



ORIGINAL ARTICLE

MISSED OPPORTUNITIES FOR VACCINATION AMONG CHILDREN AGED 12 TO 23 MONTHS IN CALABAR SOUTH, CROSS RIVER STATE, NIGERIA

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Keywords

Calabar,

Children,

Predictors,

Missed

Opportunities,

Predictors,

Vaccination

Abstract

Background: Immunization coverage disparities leave many children vulnerable to vaccine-preventable diseases. The situation in urban slums in Cross River State remains undocumented. This study assessed missed opportunities for vaccination (MOV) among children aged 12–23 months in Calabar South, Cross-River State, Nigeria.

Methods: A community-based cross-sectional analytical study was conducted among children aged 12–23 months. Information was obtained from their caregivers. Data collection occurred from August to September 2023. A sample of 460 was determined using Cochran's formula, adjusted for a 10% non-response rate and a design effect of 1.25. Data were collected using a pre-tested, semi-structured, interviewer-administered questionnaire via Kobo Toolbox. Analysis was done using SPSS version 25.0. Descriptive statistics were presented, associations tested using Chi-square, and significant variables were pulled into a multivariate logistic regression at $p < 0.05$. Ethical approval was obtained (CRSMOH/RP/HREC/2023/401).

Results: There were 190(41.3%) male children and 270(58.7%) female children in the study. Among caregivers, 65 (14.1%) were males, while 395 (85.9%) were females; the majority were mothers (92.0%), aged 30–39 years (42.8%), with secondary education (61.3%).

MOV prevalence was 8.0%. OPV₀ was the most missed vaccine, while PENTA1 and BCG were the least. The main reason cited for MOV was the perception that the child was 'too old.'. In multivariate binary logistic regression, lower age of caregiver, and having timely vaccination reduced the likelihood of MOV.

Conclusion: Strengthening routine immunization, retraining health workers on a “no MOV” policy, and targeted caregiver education are needed to reduce MOV in Calabar South.

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Article History:

Date received: 19/07/2025

Date accepted: 10/11/2025

INTRODUCTION

Immunization remains one of the most cost-effective public health interventions, serving as a shield against vaccine-preventable diseases and promoting population health and sustainable prosperity.¹ Prior to the launch of the Expanded Programme on Immunization (EPI) in 1974, fewer than 5% of infants worldwide were fully immunized.² Since its adoption in Nigeria in 1979, the EPI strategy has provided vaccines that protect against tuberculosis, hepatitis, diphtheria, pertussis, tetanus, measles, yellow fever, and *Haemophilus Influenzae* type B.³ Despite these advances, immunization coverage remains suboptimal. MOV occurs when a child who is eligible for vaccination, with no contraindications, visits a health facility but does not receive one or more recommended vaccines.⁴ Globally and regionally, coverage disparities exist both between and within countries, leaving unvaccinated and under-vaccinated populations vulnerable to vaccine-preventable diseases. Administrative estimates are often inaccurate due to errors in data compilation and reporting, while national coverage rates mask subnational gaps at state and local levels.⁵ This underscores the need for community-based assessments to guide targeted interventions better. Urbanization adds another layer of complexity. In many low- and middle-income countries, rapid urban growth has expanded slum populations where limited access to healthcare and reduced service utilization contribute to poor immunization outcomes.^{6,7} At the regional level, sub-Saharan Africa continues to face high levels of MOV. A recent analysis of DHS data (2016–2023) across 20 countries, including Nigeria, found that 75.5% of children experienced MOV, with prevalence ranging from 41.6% in Mauritania to 93.9% in the Gambia.⁸ Significant predictors included the child's age, maternal and household characteristics, place of delivery, access to healthcare, and community-level socioeconomic indicators.⁸ The Nigerian Demographic and Health Survey (NDHS) of 2018 reported that only 34.3% of children aged 12–23

months were fully immunized in Kano State, Nigeria.⁹ Evidence from across Nigeria highlights the scale of the challenge. In South-West Nigeria, the prevalence of MOV was 9.6%, with higher rates in urban areas (11.8%) compared to rural areas (7.5%).¹⁰ Commonly cited reasons included vaccine unavailability, long waiting times, unscheduled visits, illness of the child, and distance from healthcare facilities. In South-Eastern Nigeria, MOV occurred in 55.4% of children and accounted for 94.9% of non-fully immunized children.¹¹ Contributing factors ranged from presenting on “wrong” immunization days and issuing false contraindications by health workers to refusal to open new vials and vaccine unavailability. Similarly, socioeconomic characteristics such as parental education and occupation have been linked to MOV.¹¹ Studies specifically in Nigeria have also reported that nearly 30% of eligible children miss at least one vaccine during healthcare visits.⁹ However, despite these findings, there is limited evidence from Cross River State, particularly in Calabar South Local Government Area (LGA), which is characterized by high urban density and slum settlements. The immunization situation in this context remains undocumented, creating a knowledge gap for effective policy and programmatic planning. This study assesses the prevalence and predictors of MOV among children in Calabar South, Cross River State, Nigeria. Specifically, the objectives were to determine the prevalence of MOVs among children aged 0–23 months in Calabar South LGA and to identify factors associated with MOV in the study area.

METHODS

Study Area: The study was conducted in Calabar South, one of the Local Government Areas (LGAs) in Cross River State, Nigeria. Calabar South is characterized by a mix of urban and peri-urban communities with diverse socio-demographic profiles. The area has multiple healthcare facilities offering immunization services, making it a suitable location for studying vaccination timeliness and MOV.

Table 1: Socio-Demographic Characteristics Children and Caregivers In Calabar South LGA, CRS (N=460)

Variable	Frequency	Percentage
Sex of children		
Male	190	41.3
Female	270	58.7
Age group of children/months		
12-15	254	55.2
16-19	160	34.8
20-23	46	10.0
Birth order of children		
1-2	280	60.9
3-4	137	29.8
5-6	43	9.3
Sex of caregivers		
Male	65	14.1
Female	395	85.9
Age of caregiver/years		
<20	49	10.7
20-29	149	32.4
30-39	197	42.8
40-49	35	7.5
≥50	30	6.5
Highest level of education of caregivers		
No formal education	85	18.5
Primary	73	15.9
Secondary	282	61.3
Tertiary	20	4.3
Occupation of caregivers		
Business	278	60.4
Civil servant	16	3.5
Farming	34	7.4
Housewife	115	25.0
Unemployed	17	3.7
Relationship of caregivers to children		
Father	7	1.5
Grandparent	26	5.7
Mother	423	92.0
Uncle/aunt	4	.9

Study Population: The study population consisted of 460 children aged 12 to 23 months residing in Calabar South, along with their caregivers. This age group is selected because it includes children who should have received key vaccines, such as BCG, PENTA1, and measles, enabling an assessment of vaccination timeliness and MOV.

Study Design: The study adopted a community-based, cross-sectional analytical design.

Sample Size Determination and sampling technique: The sample size was determined using Cochran's formula¹² for estimating a single proportion, based on an estimated prevalence of timely vaccination in the region from previous studies. The formula is as follows: $n = Z^2pq/d^2$

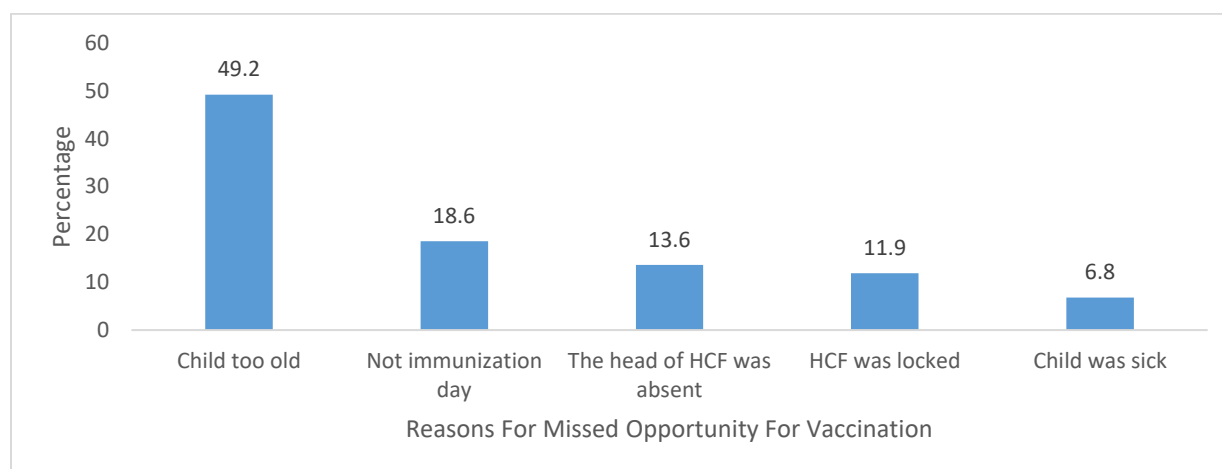


FIG 1: Reasons for Missed Opportunity for Vaccination.

Where: n = required sample size; Z = Z-value (1.96 for 95% confidence level); p = estimated prevalence of timely vaccination; d = margin of error (5%). Including a 10% non-response rate and a design effect size of 1.25, a final sample size was 460.

Sampling Technique: A multistage sampling technique was used. The simple random sampling technique, using balloting, was first employed to select five numbers randomly from an opaque bag. The corresponding wards were then chosen for the study based on these numbers. A total of five (5) wards (4, 5, 8, 11, and 12) were selected from the cluster of 12 wards, where each ward was considered a primary sampling unit. Second Stage: Within each of the selected five (5) wards, specific communities were identified. The communities within each ward represented the second stage of clustering. Each community was considered a secondary sampling unit. The selection of communities within each ward involved purposive selection to ensure spread.

Data Analysis: Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL) version 25.0 was used. Data was cleaned and coded before analysis. Descriptive statistics were presented as frequency, percentage and charts. MOV, and reasons were analyzed using the chi-square test statistic. Independent variables significantly associated with

complete vaccination were included in a multivariate binary logistic regression model to identify predictors of complete vaccination. Multivariable analysis was carried out at a 95% Confidence Interval, and a p-value of < 0.05 was considered statistically significant for all comparisons.

ETHICAL CONSIDERATION

Ethical approval and consent for the study were obtained from the Ethics and Research Committee of the Ministry of Health, Cross River State (No. CRSMOH/RP/HRE/2023/401). Informed consent was obtained from each study participant before inclusion in the study. Permission was also obtained from heads of wards in Calabar South LGA before the study commenced.

RESULTS

As shown in Table 1, there were 190 male children (41.3%) and 270 female children (58.7%) in the study. The 12-15-month age group (55.2%) is the largest. The category of 1 to 2 birth order (60.9%) is the most prevalent and female caregivers (85.9%) form the largest category. The most common age group of caregivers was 30-39 years (42.8%). Caregivers with secondary education make up the largest group at 61.3%. Those engaged in business activities constitute the majority at 60.4%. Mothers (92.0%) hold the highest proportion in caregiving relationships.

Table 2: Missed Opportunity for Vaccination Among Children Aged 12 to 23 Months in Calabar South LGA, CRS

Variable	Frequency	Percentage
Missed opportunity for vaccination		
No	423	92.0
Yes	37	8.0
Vaccines that were missed*		
BCG	4	3.6
OPV ₀	22	20.0
OPV ₂	7	6.4
PCV ₂	7	6.4
PENTA ₂	7	6.4
OPV ₃	11	10.0
PCV ₃	11	10.0
PENTA ₃	11	10.0
Measles vaccine	15	13.6
Yellow fever vaccine	15	13.6

Vaccines missed*= multiple response

The overall prevalence of MOV was 37(8.0%). The most common vaccine missed was OPV0 (20.0%), followed by the 9th month vaccines (measles vaccine and yellow fever vaccine) missed by 13.6% of children, followed by the 14th week vaccines (OPV3, PCV3 and PENTA3) missed by 10.0%, then the 10th week vaccines (OPV2, PCV2 and PENTA2) missed by 6.4% of the children. The least frequently missed vaccines were PENTA1 and BCG. (Table 2) As shown in Figure 1, the most common reason for MOV was the child being too old for vaccination (49.2%), followed by the fact that the visit day wasn't for immunization (18.6%), the head of the health facility was absent (13.6%), the Healthcare Facility (HCF) was locked (11.9%), and the child was sick (6.8%).

As shown in Table 3, MOV was significantly associated with the caregiver-child relationship ($p=0.000$), being more common among children cared for by grandparents, with 30.8% experiencing missed vaccinations. The caregiver's level of education was also significantly related to MOV ($p=0.000$), with children of caregivers without formal education having the highest rate of MOV at 17.6%, followed by those with only primary education at 15.1%. Occupational status was also

significantly associated with MOV ($p=0.004$), with higher MOV among children whose caregivers were farmers (23.5%). The means of transport to the health facility was significantly associated with MOV ($p = 0.000$). As shown in Table 4, significant predictors of MOV were caregivers' age and vaccination timeliness. Caregivers aged 31 years or younger had lower odds of their children experiencing MOV than those aged 31 or older (OR = 0.897; 95% CI: 0.831–0.968; $p = 0.005$). Children who received their vaccines on time had significantly lower odds of experiencing MOV (OR = 0.238; 95% CI: 0.105–0.542; $p = 0.001$).

DISCUSSION

The current study sought to assess the prevalence of missed opportunities for vaccination (MOV) and associated factors among children aged 12 to 23 months. The prevalence of missed vaccination opportunities (MOV) in the current study was 8.0%, substantially lower than reported in several previous studies. For instance, studies conducted in Burkina Faso and northwestern Ethiopia reported MOV prevalences of 76% and 74.9%, respectively,^{13,14} while the South Gondar Zone of Ethiopia recorded 49.1%,¹⁵ and a study in the southwest region of Nigeria reported 32.8%.¹⁶ The

Table 3a: Factors associated with missed opportunity for vaccination among children (N = 460)

Variable	Experienced MOV			Chi-square test	p-value
	Yes 37 (%)	No 423 (%)	Total 460 (%)		
Relationship to child					
Father	0 (0.0)	7 (100.0)	7 (100.0)	13.938	0.000*
Grandparents	8 (30.8)	18 (69.2)	26 (100.0)		
Mother	29 (6.9)	394 (93.1)	423 (100.0)		
Uncle/aunt	0 (0.0)	4 (100.0)	4 (100.0)		
Caregiver's education					
No formal education	15 (17.6)	70 (82.4)	85 (100.0)	23.401	0.000*
Primary	11 (15.1)	62 (84.9)	73 (100.0)		
Secondary	11 (3.9)	271 (96.1)	282 (100.0)		
Tertiary	0 (0.0)	20 (100.0)	20 (100.0)		
Occupation					
Business	18 (6.5)	260 (93.5)	278 (100.0)	14.446	0.004*
Civil servant	0 (0.0)	16 (100.0)	16 (100.0)		
Farming	8 (23.5)	26 (76.5)	34 (100.0)		
Housewife	11 (9.6)	104 (90.4)	115 (100.0)		
Unemployed	0 (0.0)	17 (100.0)	17 (100.0)		
Means of transport					
Car/bus	0 (0.0)	3 (100.0)	3 (100.0)	39.081	0.000*
Motorcycle/keke	0 (0.0)	146 (100.0)	146 (100.0)		
Others**	0 (0.0)	32 (100.0)	32 (100.0)		
Walk	37 (13.3)	242 (86.7)	279 (100.0)		
Birth order					
1-2	26(9.3)	254(90.7)	280(100.0)	2.460	0.344
3-4	7(5.1)	130(94.9)	137(100.0)		
5-6	4(9.3)	39(90.7)	43(100.0)		
Caregiver's age/years					
<20	7 (14.3)	42 (85.7)	49 (100.0)	35.046	0.000*
20-29	7 (4.7)	142 (95.3)	149 (100.0)		
30-39	7 (3.6)	190 (96.4)	197 (100.0)		
40-49	4 (11.4)	31 (88.6)	35 (100.0)		
≥50	12 (40.0)	18 (60.0)	30 (100.0)		

lower prevalence in the current study may indicate progress in immunization services within Calabar, possibly linked to ongoing outreach programs, enhanced health worker training, improved vaccine availability through national campaigns, as well as better integration of immunization activities within primary healthcare facilities. OPV₀, measles, and yellow fever vaccines were the most frequently missed in this study. Similar patterns were observed in Burkina Faso and Nigeria, with high MOV for both early- and late-dose single antigens. This was due to presentations outside scheduled vaccination days, false contraindications, and insufficient screening during non-immunization visits.^{13,17,18} These findings suggest that children may be particularly at risk of MOVs for the birth and 9-month vaccines when delivered outside

health facilities or when caregivers present late for care. Operational barriers, such as the refusal to open multi-dose vials for a few children and rigid vaccination schedules, could further exacerbate MOVs. The leading reasons reported for MOVs include the belief that the child was too old for vaccination (49.2%) and health worker absenteeism. Misconceptions regarding age limits reveal ongoing information gaps among caregivers and poor communication by health providers.¹⁹ While some studies in Africa highlight vaccine stock-outs as the predominant cause of MOV,^{13, 20} the prominence of provider absenteeism in the current study may point to local human resource constraints and weak accountability systems. Several caregiver and system-level variables were

Table 3b: Factors associated with missed opportunity for vaccination among children (N = 460)

Variable	Experienced MOV			Chi-square test	p-value
	Yes 37 (%)	No 423 (%)	Total 460 (%)		
Vaccination attitude					
Good	26 (7.0)	347 (93.0)	373 (100.0)	6.420	0.007*
Fair	7 (9.5)	67 (90.5)	74 (100.0)		
Poor	4 (30.8)	9 (69.2)	13 (100.0)		
Timely vaccination					
Yes	15 (4.6)	314 (95.4)	329 (100.0)	18.961	0.000*
No	22 (16.8)	109 (83.2)	131 (100.0)		
Knowledge of vaccination					
Good	15 (6.3)	224 (93.7)	239 (100.0)	2.101	0.147
Poor	22 (10.0)	199 (90.0)	221 (100.0)		

*Statistically significant at $p < 0.05$. Others** include canoe, bicycle

significantly associated with MOV, confirming its multifactorial nature. Children cared for by grandparents or other relatives had higher rates of MOV than those cared for by their mothers. This could reflect lower familiarity with vaccination schedules among alternate caregivers and reduced emphasis on preventive health. System-level reviews have also shown that MOV often occurs when providers fail to check immunization status during non-vaccination visits, particularly when caregivers are less engaged.²³ Lower levels of educational attainment among caregivers were significantly correlated with higher rates of missed MOV, consistent with existing reports that associate maternal education with immunization coverage completion.²⁴ Educated caregivers are more likely to understand immunization benefits, remember schedules, and navigate health facilities effectively. Conversely, uneducated caregivers may depend on myths or exhibit irregular attendance at health services, thereby increasing the risk of MOV. Furthermore, mode of transport to health facilities and caregiver occupation were significantly associated with MOV, with caregivers who trekked to the facility showing higher rates of missed vaccination. This finding reflects persistent access and affordability challenges that may discourage caregivers from returning for immunization if it is not offered during the initial

visit. However, this association also highlights underlying health facility and provider factors—such as failure to screen for vaccination status or provide vaccines during non-immunization visits that turn a caregiver’s difficult journey into a missed opportunity. Similar patterns were observed in Kano, Nigeria, where poor service integration and inadequate provider assessment practices contributed to MOV.²³ Caregiver age was also significantly associated with MOV, aligning with evidence from South Africa, where older mothers missed vaccinations more.²⁴ This may be due to competing family responsibilities, complacency from previous child-rearing experience, or decreased health-seeking motivation. Younger caregivers may be more receptive to health education and more compliant with vaccination schedules. Attitude towards immunization significantly influenced MOV. Caregivers harboring negative attitudes exhibited higher MOV, potentially attributable to mistrust, cultural beliefs, or the undervaluation of preventive measures services.²⁵ Unlike knowledge, attitude reflects deeper perceptions shaped by experience and social influence. Addressing these beliefs through community dialogue and culturally sensitive communication may enhance vaccine uptake.

Table 4: Multivariate Binary Logistic Regression of Predictors of Missed Opportunity for Vaccination among Children of Caregivers (N=460).

		95% Confidence interval		
Variable	Odd ratio	Lower	Upper	p-value
Age of caregiver/years				
≤31	0.897	0.831	0.968	0.005*
>31	1			
Caregiver’s relationship to child				
Mother/father	2.321	0.394	13.667	0.352
Grandparent/other relatives	1			
Education of caregivers				
Tertiary	0	0.243	.1.003	0.998
Secondary or less	1			
Transport means				
Trekking	0.1	0.443	.4.871	0.995
Vehicle	1			
Vaccination timeliness				
Timely	0.238	0.105	0.542	0.001*
Not timely	1			
Attitude towards vaccination				
Good	0.699	0.352	1.388	0.306
Poor	1			

*Independent predictors of MOV

CONCLUSION

The MOV prevalence observed was lower than that reported in comparable Nigerian and regional studies. However, the persistence of missed OPV0, measles, and yellow fever doses highlights the need for targeted interventions. Strategies should include linking facility delivery with birth dose administration, instituting mandatory immunization checks during every health service contact, retraining health workers to address false contraindications, and ensuring consistent vaccine supply and flexible session scheduling.

STRENGTHS AND LIMITATIONS

Using interviewer-administered questionnaires introduces possible recall and social desirability bias, though this was minimized by verifying child health cards and using trained interviewers. Some unmeasured cultural or system-level factors may also have influenced results. Nonetheless, the large, randomly selected sample across Calabar South

wards enhances generalizability and provides valuable insight into the multifactorial determinants of MOV.

AUTHOR CONTRIBUTIONS

TON contributed to manuscript development, literature review, and refining the rationale and objectives. AII actively helped design the methodology, supported data analysis, and proofread the manuscript. OEU refined the methodology, reviewed the analysis, and contributed to final editing. EAU supported the manuscript structure, literature review, and the refinement of the discussion and conclusions.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

FUNDING

This study was self-funded by the researchers; no external funding was received.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the contributions of the medical students for their assistance in data collection.

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