ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun020

Early Predictors of Developmental Delays in Low-Income Pediatric Populations: A Cross-Sectional Study from Urban Clinics in Nigeria

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Publication Date: 2025/06/12

Abstract: Developmental delays in early childhood can significantly impair long-term cognitive, behavioral, and social outcomes. In Nigeria, children from low-income urban communities face increased risk due to socioeconomic hardships, poor access to early health interventions, and limited routine developmental screening. This cross-sectional study investigated early predictors of developmental delays in children aged 6 months to 5 years attending public and faith-based primary healthcare clinics in low-income urban areas of Lagos, Kano, and Port Harcourt. Data were collected from 704 pediatric patients using caregiver interviews, health records, vaccination history, and adapted screening tools, including milestone checklists and the Ages and Stages Questionnaire (ASQ-3), where available. Findings revealed that 24% of children screened were at risk for developmental delays. Multivariate analysis identified key predictors: maternal education below secondary level (adjusted OR: 2.7, 95% CI: 1.8–4.0), frequent missed immunization appointments (OR: 2.1, 95% CI: 1.3–3.4), caregiver-reported developmental concerns before age two (OR: 3.0, 95% CI: 1.9–4.7), and poor nutritional status (based on weight-for-age and MUAC scores). The study underscores the urgent need for integrating simple, validated developmental screening tools into Nigeria's routine child health visits, and for strengthening maternal education and caregiver involvement in early child development surveillance in urban, low-resource settings.

Keywords: *Developmental Delays, Nigeria, Pediatric Screening, Low-Income Urban Communities, Early Childhood Development, Maternal Education, Immunization, Primary Healthcare, Child Health, Caregiver Concerns.*

How to Cite: Damilola Egbewole; Loretta Ekei Nsa; Chioma Udoamaka Okerulu; Ayobami Abiola Balogun; Abdulkadir Rasheedat; Adejare Sodiq Ayodeji (2025). Early Predictors of Developmental Delays in Low-Income Pediatric Populations: A Cross-Sectional Study from Urban Clinics in Nigeria. *International Journal of Innovative Science and Research Technology,* 10(6), 232-235. https://doi.org/10.38124/ijisrt/25jun020

I. INTRODUCTION

Early childhood is a critical window for cognitive, emotional, and physical development, laying the foundation for future health, education, and productivity. Developmental delays—defined as significant lags in achieving age-appropriate milestones—are common yet underrecognized in many low- and middle-income countries, including Nigeria (Adewumi et al., 2022; Anjorin & Odetola, 2023). While global estimates suggest that up to 250 million children under five may be at risk of not reaching their developmental potential, the burden is disproportionately higher in resource-limited settings where early detection and intervention services are limited or nonexistent.

In Nigeria, rapid urbanization has contributed to the expansion of low-income communities with inadequate access to healthcare, nutrition, education, and early stimulation (Ayede & Olumide, 2021). Despite the

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun020

integration of growth monitoring and immunization services within Nigeria's primary healthcare system, standardized developmental screening is rarely conducted. As a result, children with early signs of cognitive, speech, or motor delays are often missed until school entry or later, when interventions are less effective and more expensive.

Several socioeconomic and environmental risk factors have been linked to developmental delays, including maternal education, malnutrition, poor sanitation, caregiver mental health, and healthcare access (Aluko & Oluwatosin, 2022). However, there remains a significant gap in context-specific research to identify which early life indicators may serve as reliable predictors of developmental delays within Nigerian urban clinic settings. Understanding these predictors is vital to inform policy, integrate screening into routine child health services, and design targeted early interventions (Fagbamigbe & Idemudia, 2021).

This study aims to identify early predictors of developmental delays among children aged 6 months to 5 years from low-income households attending urban public and faith-based clinics in Lagos, Kano, and Port Harcourt. By examining clinical, demographic, and social determinants, this research seeks to generate actionable insights that can help strengthen Nigeria's child health surveillance framework and reduce long-term developmental inequalities.

➢ *Methods*

- *Study Design and Setting*

This was a cross-sectional, clinic-based study conducted between [January, 2024] and [March, 2025] across six urban primary healthcare centers located in three Nigerian cities: Lagos, Kano, and Port Harcourt. These centers were selected due to their high pediatric patient volumes and their service to predominantly low-income communities.

- *Study Population*

The study included children aged 6 months to 5 years who attended well-child or immunization clinics during the study period. Eligibility criteria included:

Residing in low-income urban areas as identified by local government classification, Availability of a consenting caregiver (typically the mother), No known diagnosis of congenital or neurodevelopmental disorders at enrollment. Children presenting with acute illness requiring emergency attention were excluded.

- *Sample Size and Sampling Technique*

Using an estimated developmental delay prevalence of 20% in urban low-resource settings, a 95% confidence level, and a 5% margin of error, a minimum sample size of 600 was calculated. A total of 704 eligible children were consecutively recruited using systematic random sampling from daily clinic attendance logs.

- *Data Collection Tools and Procedure*

Data were collected through: Structured caregiver interviews using a pre-tested questionnaire to obtain sociodemographic and health history information, Anthropometric measurements, including weight-for-age and mid-upper arm circumference (MUAC),

Developmental screening, conducted using the Ages and Stages Questionnaire, Third Edition (ASQ-3) adapted for local context. In settings where ASQ-3 was unavailable, milestone checklists based on national growth monitoring standards were used (Mekonnen et al., 2021)...

Caregivers were asked about any concerns regarding their child's development. Data collectors (trained nurses and research assistants) received two-day training on ethical data collection, anthropometry, and developmental screening protocols.

➢ *Variables*

- *Primary Outcome*:

Risk of developmental delay (based on ASQ-3 or red flags from milestone screening), Independent variables: Maternal education, child nutritional status, immunization completion, birth history, housing conditions, caregiver-reported developmental concerns.

- *Ethical Considerations*

Ethical approval was obtained from the Health Research Ethics Committee of Afe Babalola University Ado Ekiti, College of Medicine and Health Sciences). Verbal and written informed consent were obtained from all caregivers prior to participation. Confidentiality and data privacy were ensured.

- *Data Analysis*

Data were entered into Microsoft Excel and analyzed using SPSS version 25. Descriptive statistics summarized baseline characteristics. Chi-square tests and logistic regression were used to examine associations between risk factors and developmental delay. A p-value of <0.05 was considered statistically significant. Adjusted odds ratios (aOR) were calculated to identify independent predictors.

II. RESULTS

➢ *Sociodemographic Characteristics*

A total of 704 children aged 6 months to 5 years were enrolled in the study. The mean age of participants was 28.4 ± 12.6 months, with 52.1% (n = 367) being male. Most caregivers interviewed were mothers (89.3%) and 62.5% of them had not completed secondary education. 71.8% of the children lived in households with more than five people per room, indicating overcrowded living conditions.

➢ *Prevalence of Developmental Delay Risk:*

Out of the total sample, 24.1% (n = 170) of children screened were identified as at risk for developmental delays using the ASQ-3 or milestone red flags. Among these, motor delays accounted for 39%, followed by language and communication delays (34%), social-emotional delays (18%), and problem-solving skills (9%).

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Bivariate analysis showed significant associations between developmental delay and several variables: maternal education below secondary level ($p < 0.001$), incomplete immunization schedule ($p = 0.008$), caregiver-reported developmental concern before age 2 ($p < 0.001$), and moderate to severe malnutrition based on MUAC and weight-for-age Z-scores ($p = 0.002$).

Table 1 Multivariate Logistic Regression Identified Four Independent Predictors of Developmental Delay:

Predictor	Adjusted Odds Ratio (Aor)	95% Confidence Interval	P-Value
Maternal education < secondary level	2.74	1.84 – 4.08	<0.001
Missed ≥2 immunization visits	2.08	1.31 – 3.29	0.002
Caregiver concern before age 2	3.01	1.94 – 4.68	<0.001
MUAC < 12.5 cm (malnutrition)	1.89	1.20 – 2.98	0.006

III. DISCUSSION

This study reveals a significant prevalence of developmental delays among children aged 6 months to 5 years in urban low-income settings in Nigeria. The 24.1% prevalence rate aligns with findings from similar studies in sub-Saharan Africa, highlighting the widespread nature of this public health concern (Bello & Yusuf, 2022).

Maternal education emerged as a strong predictor of developmental delays. Children whose mothers had not completed secondary education were nearly three times more likely to experience developmental delays (Aluko & Oluwatosin, 2022; Ayede & Olumide, 2021). This finding corroborates previous research indicating that maternal literacy and education levels are critical determinants of child health outcomes, including developmental milestones (Fagbamigbe & Idemudia, 2021).

Incomplete immunization schedules were also significantly associated with developmental delays. Children who missed two or more immunization visits had over twice the risk of developmental delays compared to those with complete immunization (Anjorin & Odetola, 2023). This association underscores the importance of adherence to immunization schedules, not only for preventing infectious diseases but also for supporting overall child development.

Caregiver concerns reported before the child reached two years of age were strongly linked to developmental delays (Ibrahim & Salihu, 2022). This finding emphasizes the value of caregiver observations in early detection and the need for healthcare providers to take such concerns seriously during routine visits. Malnutrition, as indicated by MUAC measurements below 12.5 cm, was another significant predictor (Yusuf & Bello, 2022; Onwujekwe & Uzochukwu, 2021). Malnourished children had nearly twice the risk of developmental delays, highlighting the critical role of nutrition in early childhood development. This aligns with existing literature that identifies malnutrition as a key factor affecting cognitive and motor development in children (Bello & Yusuf, 2022; Ekhaguere et al., 2019). The study's findings underscore the need for integrated interventions that address maternal education, immunization adherence, caregiver engagement, and child nutrition to mitigate the risk of developmental delays in Nigerian urban low-income settings.

IV. CONCLUSION

Developmental delays are prevalent among children in urban low-income areas of Nigeria, with significant associations identified with maternal education, immunization adherence, caregiver concerns, and nutritional status. These findings highlight the need for comprehensive public health strategies that incorporate educational programs for mothers, strengthen immunization campaigns, encourage caregiver participation in child health monitoring, and address child nutrition. Implementing routine developmental screenings in primary healthcare settings could facilitate early identification and intervention, ultimately improving developmental outcomes for children in these communities.

➢ *Authors Contributions*

- Damilola Egbewole contributed to the study design, literature review, and data analysis, focusing on the socio-economic factors affecting child development in low-income settings.
- Loretta Ekei Nsa led the laboratory work and data collection, overseeing developmental screenings and ensuring the accuracy and reliability of the data gathered from the primary healthcare clinics.
- Chioma Udoamaka Okerulu contributed to the development of survey instruments and protocols, ensuring the inclusion of low-income communities, and played a key role in data analysis and interpretation.
- Ayobami Abiola Balogun provided insights into the role of maternal health factors in child development and contributed to the manuscript's writing and revision, particularly in the discussion and conclusion.
- Abdulkadir Rasheedat supported laboratory work and data collection, overseeing developmental screenings and ensuring the accuracy and reliability of the data gathered from the primary healthcare clinics.
- Adejare Sodiq Ayodeji rovided insights into the role of maternal health factors in child development.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jun020

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