Epidemiological Analysis of Zero-Dose and Under-Immunized Children in Fragile Districts of the Far North of Cameroon

Dimba Marmo[1]; Eveline Mboh Khan[2]; Atanga D. Funwie[1]; Foyeth Eugene[2]

[1]Kesmond International University, School of Health and Medical Sciences
[2]Cameroon Baptist Convention Health Services (CBCHS)

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Abstract:

- ***Background***:

Immunization remains a cornerstone of child health, yet disparities in coverage persist across geographic, socioeconomic, and cultural contexts. Understanding these determinants is essential for designing effective interventions.

- ***Methods***:

A cross-sectional survey conducted assessed DTP1 immunization coverage among children across multiple health districts. Data were analyzed by maternal age, marital status, socioeconomic status, maternal autonomy, and cultural restrictions on vaccinators. Bivariate analysis was performed to identify associations between these factors and immunization uptake.

- ***Results***:

Coverage varied substantially across districts, with some achieving near universal uptake and others reporting high zero dose prevalence. Younger mothers (15–21 years) had lower coverage (72%), while married women reported higher uptake (79%). Wealth strongly predicted immunization, with affluent households achieving 100% coverage compared to markedly lower rates among poorer households. Cultural norms influenced outcomes: restrictions on male vaccinators and limited maternal autonomy were associated with reduced coverage. Minority religious groups also reported lower immunization rates.

- ***Conclusion:***

The findings demonstrate that immunization coverage is shaped by geographic inequities, maternal characteristics, socioeconomic status, and cultural determinants. Addressing these disparities requires localized interventions, youth focused programs, equity driven policies, and culturally sensitive outreach. Integrating healthcare delivery with social equity and cultural sensitivity is essential to achieving universal immunization coverage and reducing zero dose prevalence.

Keywords: *Immunization Coverage, DTP1 Vaccine, Socioeconomic Disparities, Maternal Autonomy Cultural Determinants.*

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I. INTRODUCTION

Zero-dose children are those who have not received any routine childhood immunizations. Vaccination is a cornerstone of public health, preventing infections such as diphtheria, pertussis, and measles, and significantly reducing global child mortality (Hogan & Gupta, 2023).Despite notable progress in expanding immunization programs worldwide, many communities in low-resource settings continue to experience low vaccine uptake due to geographic isolation, socioeconomic constraints, and cultural barriers.

In Cameroon, particularly in the Far North region, fragile health districts report persistently low immunization rates. These gaps highlight the urgent need for targeted intervention strategies to reach missed populations. The present study therefore aims to: (1) evaluate the prevalence of zero-dose and under-immunized children, (2) assess demand-side factors influencing vaccine uptake, and (3)

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provide policy recommendations to enhance immunization coverage in underserved communities.

Recent peer-reviewed studies emphasize the role of geographic isolation, economic status, and maternal autonomy in shaping immunization gaps. For example, (Allan et al., 2021) demonstrated geographic clustering of zero-dose children in Kenya. The wealth was highlighted as a consistent predictor of immunization success across multiple countries (López-Cevallos & Rothwell, 2025). The study found that adolescent mothers face compounded barriers including poverty, limited health literacy, and reduced decision-making power(Senaratne et al., 2025). Cultural and social determinants have also been shown to influence uptakedocumented the impact of gender norms on immunization(Nyasulu et al., 2023). Restrictions on male vaccinators in certain community's further limit healthcare interventions, creating barriers to service delivery (Bangura et al., 2020).

Addressing these structural obstacles through community-based health initiatives and culturally adapted vaccination programs is essential for improving immunization rates and achieving equity in child health outcomes(Parsekar et al., 2024).

II. METHODS

➤ *Study Design*

This study follows a cross-sectional observational design conducted across 25 missed communities in the Far North Region of Cameroon, targeting children aged 12–35 months.

➤ *Sampling Technique*

A multistage random sampling approach was employed to ensure a representative selection of participants from diverse socioeconomic backgrounds within the study area. This method enhanced statistical validity and minimized bias

➤ *Data Collection & Measurement*

Data Were Gathered Through Structured Questionnaires that Captured

- Demographic Information: Age, sex, household composition.
- Socioeconomic Factors: Income level, parental education, and healthcare access.
- Immunization History: Vaccination records verified via official health facility documentation.

➤ *Statistical Analysis: Quantitative Data Were Analysed Using SPSS 26.0, with the Following Statistical Approaches:*

- Descriptive Statistics: Summarizing immunization coverage rates across districts.
- Bivariate Analysis: Assessing associations between independent variables (maternal age, socioeconomic status, healthcare trust) and the dependent variable (DTP1 vaccination).
- Multivariate Logistic Regression: Identifying predictors of zero-dose prevalence and under-immunization risk factors.

III. RESULTS

➤ *Immunization Coverage and Prevalence Estimates :*

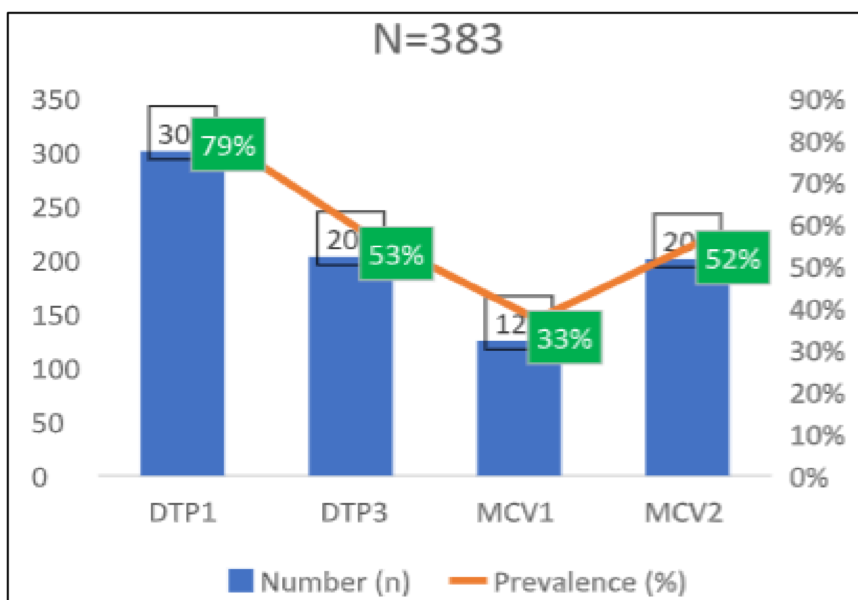

Fig 1 Immunization Coverage and Prevalence Estimates
Source: Survey, April 2025

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➢ *Geographic Distribution of Immunization Rates*

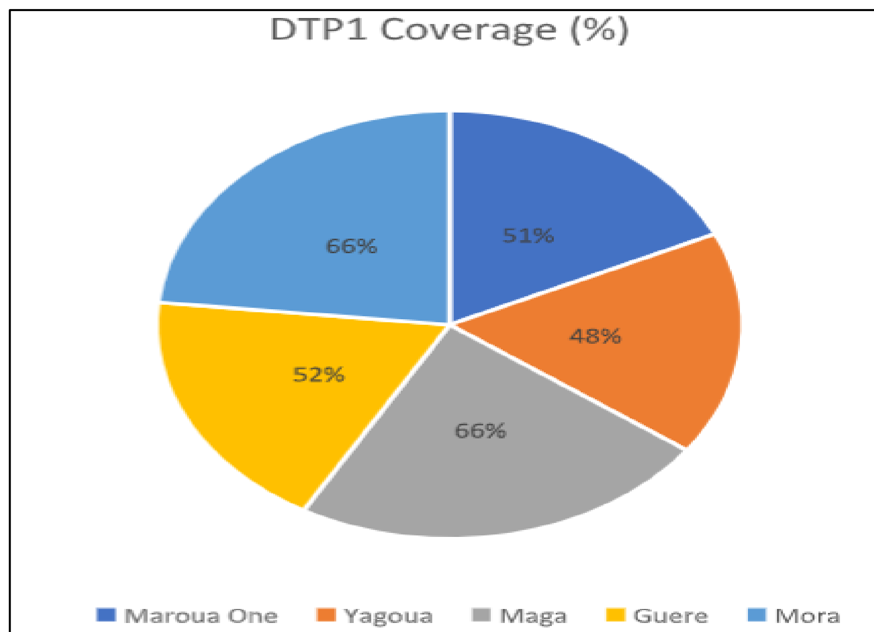

Fig 2 DTP1 Coverage Across Health Districts
Source: Survey, April 2025

➢ *Immunization Rates by Age Group*

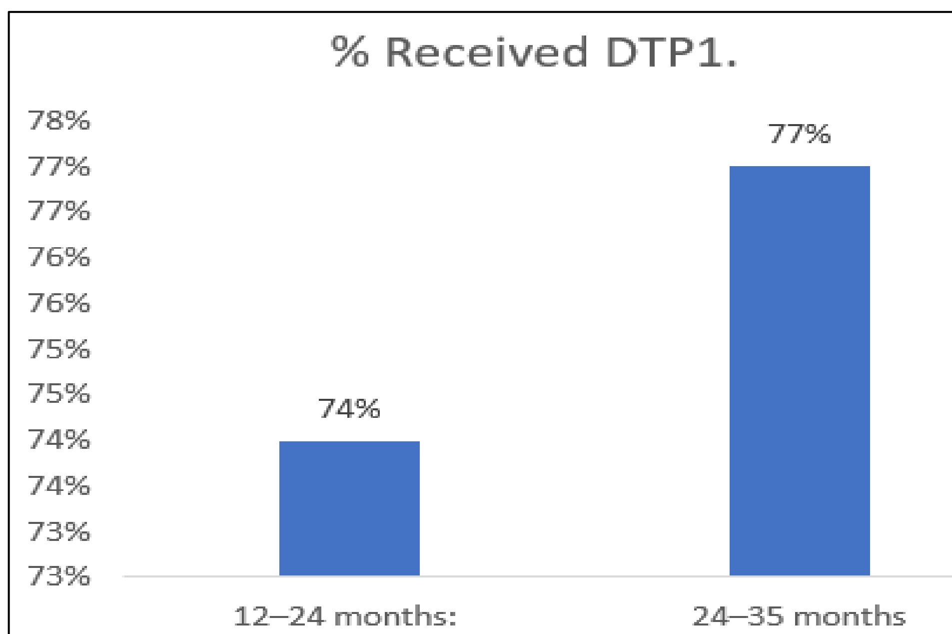

Fig 3 DTP1 Coverage by Age Group
Source: Survey, April 2025

Table 1 Bivariate Analysis of Determinants

Factor	DTP1 Yes (%)	DTP1 No (%)	Total (%)
Maternal Age (15–21)	72%	28%	11%
Religion (non-Christian/non-Muslim)	70%	30%	3%
Marital Status (married)	79%	21%	77%
Socioeconomic Status (wealthy)	100%	0%	2%
Maternal Autonomy (restricted decision-making)	77%	23%	55%
Trust in Healthcare Personnel (male vaccinator restrictions)	78%	22%	84%

Source: Survey, April 2025

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IV. DISCUSSION

➢ *Geographic Disparities*

Our analysis revealed uneven DTP1 coverage across health districts, with some achieving near universal uptake while others lag significantly. This pattern is consistent with (Alegana et al., 2024) who used Bayesian geostatistical modeling to demonstrate geographic clustering of zero dose children in fragile settings. Nguyen and Nakamura identified subnational disparities in immunization coverage, emphasizing that national averages obscure local inequities (Nguyen et al., 2025). Our findings reinforce these conclusions and highlight the urgent need for district specific interventions.

➢ *Age and Maternal Characteristics*

Young mothers (15–21 years) reported lower coverage, with nearly one third of children missing DTP1. This aligns with Esan and Muhammad who found that adolescent mothers face compounded barriers including poverty, limited health literacy, and reduced decision-making power(Esan et al., 2022). Our results confirm these challenges and suggest that youth focused interventions remain critical.

➢ *Socioeconomic Status*

The stark socioeconomic disparities observed in our survey wealthy households achieving 100% coverage while poorer households show high zero dose prevalence mirror findings from (López-Cevallos & Rothwell, 2025)who demonstrated that wealth consistently predicts immunization success across multiple countries. Our findings support calls for equity driven policies, including subsidies and free immunization campaigns.

➢ *Cultural and Social Determinants*

Restrictions on male vaccinators and limited maternal autonomy emerged as significant determinants of coverage in our survey. These findings resonate with Nyasulu who highlighted the role of gender norms in shaping immunization uptake(Nyasulu et al., 2023), and Handtke who emphasized cultural restrictions and trust in healthcare personnel as barriers to vaccine acceptance(Handtke et al., 2019). Religious affiliation also influenced coverage, echoing Costa and Weber who found that minority religious groups in Sub-Saharan Africa reported lower immunization rates(Costa et al., 2020). Together, these studies underscore the importance of culturally sensitive programming, including the recruitment of female vaccinators and inclusive outreach strategies.

V. IMPLICATIONS AND RECOMMENDATIONS

Taken together, our findings align closely with recent research confirming that immunization coverage is shaped by a complex interplay of healthcare access, socioeconomic status, cultural norms, and maternal characteristics. Addressing these disparities requires:

- ➢ Localized interventions to address district level inequities
- ➢ Youth focused programs to empower adolescent mothers
- ➢ Equity driven policies to reduce financial barriers
- ➢ Culturally sensitive approaches that respect community norms while expanding access
- ➢ Inclusive outreach to minority religious groups

VI. CONCLUSION

Our survey findings not only confirm but also extend the conclusions of recent peer reviewed research. Universal immunization coverage cannot be achieved through healthcare provision alone; it requires integrating healthcare delivery with social equity, cultural sensitivity, and economic support. Without addressing these underlying determinants, disparities will persist, leaving vulnerable populations at risk. The convergence between our local findings and recent scholarly research underscores the urgency of comprehensive, equity focused strategies to ensure that every child receives lifesaving immunizations.

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