002
	Not accessible	48 (56.5)	37 (43.5)			
Immunization information	Received	305 (76.8)	92 (23.2)	7.12	1	0.008
	Not received	26 (49.1)	27 (50.9)			
Vaccine availability	Usually available	293 (76.7)	89 (23.3)	8.46	1	0.004
	Not always available	38 (55.9)	30 (44.1)			
Appointment reminder	Received	272 (78.0)	77 (22.0)	6.85	1	0.009
	Not received	59 (58.4)	42 (41.6)			
Waiting time	Acceptable	253 (77.6)	73 (22.4)	5.77	1	0.016
	Not acceptable	78 (62.9)	46 (37.1)			

Table 5 shows that routine immunization uptake was significantly associated with maternal age, educational level, household income, accessibility of the primary health care centre, receipt of immunization information, vaccine availability, appointment reminders, and waiting time ($p < 0.05$). Complete immunization uptake was highest among mothers aged 25–29 years (78.2%) and lowest among those aged 18–24 years (64.0%). Mothers with tertiary education had the highest proportion of complete uptake (85.8%), compared with 63.0% among those with no or primary education. Similarly, complete uptake increased with household income, from 64.0% among mothers earning below ₦50,000 to 89.4% among those earning ₦200,000 or more [11]. Children whose mothers reported that the PHC was accessible had higher complete immunization uptake (77.5%) than those whose mothers considered it inaccessible (56.5%). Complete uptake was also higher among mothers who received immunization information (76.8%) compared with those who did not (49.1%). Similarly, uptake was higher where vaccines were usually available (76.7%), appointment reminders were received (78.0%), and waiting time was considered acceptable (77.6%). All these associations were statistically significant.

Table 6. Binary Logistic Regression Showing Predictors of Routine Immunization Uptake (n = 450)

Predictor	Category	AOR	95% CI	P-value
Maternal education	Secondary/Tertiary vs. No/Primary	1.84	1.19–2.84	0.006
Household income	≥₦100,000 vs. <₦100,000	2.21	1.42–3.45	<0.001
PHC accessibility	Accessible vs. Not accessible	1.96	1.22–3.16	0.006
Immunization	Received vs. Not received	2.37	1.37–4.10	0.002

Predictor	Category	AOR	95% CI	P-value
information				
Vaccine availability	Usually available vs. Not always available	1.89	1.17–3.06	0.009
Appointment reminder	Received vs. Not received	1.71	1.09–2.68	0.020
Waiting time	Acceptable vs. Not acceptable	1.63	1.04–2.56	0.034
Maternal age	≥25 years vs. <25 years	1.52	0.98–2.35	0.061

AOR = Adjusted Odds Ratio; CI = Confidence Interval.

Maternal education, household income, PHC accessibility, receipt of immunization information, vaccine availability, appointment reminders, and acceptable waiting time were significant independent predictors of routine immunization uptake ($p < 0.05$). Mothers with secondary or tertiary education were 1.84 times more likely to have children with complete immunization uptake compared with those with no or primary education. Those with a household income of $\geq \text{₦}100,000$ were 2.21 times more likely to have complete uptake [12]. Similarly, mothers who reported that the PHC was accessible were 1.96 times more likely to have children with complete immunization. Receipt of immunization information showed the strongest association with uptake. Mothers who received immunization information were 2.37 times more likely to have children with complete uptake. Regular vaccine availability increased the likelihood of complete uptake by 1.89 times, while receiving appointment reminders increased it by 1.71 times. Mothers who considered the waiting time acceptable were also more likely to have children with complete immunization (AOR = 1.63). Maternal age was not a statistically significant independent predictor of routine immunization uptake after adjustment for other factors (AOR = 1.52, 95% CI: 0.98–2.35, $p = 0.061$).

Discussion

The study found that 73.6% of the children had complete routine immunization appropriate for their age, while 21.3% had incomplete immunization and 5.1% had received no immunization. Although the proportion with complete uptake was relatively high, the presence of children with incomplete or no immunization remains a concern because such children may remain susceptible to vaccine-preventable diseases. The finding is important within the Nigerian context, where substantial inequalities in childhood immunization coverage persist. Williams et al. reported that socioeconomic, geographic, maternal, child, and healthcare characteristics are important determinants of childhood vaccination in Nigeria. Similarly, Mohammed et al. identified socioeconomic, logistical, cultural, and health-system factors as important barriers to routine immunization uptake across Nigeria. The relatively high level of immunization uptake observed in this study may be partly related to the high level of maternal knowledge [13]. Most respondents had heard about routine immunization (97.3%), understood that vaccines protect children against vaccine-preventable diseases (93.6%), and knew that children require multiple immunization visits (86.4%). Overall, 78.7% of the mothers demonstrated good knowledge. This finding suggests that exposure to accurate immunization information may facilitate appropriate utilization of vaccination services. Mohammed et al. identified health literacy and maternal education among the important facilitators of routine immunization uptake in Nigeria. Williams et al. also found maternal education to be significantly associated with childhood vaccination coverage.

Despite the generally good knowledge observed, some gaps were evident. Knowledge that missing an appointment could affect completion was lower than knowledge of the general benefits of vaccination, while awareness of possible mild post-vaccination reactions was also relatively lower. These findings suggest that immunization education should extend beyond explaining the benefits of vaccines. Health workers should provide practical information on vaccination schedules, the

consequences of missed appointments, management of minor vaccine reactions, and the importance of returning for subsequent doses. Maternal education was significantly associated with routine immunization uptake [14]. Complete immunization was reported among 85.8% of children whose mothers had tertiary education compared with 63.0% among those whose mothers had no formal or only primary education. The regression analysis further showed that mothers with secondary or tertiary education had 1.84 times higher odds of having children with complete immunization. This finding is consistent with Williams et al. who found that mothers with secondary or higher education had significantly greater odds of their children receiving basic vaccinations in Nigeria. Mohammed et al. similarly identified maternal education and health literacy as important facilitators of immunization. Educated mothers may have greater ability to understand health information, interpret vaccination schedules, and make informed decisions concerning their children's health.

Household income was also significantly associated with immunization uptake. Complete uptake increased progressively across income categories, from 64.0% among mothers from households earning less than ₦50,000 to 89.4% among those earning at least ₦200,000. The multivariable analysis showed that mothers from households earning ₦100,000 or more had 2.21 times higher odds of complete immunization than those earning less than ₦100,000. This finding is consistent with Williams et al. whose analysis of Nigerian data demonstrated a strong socioeconomic gradient in childhood vaccination, with children from wealthier households having substantially higher odds of receiving basic vaccinations. Mohammed et al. likewise identified socioeconomic circumstances as an important barrier to immunization in Nigeria. Although routine vaccines are provided free of charge at public PHCs, indirect costs such as transportation, time away from work, and other household expenses may still affect mothers' ability to attend repeated immunization appointments [15].

Accessibility of the PHC was another significant determinant. Mothers who considered their PHC accessible had a higher proportion of children with complete immunization than those who considered the facility inaccessible. The regression analysis further showed that mothers who reported that the PHC was accessible had 1.96 times higher odds of complete immunization. This finding supports the evidence reported by Mohammed et al. which identified logistical and health-system barriers as important contributors to immunization inequalities in Nigeria. Similarly, Williams et al. identified geographical location and healthcare-related characteristics among the important determinants of childhood vaccination. The finding suggests that improving physical access to PHCs and reducing transportation barriers could contribute to improved completion of routine immunization schedules.

Receipt of immunization information from health workers was strongly associated with uptake. Mothers who received immunization information had a complete uptake rate of 76.8%, compared with 49.1% among those who did not receive such information. In the adjusted analysis, mothers who received immunization information had 2.37 times higher odds of complete immunization. This was the strongest predictor identified in the regression model. The result emphasizes the central role of healthcare workers in communicating vaccination information and supporting mothers to complete immunization schedules. Mohammed et al. similarly identified health literacy, perceived vaccine benefits, and trust in healthcare providers as important facilitators of immunization across Nigerian regions.

Vaccine availability was also significantly associated with immunization uptake. Complete uptake was higher among children whose mothers reported that vaccines were usually available than among those who reported that vaccines were not always available. Mothers who reported regular vaccine availability had 1.89 times higher odds of complete immunization. This finding demonstrates that maternal willingness alone may not be sufficient to achieve complete immunization if vaccines are unavailable when mothers attend health facilities. Mohammed et al. (2024) identified systemic healthcare deficiencies and logistical challenges as important barriers to

routine immunization in Nigeria. Ensuring reliable vaccine supply at PHCs is therefore essential for translating demand for immunization into actual uptake.

The study also found a significant relationship between appointment reminders and routine immunization uptake. Mothers who received reminders had a complete uptake rate of 78.0%, compared with 58.4% among those who did not receive reminders. After adjustment, receipt of an appointment reminder was associated with 1.71 times higher odds of complete immunization. This finding is supported by Eze et al. whose systematic review and meta-analysis found high acceptability of mobile-phone reminders among Nigerian mothers and caregivers using routine childhood immunization services. Furthermore, a multicentre randomized controlled trial in Lagos found that SMS reminders significantly increased return visits for childhood vaccination. These findings support the use of SMS, telephone calls, or other reminder systems as relatively simple strategies for reducing missed immunization appointments.

Waiting time was also significantly associated with routine immunization uptake. Mothers who considered waiting time acceptable had a higher proportion of children with complete immunization than mothers who considered waiting time unacceptable. The regression model showed that acceptable waiting time was associated with 1.63 times higher odds of complete immunization. Although the present study cannot establish causality, the finding suggests that mothers' experiences with health-service delivery may influence continued utilization. Long waiting periods may discourage mothers from returning for subsequent appointments, particularly where mothers have employment, household, or childcare responsibilities. This is consistent with the broader evidence from Mohammed et al. which emphasizes that health-system and service-delivery factors contribute to immunization outcomes in Nigeria.

Maternal age was significantly associated with immunization uptake at the bivariate level, but the relationship did not remain statistically significant after adjustment for other factors. Mothers aged 25 years and above had 1.52 times higher odds of complete uptake compared with younger mothers, but the association was not statistically significant ($p = 0.061$). This suggests that maternal age alone may not be a major independent determinant once education, income, accessibility, information, vaccine availability, reminders, and waiting time are considered. Williams et al. similarly identified maternal age as one of several characteristics associated with vaccination coverage, but the influence of maternal age should be interpreted alongside other socioeconomic and healthcare determinants.

The study also showed that most mothers had received immunization information from health workers, were satisfied with health workers' attitudes, and reported that vaccines were usually available. In addition, most mothers had attended antenatal care and delivered in a health facility. These contacts provide important opportunities for health workers to introduce and reinforce immunization messages. The findings of Williams et al. (2024) support this interpretation, as antenatal care and health-facility delivery were positively associated with childhood vaccination in Nigeria. Strengthening the linkage between antenatal care, delivery services, postnatal care, child welfare clinics, and routine immunization could therefore improve continuity of vaccination.

Conclusions

This study found that routine immunization uptake among children of nursing mothers attending selected Primary Health Care Centres in Ilorin East Local Government Area was relatively high, with 73.6% achieving immunization completion appropriate for age. However, 26.4% of children had either incomplete or no immunization, indicating a continuing gap in vaccination coverage. The findings demonstrate that routine immunization uptake is influenced by both maternal socioeconomic characteristics and health-service factors. Higher maternal education and household income were significant predictors of uptake, while accessible PHC services, adequate immunization information, consistent vaccine availability, appointment reminders, and acceptable

waiting times also independently increased the likelihood of complete immunization. Maternal age, although associated with uptake at the bivariate level, was not an independent predictor after adjustment. Improving routine immunization coverage in Ilorin East therefore requires interventions that address both demand- and supply-side barriers. PHC facilities should strengthen routine health education, maintain reliable vaccine supplies, provide appointment reminders, reduce unnecessary waiting times, and improve accessibility of immunization services. Particular attention should be given to mothers with lower educational and socioeconomic status. These measures could help reduce missed opportunities for vaccination and improve completion of routine immunization among children in the study area.

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