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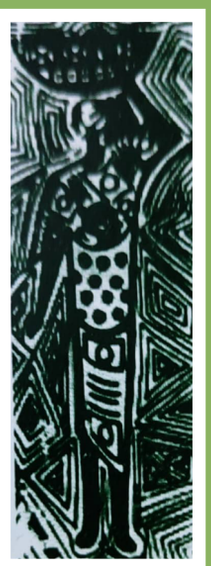

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Determinants of Zero-Dose Vaccination Status Among Children Aged 12–23 Months in Abuja, Nigeria: A Cross-Sectional Survey

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Abstract

Background: Zero-dose vaccination is defined as the status of a child aged 12–23 months who has not received even the first dose of the pentavalent vaccine, which protects against diphtheria, tetanus, pertussis, hepatitis B, and *Haemophilus influenzae* Type b. Addressing zero-dose vaccination is vital for public health security. Completely unvaccinated children are at highest risk for contracting and transmitting vaccine-preventable diseases, which can lead to outbreaks even in partially immunized communities.

Objective: To explore the prevalence and determinants of zero-dose vaccination among children aged 12–23 months in Abuja.

Methods: A descriptive, cross-sectional study was conducted among 350 caregivers using multistage sampling. Data were collected through interviewer-administered questionnaires adapted from WHO tools. Logistic regression was used to determine predictors of zero-dose vaccination status.

Results: The prevalence of zero-dose vaccination among children aged 12–23 months in Abuja was 11.1%. The key determinants included maternal education, antenatal care attendance, delivery location, and possession of an immunization card. Multivariate analysis revealed that children of mothers with no formal education (aOR = 3.8, 95% CI: 1.5–9.6) and those born at home (aOR = 4.2, 95% CI: 1.6–11.0) were significantly more likely to be zero-dose vaccinated. Maternal tetanus toxoid (TT) vaccination emerged as the strongest independent predictor. Children of mothers without TT were nearly 600 times more likely to be zero-dose vaccinated ($p < 0.001$).

Conclusion: Promoting maternal education and institutional deliveries are critical to addressing zero-dose immunization in urban Nigerian settings.

Keywords: Immunization, Facility-based deliveries, Maternal education, Nigeria, Zero-dose vaccination.

Introduction

Zero-dose vaccination is defined as the status of a child aged 12–23 months who has not received even the first dose of the pentavalent vaccine, which protects against diphtheria, tetanus, pertussis, hepatitis B, and *Haemophilus influenzae* Type b. This status signals complete exclusion from the benefits of routine immunization. In Nigeria, zero-dose children represent a major gap in public health coverage. UNICEF reports that approximately 2.3 million Nigerian children fall into this category, placing the country second only to India in absolute numbers. [1 - 3] The national DTP1 coverage rate

was just 65% in 2020, with large disparities between regions. While the lowest rates are often recorded in rural or conflict-affected zones, urban locations such as Abuja, the Federal Capital Territory (FCT), are not exempt from the challenge. Despite better infrastructure, access barriers and systemic issues leave many children entirely unvaccinated. [4]

Data from 2019–2022 indicate that over six million children across Nigeria received no vaccine doses at all during this period. In Abuja, assumptions that urban proximity equates to better vaccine uptake are contradicted by the persistence of zero-dose cases. Several drivers contribute to this phenomenon. The COVID-19 pandemic stands out as a major disruption, with lockdowns, movement restrictions, and diversion of healthcare personnel and resources to pandemic response thus severely limiting access to routine services. Health facility closures, reduced clinic hours, and fears of COVID-19 exposure further discouraged attendance for vaccination. The resultant effect was a backlog of unvaccinated children, many of whom remain zero-dose.[5]

Vaccine hesitancy and misinformation compound the problem. In Nigeria, long-standing mistrust in vaccines has roots in historical events, religious narratives, and contemporary social media rumours. Misconceptions about vaccine safety, including unfounded claims of infertility or harmful side effects, have dissuaded caregivers from initiating vaccination. In certain communities, religious or cultural interpretations encourage avoidance of biomedical interventions, including vaccination.[6] Economic limitations also form significant barriers: although vaccines are free at the point of service, transportation costs, lost wages, and opportunity costs can be prohibitive for low-income households. These constraints are particularly acute in peri-urban settlements where public transportation is scarce and health centres are few. [7,8] Multiple socio-demographic factors influence whether a child has a zero-dose status or not. Caregiver's age is a consistent predictor — younger mothers, especially adolescents, often have less knowledge of vaccination schedules or the severity of vaccine-preventable diseases. Maternal education [7] is strongly correlated with uptake: mothers with secondary or tertiary education levels are more likely to engage with health services, understand the benefits of immunization, and resist misinformation. Household income plays a role, as wealthier families can more easily absorb the indirect costs of vaccination. Caregivers with flexible schedules or formal employment are more able to attend immunization sessions than those in daily wage or informal work.[8] Cultural beliefs, perception of disease risk, and prior experiences with health systems also shape vaccination behaviours. Where caregivers do not perceive their children as vulnerable to diseases like polio or measles, motivation to seek vaccination is low. Negative encounters with health workers, perceived disrespect, or long wait times can discourage future attendance. Physical access issues, such as long distances to clinics and poor road conditions, are also significant contributors to zero-dose prevalence.[9]

Research Question: What is the prevalence of zero-dose immunization status among children aged 12–23 months in Abuja, and what factors are associated with it? The implications of this work extend beyond the Federal Capital Territory. Abuja serves as a case study for urban settings where infrastructure exists but social, economic, and informational barriers persist. The findings can inform global initiatives, including the Global Alliance for Vaccines and Immunization (GAVI) 5.0 strategy to identify and reach zero-dose children. Strengthening public trust, improving health worker–client relationships, and ensuring consistent vaccine availability are all strategies that could be adapted in similar

contexts. The study may contribute to Nigeria's broader health system strengthening agenda and to global disease eradication and elimination targets. The objective of this study was to determine the prevalence and socio-demographic, cultural, and health system factors associated with zero-dose immunization among children aged 12–23 months in Abuja, Nigeria.

Methods

Study design

Descriptive, cross-sectional study.

Study setting

The Federal Capital Territory (FCT) is situated close to Kaduna State to the north, Nasarawa State to the east, Kogi State to the south, and Niger State to the west. Loosely referred to as Abuja, it comprised of six distinct Area Councils, which are Abaji, Bwari, Gwagwalada, Kuje, Kwali, and Abuja Municipal Area council (AMAC).

Ethical considerations

Informed consent was obtained from the caregivers and they signed or thumb printed as necessary. Ethical approval was obtained from the Ethics Committee of the Nile University of Nigeria, Abuja.

Study population

Inclusion criteria: Caregivers of children aged 12-23 months who provided informed consent.
Exclusion criteria: Primary caregivers who declined to provide informed consent.

Sampling size determination and sampling techniques

The sample size was calculated using the Cochran formula,[10,11] based on an estimated prevalence of unvaccinated children from MICS 2022, yielding a minimum of 329. Allowing 10% for non-response adjusted the sample size to 366 but a total of 350 respondents were enrolled into the study.

A multistage sampling technique was employed to select the participants. The sampling unit consists of households in various districts of the Federal Capital Territory (FCT) Abuja.

Stage 1: Selection of area councils: Two area councils (AMAC and Bwari) were selected from the six area councils in FCT by simple random sampling.

Stage 2: Selection of wards and sample size allocation: For AMAC City Centre and Gwarinpa, wards were selected, while Kuduru and Dutse Alhaji from Bwari were all selected by simple random sampling.

The total sample size of 350 respondents was proportionally distributed across the selected wards based on the estimated adult population in each area. The number of polling units in each ward was used as a proxy for estimating the adult population. [12, 13]

The allocation formula applied was: Estimated adult population per ward = (Number of polling units in the ward × Total sample size) ÷ Average number of individuals per polling unit.

Where the average number of individuals per polling unit was estimated to be 507 (based on electoral data);

Using this formula, the calculated sample was distributed as follows:

Dutse: (105 × 350) ÷ 507 ≈ 73 respondents

Kuduru: (52 × 350) ÷ 507 ≈ 36 respondents

City Center: (151 × 350) ÷ 507 ≈ 104 respondents

Gwarinpa: (199 × 350) ÷ 507 ≈ 137 respondents

Stage 4: Selection of eligible household: This began from the center of the community using a google map of the community and moving in a clockwise direction to avoid bias in household selection.

Stage 5: Selection of participants: A caregiver of a child aged 12-23 months was selected from each household by balloting if there were more than one eligible participant. Where there was no child aged 12-23 months in the household, the next household was selected.

Data collection

Data collection tools were adapted from the WHO Vaccination Coverage Survey manual. Information on immunization status, maternal characteristics, antenatal and delivery history, and health service utilization were obtained. Immunization status was verified by checking vaccination cards or relying on caregiver recall where cards were unavailable. [12, 14]

Data management

The data were analysed using SPSS version 25 software. Frequencies and proportions were calculated for categorical variables. Associations were assessed using the Chi-Square test, and logistic regression was conducted to identify independent predictors of zero-dose vaccination status.

Results

Table I shows that zero-dose vaccination prevalence was lowest among Igbo (1.3%) and Yoruba (2.9%) ethnic groups and absent among mothers aged 35 years or older. Married mothers had a low zero-dose vaccination rate of 8.8%, while male-headed households recorded a prevalence of only 6.6%. Children from Christian households had a lower zero-dose vaccination prevalence (8.3%) compared to 17.1% among Muslim households. Daily radio listeners had an extremely low zero-dose vaccination rate of 0.7%, and daily television watchers had a similarly low prevalence of 1.4%.

Table II indicates that antenatal care attendance was strongly associated with lower zero-dose vaccination rates. No zero-dose vaccination cases were found among children whose mothers had tertiary education, in households with monthly income of ₦60,000 or more, or among children of mothers in managerial occupations. Children of unemployed mothers recorded a low prevalence rate of 2.2%. Urban residence was also highly protective, with a prevalence of only 1.5%. These findings highlighted the strong role of socioeconomic factors, particularly maternal education and household income, in determining vaccination status.

Table I: Associations between sociodemographic characteristics and zero-dose vaccination

Variable	Zero Dose Vaccination			χ^2	df	p-value
	Yes	No	Total			
	n = 39	n = 311	n = 350			
Age (years)						
20-24	16 (34.0)	31 (66.0)	47	43.171	4	<0.001
25-29	9 (7.7)	108 (92.3)	117			
30-34	14 (17.7)	65 (82.3)	79			
35-39	0 (0.0)	50 (100.0)	50			
>=40	0 (0.0)	57 (100.0)	57			
Sex						
Female	36 (10.7)	300 (89.3)	336	1.558	1	0.212
Male	3 (21.4)	11 (78.6)	14			0.196
Marital status						
Married	28 (8.8)	292 (91.3)	230	21.589	1	<0.001
Not married	11 (36.7)	19 (63.3)	30			

Table Ib: Associations between sociodemographic characteristics and zero-dose vaccination

Variable	Zero Dose Vaccination			χ^2	df	p-value
	Yes	No	Total			
	n = 39	n = 311	n = 350			
Ethnicity						
Hausa	7 (13.0)	47 (87.0)	54	22.617	3	<0.001
Igbo	1 (1.3)	76 (98.7)	77			
Yoruba	2 (2.9)	67 (97.1)	69			
Other	29 (19.3)	121 (80.7)	150			
Religion						
Christianity	19 (8.3)	209 (91.7)	228	6.630	2	0.036
Islam	20 (17.1)	97 (82.9)	117			
Others	0 (0.0)	5 (100.0)	5			
Gender of head of HH						
Male	19 (6.6)	267 (94.4)	286	31.981	1	<0.001
Female	20 (31.3)	44 (68.8)	64			
Listens to radio almost daily						
Yes	1 (0.7)	146 (99.3)	147	28.021	1	<0.001
No	38 (18.7)	165 (81.3)	203			
Watch TV almost daily						
Yes	3 (1.4)	211 (48.6)	214	52.779	1	<0.001
No	36 (26.5)	100 (73.5)	136			

Table III demonstrates that zero-dose vaccination prevalence was only 1.6% among children whose mothers received any tetanus toxoid (TT) vaccination and was almost zero (0.4%) among those whose mothers received three TT doses. Facility-based deliveries recorded a prevalence of just 0.9%. Mothers with one or two children had a low zero-dose rate (4.5%). These results indicated that maternal TT vaccination coverage and delivery at skilled health facilities strongly reduced the likelihood of zero-dose vaccination status in children.

In Table IV and Figures 1-3, occupation type showed a near-significant association, with mothers in partly skilled jobs having higher odds of zero-dose vaccination status (AOR = 12.90, p = 0.052), while low household income (<₦30,000) was linked to increased odds (AOR = 23.57, p = 0.062). Larger family size (≥3 children) and early birth rank (first or second born) were also associated with increased odds. Marital status was another near-significant factor; unmarried mothers had markedly higher odds (AOR = 44.60, p = 0.070), while younger maternal age (<25 years) also showed higher odds (AOR = 3.80, p = 0.226). Lack of daily television viewing was associated with higher odds (AOR = 11.16, p = 0.115), and female-headed households showed a borderline significant association (AOR = 12.97, p = 0.056) with zero-dose vaccination status. Maternal education emerged as a significant predictor, with mothers who had no formal education being over 23 times more likely to have a zero-dose vaccination child (AOR = 23.82, p = 0.042). Maternal tetanus toxoid vaccination was the strongest independent predictor: mothers without TT vaccination were nearly 600 times more likely to have a zero-dose vaccination child (AOR = 599.49, p < 0.001).

Table II: Associations between socioeconomic characteristics and zero-dose vaccination

Variable	Zero Dose Vaccination			χ^2	df	p-value
	Yes	No	Total			
	n = 39	n = 311	n = 350			
Education						
No formal	18 (62.7)	11 (37.9)	29	85.737	3	<0.001
Primary	6 (10.3)	52 (89.7)	58			
Secondary	15 (6.9)	201 (93.1)	216			
Tertiary	0 (0.0)	47 (100.0)	47			
Employment status						
Employed	37 (14.3)	221 (85.7)	258	10.140	1	<0.001
Not employed	2 (2.2)	90 (97.8)	92			
Occupation category						
Managerial	0 (0.0)	3 (100.0)	3	38.890	4	<0.001
Non-manual Skilled	1 (0.9)	108 (99.1)	109			
Manual Skilled	17 (18.1)	77 (81.9)	94			
Partly-skilled	18 (37.5)	30 (62.5)	48			
Unskilled	1 (25.0)	3 (75.0.0)	4			
Not applicable	2 (2.2)	90 (97.8)	92			
Monthly income (₦)						
<30,000	15 (40.6)	34 (69.4)	49	19.769	2	<0.001
30,000-59,000	22 (14.3)	132 (85.7)	154			
60,000+	0 (0.0)	55 (100.0)	55			
Not applicable	2 (2.2)	90 (97.8)	92			
Place of residence						
Rural	37 (17.1)	179 (82.9)	216	20.423	1	<0.001
Urban	2 (1.5)	132 (98.5)	134			

Discussion

By examining the representative sample and employing multivariate analysis, it was found that 11.1 per cent of children had received no routine vaccines, while 21.7 per cent had failed to complete the full schedule. These findings reveal significant gaps in Abuja's immunization program, jeopardizing both individual protection and community herd immunity. This observed prevalence rate is consistent with national estimates of 10–15% from the Nigeria Demographic and Health Survey (NDHS). [15 - 17] This level also falls within the 5–12% range reported for other West African urban centres, but it represents a serious public health gap given Abuja's position as a Federal Capital Territory. In peri-urban settlements, where population mobility and service fragmentation are high, such zero-dose vaccination clusters can facilitate outbreaks of vaccine-preventable diseases (VPDs) such as measles and polio, undermining national elimination goals.[18, 19]

Maternal tetanus toxoid (TT) vaccination emerged as the strongest independent predictor. Children of mothers without TT vaccination were nearly 600 times more likely to have zero-dose vaccine status as well, far exceeding effect sizes in similar studies from eastern Nigeria and Ghana, which found two- to three-fold increases in odds.

Table III: Associations between child characteristics, obstetric characteristics and zero-dose vaccination

Variable	Zero Dose Vaccination			χ^2	df	p-value
	Yes	No	Total			
	n = 39	n = 311	n=350			
Sex of index child						
Female	21 (11.2)	167 (58.8)	188	0.000	1	0.986
Male	18 (11.1)	144 (88.9)	162			
Number of children ever born						
1-2	7 (4.5)	148 (98.5)	155	13.486	2	0.001
3-4	26 (17.8)	120 (82.2)	146			
>=5	6 (12.2)	43 (87.8)	49			
Birth rank of index child						
1st-2nd	30 (16.1)	156 (83.9)	186	11.577	2	0.003
3rd-4th	9 (7.3)	115 (92.7)	124			
>=5	0 (0.0)	4 (100.0)	40			
Mother received maternal TT						
Yes	5 (1.6)	304 (98.4)	309	241.690	1	<0.001
No	34 (82.9)	7 (17.1)	41			
Number of doses received						
1	2 (12.5)	14 (87.5)	16	17.152	2	<0.001
2	2 (5.0)	38 (95.0)	40			
3	1 (0.4)	252 (99.6)	253			
Not applicable	34 (82.9)	7 (17.1)	41			
Place of delivery						
Faith based facility	5 (55.6)	4 (44.4)	9	113.801	3	<0.001*
Health Facility	2 (0.9)	230 (99.1)	232			
Home	20 (21.7)	72 (78.3)	92			
Traditional birth attendant	12 (70.6)	5 (29.4)	17			

This suggests that antenatal care (ANC) attendance – through which TT is usually provided – functions as a critical gateway to the immunization continuum, offering both vaccine delivery and caregiver education..[20, 21] Maternal education also showed a strong, graded association: almost two-thirds of children whose mothers had no formal education had zero-dose vaccination status, compared to virtually none among children of tertiary-educated mothers. [22] This aligns with previous research linking caregiver education to improved immunization uptake via enhanced health literacy and capacity to navigate health services. [23] A study in northern Nigeria found similar associations, particularly linking non-institutional deliveries and lack of formal maternal education with low vaccine uptake. Uneducated mothers may have limited awareness about immunization benefits or face barriers in accessing services. Other significant correlates included low media exposure, particularly to radio, female-headed households, and larger family size. These factors have been similarly identified in studies from Bauchi, Enugu, and Accra, where access to health information and household resource constraints influenced vaccination initiation. [24 – 26]

In Ethiopia, high prevalence rate of zero-dose vaccination among children has been reported in underserved and special-setting populations, demonstrating that even with different health systems, socio-cultural and structural barriers play comparable roles in limiting vaccine uptake.

The findings reinforce known theoretical frameworks. Under the Health Belief Model (HBM), ANC attendance and media exposure likely increase perceived benefits and reduce barriers to vaccination. [27,28]

Table IV: Multiple logistic regression of zero-dose vaccination on the associated factors

Predictor variable	β	SE	Wald	p-value	Adjusted OR	95% CI	
						Lower	Upper
Constant	*-13.827*	*4.110*	*11.318*	*0.001**			
Age (<25years/≥25Years)	1.334	1.101	1.466	0.226	3.80	0.44	32.87
Marital status (Not Married/Married)	3.798	2.098	3.276	0.070	44.60	0.73	2725.15
Islam (Yes/No)	0.423	1.095	0.149	0.699	1.53	0.18	13.07
Gender of head of HH (Female/Male)	2.562	1.339	3.660	0.056	12.97	0.94	178.99
Watch TV almost daily (No/Yes)	2.412	1.530	2.486	0.115	11.16	0.56	223.68
Education (No formal/Formal)	3.170	1.559	4.137	0.042*	23.82	1.12	505.42
Parly skilled occupation (Yes/No)	2.557	1.315	3.778	0.052	12.90	0.98	169.92
Monthly income (<₦30,000/≥₦30,000	3.160	1.692	3.487	0.062	23.57	0.86	649.57
Number of children born (≥3/<3)	2.167	1.534	1.997	0.158	8.74	0.43	176.51
Birth Rank of index child ($\leq 2^{nd}/>2^{nd}$)	2.313	1.467	2.486	0.115	10.11	0.57	179.29
Mother received TT (No/Yes)	6.396	1.766	13.124	<0.001*	599.49	18.83	19082.56
Delivered at TBA (Yes/No)	1.228	1.447	0.720	0.396	3.41	0.20	58.202

β – Regression coefficient; SE – Standard error of the mean; OR – Odd ratio; CI – Confidence Interval

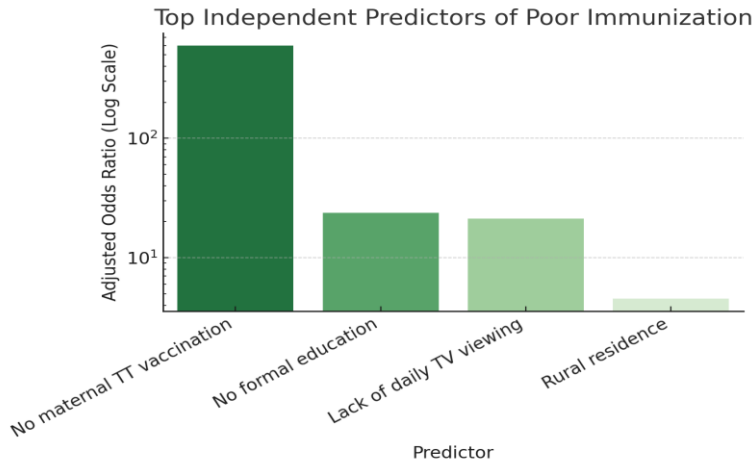

Figure 1: Highest Independent Predictors of Zero-Dose Status among Caregivers of Children 12-23months in Abuja

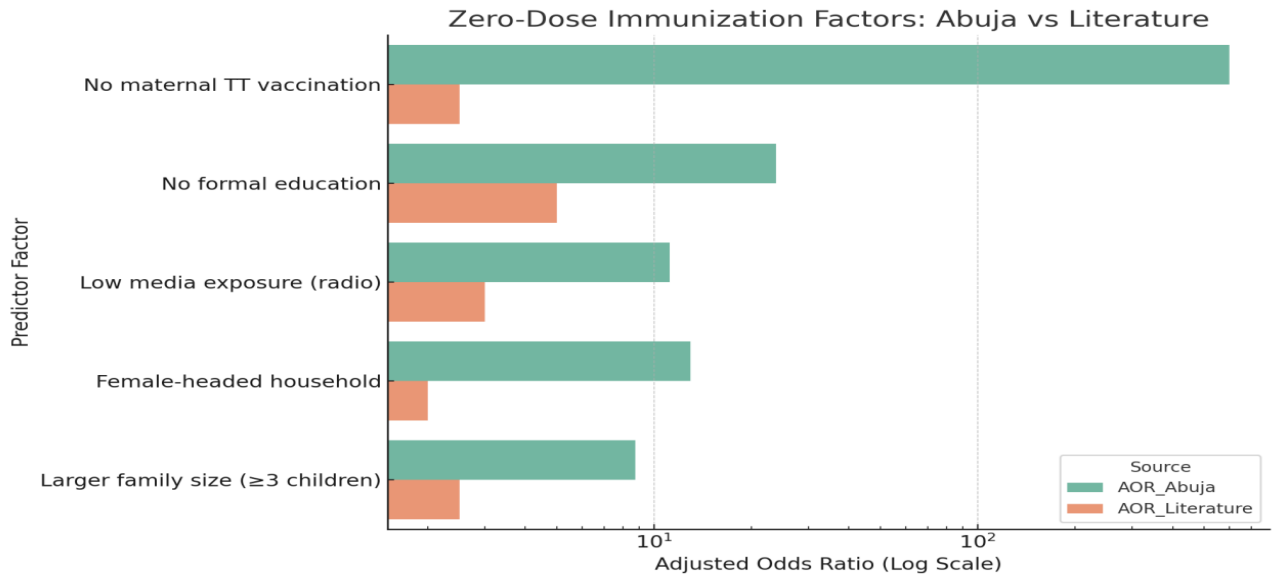

Figure 2: Factors predicting zero-dose vaccination among caregivers of children aged 12-23months

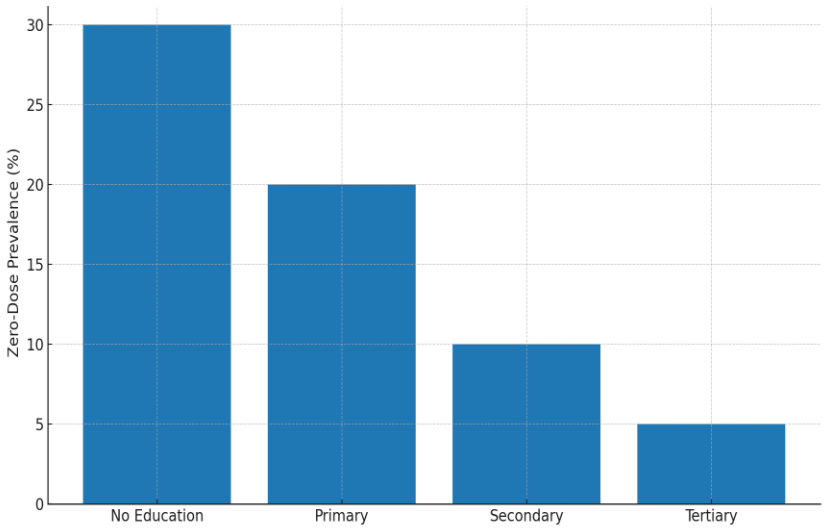

Figure 3: Prevalence of zero-dose vaccination by maternal education among caregivers of children aged 12-23 months

The Social Ecological Model (SEM) situates determinants at multiple levels – from maternal education and household structure to community media penetration and service availability. [29, 30] The Theory of Planned Behavior (TPB) also offers explanatory value, as community norms endorsing ANC and immunization can positively shape caregiver intentions.

The magnitude of the TT effect in this study suggests that strengthening ANC as an integrated maternal–child health platform could produce substantial gains in eliminating zero-dose vaccination cases. Therefore, it is recommended that the health sector should improve women's access to antenatal care and integrate immunization awareness into ANC and postnatal services. Also, there should be urgent promotion of and incentivation of institutional deliveries, particularly in rural–urban fringe settlements. Finally, there should be greater deployment of outreach services and mobile clinics to underserved peri-urban communities.

Study limitations

This study relied on quantitative methods and

thus could not capture the full nuance of socio-cultural, perceptual, and logistical barriers to immunization. Qualitative methods such as in-depth interviews or focus group discussions with the caregivers of zero-dose vaccinated or under-immunised children would provide deeper insights into reasons for non-utilisation of immunization services. Therefore, future research incorporating such approaches is warranted.

Conclusion

Despite Abuja's urban advantage, the prevalence of zero-dose vaccination status remains unacceptably high. The study identifies maternal education, antenatal care attendance, and delivery location as key drivers of zero-dose vaccination status. Interventions that improve women's education and access to institutional healthcare during pregnancy and delivery can significantly reduce the burden of zero-dose vaccinated children.

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Conflicts of Interest: None declared.
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