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Disparities in Vaccination Coverage and Timeliness among Children Aged 12 to 23 Months within Calabar South, Cross River State, Nigeria

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Abstract

Immunization serves as a cost-effective shield against vaccine-preventable diseases, promoting population health and sustainable prosperity. This study aimed to determine vaccination coverage and assess the timeliness of vaccination (BCG, PENTA1, and measles vaccines) among children aged 12 to 23 months in the wards of Calabar South Local Government Area (LGA) in Cross River State. A community-based cross-sectional descriptive design was employed, with the number of children sampled being 460 to account for non-response and design. Information about children were obtained through interviews with proxy caregivers. Data analysis was performed using SPSS version 25.0. Ethical approval was obtained from the CRS Ministry of Health. There were 190 male children (41.3%) and 275 female children (58.7%) in the study. The age group of 12-15 months (55.2%) represents the largest category. The overall vaccination coverage was 88.3%, varying across wards (100% in ward 4, followed by 96.1% in ward 8, then 96% in ward 5, 91.6% in ward 12, and 80.8% in ward 11). The proportion of overall timely vaccination was 71.5%, with PENTA1 having the highest timeliness (88.3%). The proportions of timely vaccination for BCG and PENTA1 were highest in ward 4, followed by ward 5, but lowest in ward 11. Timeliness for all vaccines was also highest in ward 4, followed by ward 12, then ward 5, ward 8 and ward 11. Vaccination coverage and timeliness differed between locations, highlighting the need for Government interventions to be context-specific, addressing challenges within different ward locations rather than applying a one-size-fits-all approach.

Keywords*: Coverage, Childhood, Calabar South, Disparity, Timeliness, Vaccination.*

Introduction

Immunization serves as a cost-effective shield against vaccine-preventable diseases, fostering population health and sustainable prosperity [1]. Contributing significantly to 14 of the 17 United Nations Sustainable Development Goals, particularly SDG 3, "Ensure healthy lives and promote well-being for all" (Datta et al., 2023), childhood immunization has come a long way since the initiation of the Expanded Programme on Immunisation (EPI) in 1974. Prior to the EPI, less than 5% of infants worldwide were fully immunized [2]. The subsequent coordinated efforts at the country level, particularly through WHO's EPI, have resulted in significant progress in routine vaccination against vaccine-preventable diseases [3]. Nigeria, implementing the EPI strategy since 1979, provides vaccines protecting against a range of diseases [4]. Despite global initiatives like the Global Immunization Vision and Strategy by WHO and UNICEF [5] and the 2011-2020 Global Action Plan's target of achieving 90% coverage across all vaccines [6], challenges persist. An estimated 19.3 million children remain unvaccinated, with significant

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disparities across countries, particularly in India, Nigeria, and the Democratic Republic of Congo [7]. The recent WHO and UNICEF Estimates of National Immunization Coverage (2021) reported approximately 25 million under-vaccinated children, emphasizing the need to not only focus on coverage rates but also consider the timeliness of vaccine administration. Timely vaccination is crucial, as delays can leave children vulnerable to infectious diseases [8.9]. This article explores the disparities in vaccination coverage and timeliness, examining studies from various regions and settings. It delves into factors influencing immunization, ranging from socio-demographic determinants to knowledge and attitudes of parents. The aim is to shed light on the multifaceted challenges faced in achieving optimal vaccination coverage and timely administration, thereby providing insights for targeted interventions and improvements in global vaccination programs. The Global Vaccine Action Plan (GVAP) ambitiously aimed for a minimum of 90% national-level vaccine coverage across various vaccines by the year 2020 [10]. Despite concerted efforts to enhance routine immunization coverage, significant disparities persist, particularly affecting unvaccinated and under-vaccinated children in diverse settings, including urban, rural, and conflict-affected areas. The Equity Reference Group on Immunization (ERG) underscores the urgency of prioritizing strategies directed at these vulnerable populations due to acute inequities. While some regions exhibit signs of progress in routine immunization coverage by the close of 2021, cautionary signals indicate lingering gaps without substantial reinforcement of immunization systems [11,12]. However, a critical gap in understanding exists regarding the specific vaccination coverage situation in Calabar South Local Government Area (LGA), with some locations having characteristics of urban slum. The rapid urbanization observed in low- and middle-income countries has led to a surge in large informal settlements and urban-poor populations, thereby creating marked disparities in accessing essential healthcare services, including immunization [13]. The childhood immunization landscape in Calabar South LGA, predominantly an urban slum environment in Cross River State, remains undocumented, raising concerns about the potential vulnerabilities of this population. Urbanization is linked with a burgeoning populace in impoverished urban communities and slum environments [14], contributing to adverse health outcomes due to reduced healthcare accessibility and hesitancy in seeking medical services 15]. Within this context, immunization coverage disparities persist both between and within countries, leaving unvaccinated and under-vaccinated populations exposed to the threat of vaccine-preventable diseases. Administrative coverage estimates often lack precision due to errors in data compilation and reporting at health facilities [16]. Mass childhood vaccination programs have been a pivotal public health achievement, significantly impacting child survival and health outcomes worldwide [17,18,19,20]. Furthermore, national coverage rates conceal subnational gaps at state and local district levels, underscoring the need for community-based immunization coverage assessments in Cross River State. Such assessments are vital to inform targeted interventions and mitigate the heightened risk of vaccine-preventable diseases in Calabar South LGA, thereby addressing a critical gap in our understanding of immunization dynamics in urban slum environments. The study therefore aimed to determine vaccination coverage as well as timeliness of vaccination (BCG, PENTA1, and measles) among children aged 12 to 23 months in selected wards within Calabar South LGA.

Methods

The research was conducted within the wards of Calabar South Local Government

Area, situated in the Southern Senatorial District of Cross River State, Nigeria. Spanning an area of 264 km², this region recorded a population of 191,630 individuals during the 2006 census (NPC, 2006), with its administrative center located in Ward 12. Calabar South LGA shares its northern boundary with Calabar Municipality LGA, while its southern edge meets the Atlantic Ocean, and to the east, it is bounded by Akpabuyo LGA. The indigenous populace of Calabar South LGA primarily comprises two ethnic groups, the Quas and the Efiks. However, owing to its diverse and cosmopolitan nature, the area accommodates individuals from various parts of both the state and Nigeria as a whole. The LGA comprises 11 local government wards, with certain areas exhibiting distinct characteristics of dilapidated environments, degraded housing structures, and inadequate sanitation systems, indicative of a trend toward slum development. The study area faces a pressing challenge of land cover degradation, evident through erosion, deforestation, pollution, the proliferation of solid waste, housing deficits, insufficient water supply, traffic congestion, and elevated food costs. This persistent challenge stems from the lack of implementation of urban renewal programs/projects. Consequently, there has been a marked increase in the sporadic emergence of slums within Calabar South LGA. Understanding the unique characteristics and challenges of this study area is essential for contextualizing the research findings and implementing targeted interventions to address immunization disparities in this urban slum environment. The research adopted a community-based cross-sectional descriptive design among children aged 12 to 23 months while information about them were obtained through interviews with proxy caregivers. Assessment of vaccination coverage and related characteristics among children in this age group controls for recall bias [21]. The restriction to this age group is also to ensure that recommendations from the EPI which could change over time, as new vaccines are introduced were the same for all these children [22]. The sample size was determined using the Cochran sample size formula for a single proportion, n = $\frac{z^2PQ}{d^2}$ (where n is the minimum sample size, Z is the standard normal deviate corresponding to a 2-sided level of significance of 5% = 1.96, P is the proportion of coverage from previous study = 69% [23], Q = 1-P = 1= 1-0.69 = 0.31, d is the desired level of precision =5%). To account for non-response, 10% none-response rate was added, and to adapt this formula for cluster sampling with the design effect (f), a design effect size of 1.25 was multiplied by the sample size and rounded off to 460. A two-stage cluster sampling method was used. At the first stage, five of the 12 wards in Calabar south were selected through simple random sampling technique by balloting (4, 5, 8, 11, and 12) where each ward was considered a primary sampling unit. At the second stage, in each of the selected five (5) wards, specific communities were identified. The communities within each ward represent the second stage of clustering. Each community is considered a secondary sampling unit. Proportionately, sample recruited per ward were 25 (ward 4), 25 (ward 5), 51 (ward 8), 193 (ward 11), and 166 (ward 12). Within the selected wards, all households were visited caregivers of children aged 12 to 23 months permanently residing there and gave informed consent were interviewed until the sample proportionately allocated to the ward was reached. Households without children aged 12 to 23 months were skipped. On the other hand, where there were more than 1 caregiver per household, one of them was selected through balloting. A semi-structured pre-tested interviewer-administered semi-structured questionnaire made up of four sections was used for the study through Kobo tool box was used by 5 trained research assistants. Statistical Software for Social Sciences version 25.0 software was used for data analysis. Data was cleaned and coded before analysis. Descriptive statistics was presented as frequency, percentage and charts. Vaccination coverage and timeliness were presented as figures. The ethical approval and consent for the study was obtained from the ethics and research committees of the Ministry of Health, Cross River State (CRSMOH/RP/HREC/2023/401). Informed consent was obtained from each study participant prior to inclusion in the study Permission was also obtained from heads of wards and family heads in Calabar South LGA before the study began.

Results

Socio-demographic Characteristics Children and Caregivers

Table 1 shows the distribution across different categories, such as age, sex, highest level of education, occupation, and the relationship of caregivers to the children involved in the research. There were 190 male children (41.3%) and 275 female children (58.7%) in the study. The age group of 12-15 months (55.2%) represents the largest category. The category of 1 to 2 birth order (60.9%) is the most prevalent. Female caregivers (85.9%) form the largest category. The age group of 30-39 years among caregivers (42.8%) is the most prominent. Caregivers with secondary education (61.3%) constitute the highest category. Those involved in business (60.4%) represent the most significant category. Mothers (92.0%) hold the highest proportion in caregiving relationships.

Table 1. Socio-demographic Characteristics Children and their Caregivers (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		
<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

Childhood Vaccination Coverage Among Children Aged 12 to 23 Months

Figure 1 is a bar chart showing childhood vaccination coverage among children aged 12 to 23 months. With an overall vaccination coverage of 88.3%, it was highest in ward 4(100%), followed by ward 8 (96.1%), then ward 5 (96%), 91.6%), and lowest in ward 11 (80.8%).

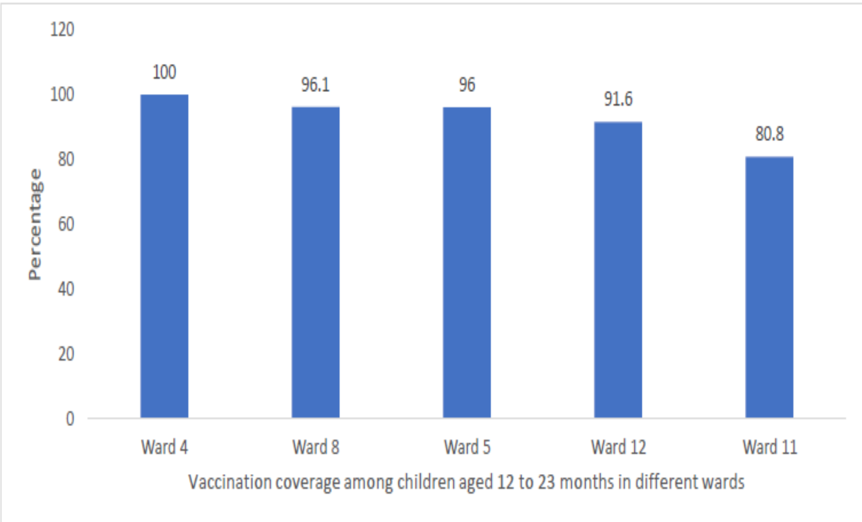

Figure 1. Childhood Vaccination Coverage Among Children Aged 12 to 23 Months Stratified According to Ward

Vaccine-specific Childhood Vaccinated Coverage

As shown in figure 2, the coverage for BCG is 87.4% while that of OPV0 is 73.0%. The vaccination coverage is 88.3% for all the 6th week vaccines (OPV1, PENTA1 and PCV1). The coverage for 10th week vaccines were different, being 82.8% for OPV2, 83.7% for PENTA2 and 83.9% for PCV2. The proportion of vaccination coverage was lowest for the 9th month vaccines: being 72.2% for measles vaccine, and 70.9% for yellow fever vaccine.

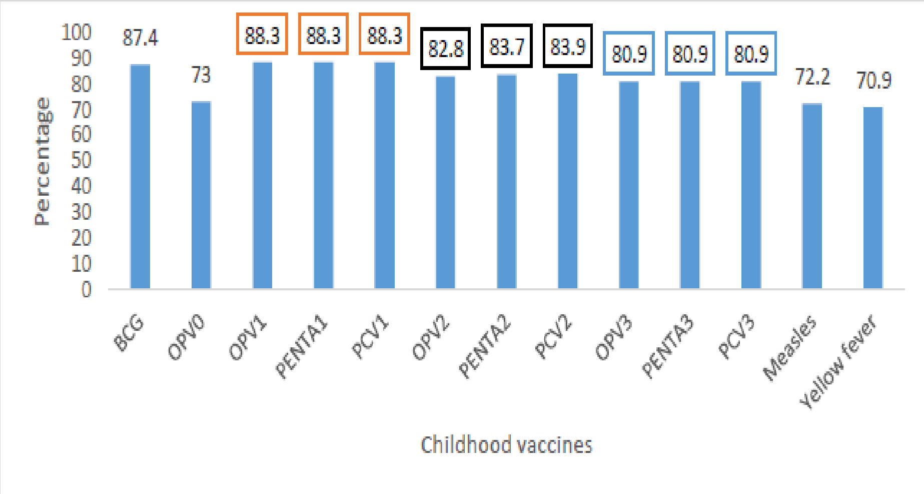

Figure 2. Vaccine-Specific Childhood Vaccinated Coverage among Children Aged 12 to 23 Months in Calabar South LGA of Cross River State

Timeliness of BCG, PENTA1 and Measles Vaccines Stratified According to Wards

As shown in figure 3, the proportions of timely vaccination were 100% for BCG and PENTA1 in ward 4, 96% for both BCG and PENTA1 in ward 5, and lowest in ward 11 (80.8%). Timeliness for BCG, PENTA1 and measles vaccines was 88% in ward 4, 80% in ward 5, 68.6% in ward 8, 59.1% in ward 11, and 83.1% in ward 12 of Calabar South LGA. Others are as shown in figure 3.

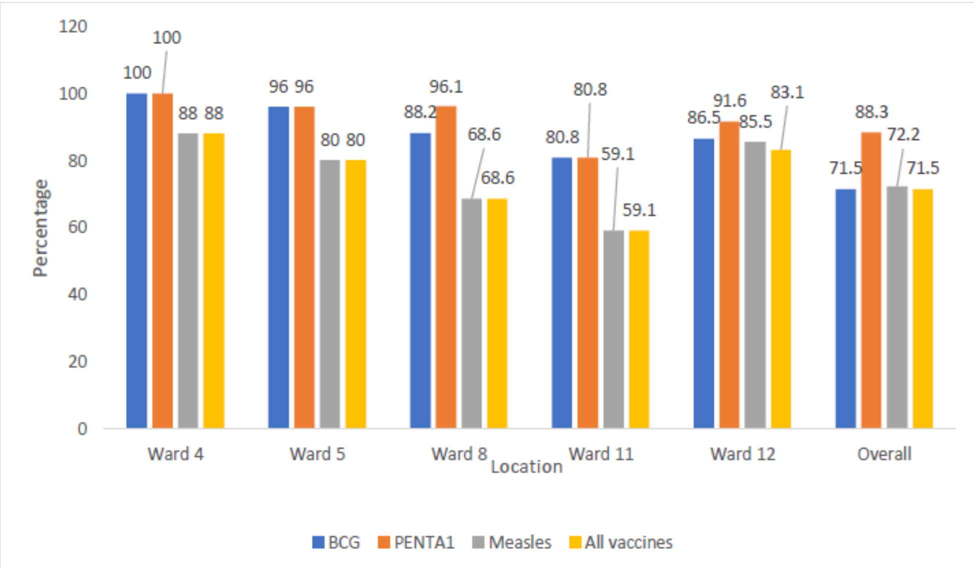

Figure 3. Timeliness of BCG, PENTA1 and Measles Vaccines Stratified According to Wards

Discussion

This study investigated the landscape of vaccination coverage and timeliness among children aged 12 to 23 months in Calabar South Local Government Area (LGA) of Cross River State, Nigeria. The overarching vaccination coverage revealed an impressive 88.3%, showcasing varying rates across different vaccines. Specifically, the coverage for measles vaccine was 72.2%, while BCG demonstrated a higher coverage at 87.4%. Further exploration revealed a coverage rate of 87.4% for BCG, contrasting with a lower rate of 73.0% for

OPV0. Notably, a combined 6th-week vaccine coverage of 88.3% (OPV1, PENTA1, and PCV1) was observed. However, coverage rates decreased at the 9th-month stage, with measles and yellow fever vaccines at 72.2% and 70.9%, respectively. Comparison with prior studies reveals a diverse landscape. Adelo Timeliness of BCG, PENTA1 and measles vaccines stratified according to wards ye et al. reported a national coverage of fully immunized children at 34.4%, with significant disparities across zones in Nigeria [24]. Gelaye et al. observed vaccination coverage of 67% in rural and 60% in urban areas, emphasizing differences between settings [25]. Darebo et al reported a national coverage of 47.0% fully vaccinated, 41.7% partially vaccinated, and 11.3% unvaccinated [26]. Mekonnen et al highlighted a more optimistic scenario with 75.6% fully vaccinated children [27], whereas a study in Abakaliki, Ebonyi State by Okoro et al, recorded a lower proportion of 41.6% [28]. Farrenkopf et al identified a 7.5% prevalence of zero-dose children across low to upper-middle-income countries, with prominent figures in African countries [29]. Disparities in these studies may arise from healthcare infrastructure, accessibility, socio-economic disparities, cultural beliefs, and methodological variations.

Timeliness of vaccination in the current study indicates a relatively higher prevalence at 71.5%. However, contrasting figures are evident in previous studies conducted in Ethiopia by Dejene *et al* [30], Dirirsa *et al* [31], and in Kampala by Kamya *et al.* [32], reporting lower rates of 33.7%, 23.9%, and 26.6% respectively. The discrepancy in timeliness rates across these studies might stem from several factors. Firstly, variations in healthcare infrastructure and accessibility could contribute significantly. Regions with well-established healthcare systems and better access to vaccination services may exhibit higher rates of timely vaccinations, as seen in the current study. Variances may stem from healthcare infrastructure, accessibility, and socio-economic factors. Higher prevalence in our study suggests strengthened healthcare systems and targeted interventions. Disparities underscore the complex interplay of healthcare infrastructure, socio-economic determinants, and policies. Improving healthcare access, increasing awareness, and targeted strategies could enhance timely vaccination rates, contributing to effective immunization programs and better public health outcomes.

Conclusion

The study unveils disparities in vaccination coverage and timeliness across wards in Calabar South LGA. Government interventions should be contextualized to address location-specific challenges, tailoring strategies for optimal impact.

Recommendations

1. Government:

   Tailored Interventions: Implement location-specific interventions considering variations in vaccination coverage and timeliness across different wards.

   Infrastructure Investment: Allocate resources to strengthen healthcare infrastructure, especially in areas with lower coverage, to enhance accessibility to vaccination services.

   Community Engagement: Foster community engagement programs to address specific challenges and promote awareness about the importance of timely vaccinations.

2. Communities:

   Collaborative Efforts: Collaborate with government initiatives by actively participating in vaccination awareness campaigns and programs.

   Local Advocacy: Advocate for improved healthcare facilities and accessibility within communities, emphasizing the significance of vaccination in overall public health.

Community Support Networks: Establish support networks to ensure that caregivers have access to information and resources related to vaccinations.

3. Healthcare Providers:

   Training and Education: Provide ongoing training for healthcare professionals to stay updated on vaccination protocols and communicate effectively with caregivers.

   Accessible Services: Ensure that vaccination services are easily accessible within communities, particularly in areas with lower coverage.

   Community Outreach: Engage in proactive community outreach to address concerns, dispel myths, and educate caregivers on the importance of timely vaccinations.

4. Caregivers:

   Education and Awareness: Stay informed about the importance of vaccinations and the recommended schedules for children's immunization.

   Regular Check-ups: Schedule regular health check-ups for children to monitor their vaccination status and ensure timely updates.

   Community Participation: Actively participate in community-based vaccination programs and support initiatives that enhance healthcare services within the community.

Conflict of Interest

The authors declares that there is no conflict of interest.

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