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Acceptance Without Adherence: Health System Bottlenecks and Residual Vaccine Hesitancy in Maternal and Child Healthcare Utilisation in Kwara State, Nigeria

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Abstract *Caregiver acceptance of routine immunisation in Kwara State, Nigeria, is generally high, yet persistent missed doses and incomplete continuity of maternal–child care signal significant coverage bottlenecks. This study examined utilisation patterns, knowledge, attitudes, and residual hesitancy among 1,173 caregivers of children aged 0–23 months across six Local Government Areas to identify independent predictors of zero-dose status, missed immunisation visits, and suboptimal antenatal care attendance. Data were analysed using SPSS v28. While ANC attendance reached 87.4% and facility delivery 80.4%, only 47.3% of ANC attendees completed at least four visits, and 13.9% reached the eight-contact standard. Despite high vaccine safety perceptions (96.6%), 9.7% of children were zero-dose for Penta-1, and 9.1% of caregivers reported missed immunisation visits. In adjusted models, the strongest protective factor against zero-dose status was receiving immunisation reminders, underscoring the critical role of systematic patient tracking in overcoming service-side barriers. Community rumours discouraging immunisation significantly increased the odds of zero-dose status and missed visits, while urban/peri-urban residence was strongly protective against missed visits. These findings demonstrate that in Kwara State, acceptance is not the binding constraint. Closing the immunisation gap requires reliable system performance, structured reminders, and risk communication that actively engages residual safety concerns through trusted interpersonal channels.*

Keywords *Continuity of Care, Routine Immunisation, Vaccine Hesitancy, Zero-Dose Children.*

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Introduction

Vaccination remains one of the most cost-effective public health interventions for reducing childhood morbidity and mortality. Modelling of the first fifty years of the Expanded Programme on Immunization (EPI) credits vaccines with averting an estimated 154 million deaths globally [1]. Yet significant disparities in coverage persist, with millions of children remaining under-immunised or unvaccinated. The "zero-dose" child - one who has received no dose of routine vaccines, operationalised through the absence of the first dose of diphtheria–tetanus–pertussis-containing vaccine (DTP1 or Penta-1) - has become the principal marker of immunisation inequity [2]. The drivers are not random; they reflect overlapping socio-economic, geographic, political, and behavioural disadvantages, both between and within countries [3].

In response, the global immunisation agenda has shifted toward more equity-oriented approaches. The Immunization Agenda 2030 (IA2030) prioritises underserved populations through tailored strategies, sharper monitoring, and stronger community engagement [4]. Achieving these goals in low- and middle-income countries (LMICs) remains constrained by health-system limitations that hinder equitable access. Geographic barriers - distance to facilities, weak transport networks, difficult terrain - particularly affect remote and marginalised communities [5]. These structural barriers interact with socio-behavioural factors such as low caregiver literacy, misinformation, cultural practices, and social support to produce uneven immunisation outcomes [6].

The burden of zero-dose and under-immunised children remains disproportionately high in sub-Saharan Africa, reflecting disparities in health systems and resource allocation [6]. Progress has been documented in some countries, but spatial inequalities persist in rural, peri-urban, and conflict-affected settings. The COVID-19 pandemic compounded these challenges, disrupting routine services, depressing facility attendance, and increasing the number of zero-dose children across the region [7].

Nigeria carries a disproportionate share of the global zero-dose burden [7]. Despite long-standing national EPI investment, coverage remains highly inequitable, with marked inter- and intra-state variation [7, 8]. National averages mask local realities that only emerge through subnational analysis [8]. Children in rural, riverine, border, and nomadic communities are especially likely to be unvaccinated owing to geodemographic and socio-economic vulnerability.

These disparities are amplified by service-delivery gaps - inadequate infrastructure and human resources, unstable vaccine supply, weak microplanning, and fragmented monitoring [9, 10]. Stock-outs, long waiting times, and irregular outreach deter caregivers from returning for subsequent doses, producing drop-outs and incomplete coverage [11]. Cold-chain and financing bottlenecks further hinder equitable distribution, particularly in low-resource settings [12].

Behavioural determinants also matter. Caregiver trust in health systems, sources of information, sociocultural norms, and gender dynamics all shape health-seeking decisions [2, 11, 13]. Reliance on informal sources of information - community leaders, religious leaders, traditional practitioners - can either reinforce or undermine uptake [14]. Vaccine confidence is frequently eroded by concerns about side effects, rumours, and inconsistent service communication [15].

The COVID-19 pandemic exposed further vulnerabilities in service delivery [16]. Facility closures, staff redeployment, and supply-chain disruption disproportionately affected hard-to-reach populations [17], underscoring the need for resilient health systems capable of sustaining essential services during crises [18].

Gender and socio-cultural factors exacerbate these challenges. Limited maternal agency,

restricted mobility, and competing domestic responsibilities often delay or prevent timely care [19]. Children with disabilities face additional barriers owing to inadequate service adaptation, stigma, and communication gaps, contributing to their over-representation among zero-dose children [20].

In Nigeria, and in mixed urban–rural settings such as Kwara State, a critical evidence gap remains on the interplay between system-side and caregiver-side factors in shaping the continuity of maternal and child healthcare. Available evidence suggests that continuity of care - attaining the recommended number of antenatal visits and adhering to the immunisation schedule - is often suboptimal [21, 22]. Residual vaccine hesitancy, driven by safety concerns and community-level rumours, persists alongside generally favourable caregiver attitudes [15].

This study moves beyond descriptive coverage estimates to identify caregiver- and community-level predictors of three outcomes: zero-dose status for Penta-1, missed immunisation visits in the previous six months, and at-least-four ANC visits (ANC4+). By doing so, it responds to IA2030's call for evidence-based, context-specific action on system and behavioural drivers [4]. The specific objectives were to:

1. Describe maternal and child healthcare utilisation among caregivers of children aged 0–23 months in Kwara State;
2. Assess caregiver knowledge, attitudes, and sources of information regarding routine immunisation; and
3. Identify caregiver- and community-level predictors of zero-dose status, missed immunisation visits, and ANC4+ attainment.

Materials and Methods

Study Setting

The study was conducted in Kwara State, located in the North-Central geopolitical zone of Nigeria, with Ilorin as its capital. The state comprises 16 Local Government Areas (LGAs) and presents a mixed settlement profile: densely populated urban and peri-urban centres around Ilorin alongside extensive rural, riverine, and border communities, several of which lie along the state's northern and western frontiers. This gradient shapes both the density of health facilities and the ease with which caregivers can reach immunisation sessions, making the state a useful setting in which to examine how system-side reliability and caregiver-side behaviour interact. The population is religiously and ethnically diverse, with Yoruba, Nupe, Bariba, and Fulani communities among the major groups; routine immunisation and antenatal services are delivered principally through the network of primary health-care facilities coordinated by the State Primary Health Care Development Agency. The six LGAs sampled were drawn to span this urban–rural spectrum so that the findings would reflect the heterogeneity of service access across the state rather than the conditions of any single setting.

Study Design and Population

The study used a descriptive cross-sectional survey design. The target population comprised caregivers - predominantly mothers - of children aged 0–23 months, the principal decision-makers for presenting a child for vaccination. The sample size was estimated using Cochran's formula for large populations [23], shown in Equation (1):

$$n_0 = \frac{Z^2 pq}{e^2} \qquad (1)$$

where $Z = 1.96$ (95% confidence), $p = 0.5$ (the most conservative estimate of the population proportion), $q = 1 - p = 0.5$, and $e = 0.03$ (3% margin of error). This gives $n_0 = 1{,}067.1$. Adjusting for a 10% non-response allowance (1,067 + 107 = 1,174), a total of 1,173 valid questionnaires were retained for analysis (one excluded for incompleteness).

Sampling Procedure

A multi-stage sampling procedure captured the diverse geographic and socio-demographic profile of Kwara State. First, the 16 Local Government Areas (LGAs) were stratified into urban/peri-urban and rural categories. Second, six LGAs were randomly selected: three urban/peri-urban (Ilorin East, Ilorin West, and Asa) and three rural (Baruten, Kaiama, and Edu). Third, three wards were randomly selected within each LGA, yielding 18 wards. Fourth, systematic random sampling identified households with eligible children aged 0–23 months within each ward.

Data Collection Instrument

A structured questionnaire captured socio-demographic variables, maternal and child healthcare utilisation, and caregiver knowledge, attitudes, perceptions, and hesitancy toward routine immunisation. Items were adapted from the Nigeria Demographic and Health Survey (2021) and WHO Immunization Coverage Cluster Survey guidelines. Face and content validity were established through review by experts in public health nursing and in tests and measurement, and item wording was refined accordingly. The questionnaire was administered in English and the predominant local languages (Yoruba, Nupe, Bariba, and Fulfulde) by trained enumerators.

Outcome Definitions and Statistical Analysis

Three binary outcomes were defined a priori: zero-dose status for Penta-1 (no receipt of the first pentavalent dose among age-eligible children), a missed immunisation visit in the previous six months (caregiver-reported), and antenatal-care continuity. For the antenatal outcome, completion of at least four ANC visits (ANC4+) was retained as the primary analytical benchmark. We recognise that the World Health Organization's 2016 antenatal-care model recommends a minimum of eight contacts (ANC8+) for optimal maternal care [22]. ANC4+ was nonetheless adopted for three context-specific reasons: it remains the operational continuity-of-care indicator embedded in Nigeria's routine health management information system and in the major national survey instruments, including the Demographic and Health Survey; it preserves comparability with the existing Nigerian subnational literature against which our findings are interpreted [21, 22]; and the very low ANC8+ attainment observed in this sample (reported below) would have left too few events for stable multivariable estimation. To avoid an over-optimistic reading of maternal-care quality, ANC8+ attainment is reported descriptively alongside ANC4+, and the continuity gap is interpreted against both standards.

Data were entered into SPSS version 28 after manual completeness checks. Analysis proceeded in three steps. First, descriptive statistics (frequencies and proportions) were computed for all variables; where denominators differed because of item non-response, the valid sample size is reported alongside each variable. Second, bivariate associations between caregiver- and community-level factors and the three outcomes were tested using Pearson's chi-square, with Fisher's exact test where expected cell counts fell below five. Third, multivariable logistic regression was performed for each outcome using predictors that were significant in bivariate analysis ($p < 0.20$) and conceptually relevant: urban residence, education (secondary or higher), religion, occupation, perceived community rumours discouraging immunisation, worry about side effects, and receipt of immunisation reminders. Adjusted odds ratios (aORs) with 95% confidence intervals are reported, with statistical significance set at $p < 0.05$. Reporting follows the STROBE guidance for cross-sectional studies.

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Ethical Considerations

Ethical clearance was obtained from the Kwara State Ministry of Health Ethical Review Committee. Written informed consent was obtained from all caregivers prior to enrolment; participation was voluntary, and respondents could withdraw at any point without penalty. Data were de-identified at the point of entry and stored on password-protected devices accessible only to the research team.

Results

Table 1. Socio-demographic Characteristics of Respondents (N = 1,173)

Characteristic	n	%
Sex of child		
Female	606	51.7
Male	560	47.7
Age of child (months)		
0–5	538	45.9
6–11	278	23.7
12–23	350	29.8
Relationship to child		
Mother	1,109	94.5
Father	26	2.2
Grandparent	24	2.0
Other	7	0.6
Marital status		
Married / cohabiting	1,097	93.5
Single	41	3.5
Divorced / separated	21	1.8
Widowed	7	0.6
Highest education (n = 1,003)		
Senior secondary	509	50.7
Tertiary	266	26.5
Primary	126	12.6
Junior secondary	88	8.8
Quranic / other	14	1.4
Main occupation		
Trading	552	47.1
Farming	246	21.0
Unemployed	113	9.6
Artisan	111	9.5
Civil / private employee	98	8.4
Student	31	2.6
Other	15	1.3
Religion		
Islam	1,017	86.7
Christianity	135	11.5
Traditional	13	1.1
Number of children under 5 in household		

1	515	43.9
2	508	43.3
≥3	140	11.9

Note: *N = 1,173. Cell counts are based on valid (non-missing) responses for each characteristic; denominators therefore vary across variables owing to item non-response (for example, highest education, n = 1,003). Percentages are computed on the valid responses for each characteristic and may not sum to 100% because of rounding and the exclusion of missing values.*

The socio-demographic profile (Table 1) shows a predominantly maternal sample (94.5%), with most respondents married or cohabiting (93.5%) and Muslim (86.7%). Educational attainment was moderate: over half had senior secondary education and 26.5% had tertiary education. Trading (47.1%) and farming (21.0%) were the main occupations. Children were almost evenly distributed by sex (51.7% female, 47.7% male), and 45.9% were under six months old.

Table 2. Maternal and Child Healthcare Utilisation (N = 1,173)

Indicator	**n**	**%**
Antenatal and Delivery		
ANC attendance – Yes	1,025	87.4
ANC attendance – No	121	10.3
ANC visits (1–3)	521	44.4
ANC visits (4–7)	304	25.9
ANC visits (≥8)	163	13.9
Place of delivery – Public facility	765	65.2
Place of delivery – Private facility	178	15.2
Place of delivery – Home	151	12.9
Place of delivery – TBA / Mission	53	4.5
Child Health-Seeking Behaviour (last 6 months)		
Facility visits – None	99	8.4
Facility visits – Once	291	24.8
Facility visits – 2–3 times	481	41.0
Facility visits – ≥4 times	213	18.2
First care-seeking – Public facility	841	71.7
First care-seeking – Private facility	187	15.9
First care-seeking – PPMV / Pharmacy	98	8.4
First care-seeking – Traditional healer	37	3.2
Immunisation Service Experience		
Missed vaccination visit – No	1,050	89.5
Missed vaccination visit – Yes	107	9.1
Main reason (missed) – Vaccine stock-out	40	3.4
Main reason (missed) – Long waiting time	24	2.0
Main reason (missed) – Child's illness	18	1.5
Main reason (missed) – Session cancelled	10	0.9
Treatment rating – Very good / good	1,121	95.5
Treatment rating – Fair / poor	35	3.0

Health worker discussed RI – Yes	1,121	95.6
Zero-dose Penta-1 (age-eligible, N = 943)	91	9.7

ANC = antenatal care; PPMV = patent and proprietary medicine vendor; RI = routine immunisation; TBA = traditional birth attendant.

Utilisation of maternal and child health services was generally high but uneven (Table 2). ANC attendance reached 87.4% and facility delivery 80.4% (public 65.2%; private 15.2%). However, continuity fell away sharply with each additional contact: 44.4% of respondents reported one to three ANC visits, 25.9% completed four to seven, and only 13.9% reached the WHO-recommended eight or more contacts (ANC8+). Overall, 39.8% of all women - 47.3% of ANC attendees - completed at least four visits (ANC4+). The drop from ANC4+ to ANC8+ underscores that the continuity gap is considerably wider when measured against the current eight-contact standard. About one in twelve children (8.4%) had no facility visit in the previous six months. Reported quality of interaction with health workers was high (95.5% rated it very good or good), and 95.6% of caregivers had been engaged on routine immunisation by a health worker. Despite this, 9.1% of caregivers had missed an immunisation visit in the previous six months, primarily owing to vaccine stock-outs (3.4%) and long waiting times (2.0%). Among age-eligible children, 9.7% were zero-dose for Penta-1.

Table 3. Caregiver Knowledge and Information Sources for Routine Immunisation (N = 1,173)

Indicator	**n**	**%**
Awareness and Knowledge		
Heard of routine immunisation – Yes	1,152	98.2
Main purpose – Prevent disease	1,102	93.9
Knows where RI is offered – Yes	1,138	97.0
Knows vaccination starts at birth	1,135	96.8
Receives immunisation reminders – Yes	1,029	87.7
Information Sources (multiple responses)		
Health worker	1,016	86.6
Family / community / religious leader	646	55.1
Friends / neighbours	591	50.4
Radio	213	18.2
Social media	201	17.1
Television	73	6.2

RI = routine immunisation.

Awareness and knowledge of routine immunisation were near-universal among respondents: 98.2% had heard of routine immunisation, 93.9% identified disease prevention as its main purpose, and 96.8% knew that vaccination should begin at birth (Table 3). Health workers were the dominant source of information (86.6%), followed by family and community leaders (55.1%). Mass media played a marginal role (radio 18.2%, social media 17.1%, television 6.2%), indicating that information flow in this setting is principally interpersonal.

Table 4. Caregiver Attitudes, Perceptions and Hesitancy Toward Routine Immunisation (N = 1,173)

Indicator	n	%
Vaccine Confidence (agree / strongly agree)		
Vaccines are safe	1,133	96.6
Vaccines are effective	1,121	95.6
RI is important even when child is healthy	1,097	93.5
Family supports routine immunisation	1,090	92.9
Hesitancy and Community Factors		
Worry about vaccine side effects (agree / strongly agree)	608	51.8
Community rumours discourage RI (agree / strongly agree)	451	38.4
Service Quality Perception		
Health workers treat caregivers respectfully	1,092	93.1

RI = routine immunisation.

Attitudes towards routine immunisation were strongly positive (Table 4): 96.6% of caregivers considered vaccines safe, 95.6% effective, and 93.5% endorsed vaccination even for apparently healthy children. Family support was reported at 92.9%, and 93.1% felt health workers treated caregivers respectfully. Two markers of residual hesitancy persisted: 51.8% of caregivers worried about vaccine side effects, and 38.4% agreed that community rumours discourage routine immunisation.

Table 5. Multivariable Logistic Regression: Predictors of Zero-Dose Status, Missed Immunisation Visit, and ANC4+ Attainment

Predictor	Zero-dose Penta-1 (n = 830) aOR (95% CI), p	Missed immunisation visit (n = 996) aOR (95% CI), p	ANC4+ attainment (n = 871) aOR (95% CI), p
Urban/peri-urban residence	0.86 (0.51–1.45), 0.574	0.23 (0.13–0.42), <0.001	1.59 (1.19–2.12), 0.002
Education ≥ secondary	0.56 (0.33–0.96), 0.034	0.64 (0.39–1.07), 0.088	1.49 (1.06–2.11), 0.024
Religion (Islam vs other)	0.77 (0.41–1.47), 0.429	1.20 (0.64–2.26), 0.563	0.79 (0.53–1.19), 0.264
Formal-sector occupation	1.52 (0.79–2.93), 0.208	1.36 (0.72–2.59), 0.347	1.07 (0.71–1.60), 0.754
Community rumours discourage RI	1.98 (1.15–3.40), 0.014	4.06 (2.46–6.70), <0.001	1.03 (0.75–1.42), 0.834
Worry about side effects	0.96 (0.56–1.63), 0.867	1.08 (0.66–1.75), 0.764	0.61 (0.45–0.82), 0.001
Immunisation reminders received	0.15 (0.08–0.28), <0.001	2.07 (0.72–5.99), 0.179	0.68 (0.39–1.17), 0.158

aOR = adjusted odds ratio; CI = confidence interval; RI = routine immunisation; ANC4+ = at least four antenatal-care visits. Each outcome was modelled in the affirmative direction (presence of zero-dose status, occurrence of a missed visit, attainment of ANC4+); an aOR below 1 therefore denotes lower odds of the named outcome. Models adjusted for all listed variables. Statistical significance at $p < 0.05$.

The multivariable models in Table 5 reveal patterns that descriptive figures alone do not capture. All three outcomes were modelled in the affirmative direction - that is, as the presence of zero-dose status, the occurrence of a missed visit, and the attainment of ANC4+ - so that an adjusted odds ratio below 1 denotes lower odds of the named outcome. For zero-dose status, the single strongest independent protective factor was receipt of immunisation reminders (aOR 0.15; 95% CI 0.08–0.28; $p < 0.001$): children of caregivers who received reminders were approximately 85% less likely to be zero-dose, holding other factors constant. Education at secondary level or higher was independently protective (aOR 0.56; 0.33–0.96; $p = 0.034$), while perceived community rumours nearly doubled the odds of zero-dose status (aOR 1.98; 1.15–3.40; $p = 0.014$).

For missed immunisation visits, urban/peri-urban residence was strongly protective (aOR 0.23; 0.13–0.42; $p < 0.001$), and community rumours were the dominant behavioural driver, quadrupling the odds of a missed visit (aOR 4.06; 2.46–6.70; $p < 0.001$). For ANC4+ attainment - where the modelled outcome is completion of four or more visits - urban residence (aOR 1.59; 1.19–2.12; $p = 0.002$) and secondary-or-higher education (aOR 1.49; 1.06–2.11; $p = 0.024$) were facilitators. Worry about vaccine side effects carried an aOR of 0.61 (0.45–0.82; $p = 0.001$) for this outcome; because the outcome is attainment, an odds ratio below 1 indicates that caregivers who worried about side effects were significantly less likely to complete four ANC visits. This suggests that hesitancy spills over from immunisation into antenatal continuity of care.

Discussion

Utilisation of Healthcare and Its Implications for Immunisation

Caregivers in this study had substantial contact with the formal health system. Most respondents attended antenatal care (87.4%), and 80.4% delivered in a health facility. In addition, 89.5% reported not having missed any immunisation visit in the preceding six months. These findings suggest that many caregivers had repeated opportunities to interact with maternal and child health services before and after delivery. This is consistent with evidence from similar Nigerian and West African settings, where ANC attendance provides an important entry point for immunisation counselling, birth-dose planning, and early linkage to routine immunisation services [24, 25]. Evidence from other low-resource settings also shows that frequent contact with health services is associated with better immunisation uptake, largely because each encounter creates an opportunity for education, reminder, referral, and follow-up [26, 27].

However, access alone did not guarantee continuity of care. Although initial contact with services was relatively high, only 47.3% of ANC attendees completed at least four visits, and just 13.9% of respondents reached the eight-contact standard now recommended by WHO [22]; 9.1% of caregivers reported missing an immunisation visit, mainly because of vaccine stock-outs and long waiting times. Among age-eligible children, 9.7% had not received Penta-1, placing them in the zero-dose category. The gap is therefore even more pronounced when continuity is benchmarked against ANC8+ rather than ANC4+, reinforcing the central argument of this paper: the binding constraint is adherence and retention, not first contact.

This pattern of high initial uptake but incomplete follow-through, reflects the “missed-opportunity” paradox reported in several sub-Saharan African settings [28]. It suggests that the major barrier is not simply whether caregivers can access services, but whether the health system can retain them through reliable, timely, and client-responsive service delivery. The implication is that improving adherence and retention is as important as expanding access if immunisation-completion targets are to be achieved [29].

Multivariable analysis showed that urban/peri-urban residence was the strongest protective factor against missed visits (aOR 0.23). This suggests that continuity of immunisation is driven less by caregiver-level characteristics and more by system-level reliability such as vaccine availability, frequency of sessions, predictable service hours, and easier physical access to facilities. Receipt of immunisation reminders was also strongly protective, reducing the odds of zero-dose status by 85% in the adjusted model. This reinforces the value of structured demand-generation and is consistent with IA2030-aligned programmes in which reminders, caregiver tracking, and proactive follow-up improve uptake and reduce missed opportunities [30]. Recent Nigerian evidence strengthens this interpretation: a quasi-experimental study in Borno State found that parental SMS reminders significantly improved infant immunisation coverage and timeliness and reduced caregiver-reported barriers [31], while a qualitative evaluation of an SMS reminder system in Kebbi State, north-western Nigeria, identified the operational conditions - phone ownership, network reliability, caregiver literacy, and language of messaging - that determine whether such systems actually reach their intended users [32]. The high self-reported reminder coverage in our sample (87.7%) should therefore be interpreted with attention to these local feasibility constraints.

Knowledge and Information Sources

Awareness of routine immunisation was almost universal, with 98.2% of caregivers reporting awareness and 93.9% correctly identifying disease prevention as its primary purpose. These figures are higher than those reported in many comparable settings, where limited knowledge remains an important constraint to immunisation coverage [33]. The high awareness observed here likely reflects the cumulative effect of sustained social mobilisation, health education, and community engagement by the Government of Nigeria and partner agencies [34].

Information flow in this setting was predominantly interpersonal. Health workers were the main source of immunisation information (86.6%), followed by family members, community and religious leaders (55.1%), and friends or neighbours (50.4%). By contrast, mass media played a much smaller role (radio 18.2%, social media 17.1%, television 6.2%). This pattern highlights the central role of trusted human channels in shaping immunisation decisions in low-resource Nigerian settings and suggests that interventions aimed at addressing misinformation should not rely on mass-media campaigns alone, but should be delivered through the same trusted interpersonal networks that caregivers already use.

High knowledge did not, however, translate uniformly into adherence. The continued occurrence of zero-dose children and missed visits, despite near-universal awareness, reflects the knowledge–behaviour gap described in other settings. Information is therefore necessary but not sufficient for full immunisation. Programme interventions should move beyond general awareness creation toward schedule completion, timely return for subsequent doses, and the active correction of specific misconceptions.

Attitudes, Confidence, and Residual Hesitancy

Caregivers generally expressed strong confidence in vaccination. Most considered vaccines safe (96.6%) and effective (95.6%), and 93.5% supported routine immunisation for children who appeared healthy. These findings are consistent with the high vaccine acceptance reported in several sub-Saharan African settings, although the regional picture is becoming increasingly heterogeneous [35]. The value of vaccination also extends beyond infectious-disease prevention to broader child health and developmental outcomes [36].

Despite this confidence, residual hesitancy remains, revealing a nuanced landscape of behavioural barriers. More than half of caregivers expressed concern about vaccine side effects, and 38.4% identified community rumours as a deterrent to routine immunisation. These factors appear to operate through distinct pathways. Multivariable models indicate that community rumours are independently associated with both zero-dose status and missed visits, whereas private concerns about side effects are linked more specifically to non-attainment of ANC4+. This divergence suggests that collective misinformation poses a greater threat to routine-immunisation coverage than individual safety anxieties - a pattern consistent with broader evidence on the social production of vaccine hesitancy [37] and with Nigerian studies documenting how community-level misconceptions and rumours about childhood vaccines depress demand independently of individual safety concerns [11].

Hesitancy in this context is therefore better understood as a continuum than a simple accept–reject binary [15]. Most caregivers accept vaccination, but some continue to hold specific concerns which, when reinforced by community rumour networks, may result in delayed or missed doses. Effective risk communication should engage these concerns directly, using the trusted interpersonal channels that already dominate information flow in the study setting.

Strengths and Limitations

This study has several strengths: a large multi-stage sample spanning urban/peri-urban and rural LGAs, locally validated instruments administered in the major languages of the state, and multivariable models that separate caregiver-level from community-level drivers. Several limitations should nonetheless temper interpretation. The cross-sectional design precludes causal inference; the associations reported here describe correlation, not proven effect. Most indicators were caregiver-reported and were not systematically verified against home-based or facility immunisation records, introducing potential recall bias - particularly for events such as missed visits over the preceding six months - and social-desirability bias in the reporting of attitudes, adherence, and respectful treatment, which may inflate favourable responses. Item non-response produced varying denominators across variables, as noted in the tables. Finally, although the six study LGAs were purposively spread across the urban–rural gradient, they may not capture the full heterogeneity of all 16 LGAs. Reporting followed the STROBE guidance for observational studies to support transparency and replicability.

Conclusion

In Kwara State, low acceptance is not the principal constraint to routine immunisation. Caregivers reported high awareness, strong vaccine confidence, and high uptake of first-contact maternal and child health services. Yet a meaningful minority of children remained zero-dose, and continuity of care was uneven - markedly so when benchmarked against the eight-contact antenatal standard.

The multivariable findings point to three practical levers for programme improvement. First, system-side reliability must be strengthened through consistent vaccine availability, reduced waiting times, and predictable immunisation sessions, particularly in rural LGAs where missed visits are concentrated. Second, caregiver reminder systems should be expanded, given their strong protective effect against zero-dose status, with attention to the local feasibility conditions that govern their reach. Third, risk communication should directly address community rumours, which were strongly associated with both zero-dose status and missed visits.

Closing the remaining gap will require a shift in programme emphasis: from access alone to adherence, from awareness to completion, and

from broadcast messaging to sustained engagement through the trusted interpersonal channels that shape caregiver decisions.

Recommendations

1. Strengthen reminder systems for routine immunisation - SMS, voice calls, and in-person follow-up by ward-level focal persons - prioritising rural LGAs and the 12.3% of caregivers who currently receive no reminders.
2. Improve system reliability by reducing vaccine stock-outs and waiting times at primary health facilities, particularly in rural LGAs where missed visits cluster.
3. Develop and field-test rumour-response protocols delivered through health workers, community leaders, and religious leaders - the dominant information channels in this setting - to engage residual safety concerns directly rather than displace them.
4. Integrate ANC continuity into immunisation programming: women who worry about vaccine side effects are also less likely to complete ANC4+, indicating that hesitancy interventions should span the maternal–child care continuum.
5. Embed routine collection of zero-dose indicators in subnational monitoring, with ward-level disaggregation, to identify and respond to hotspots within ostensibly high-coverage LGAs.

Conflict of Interest

The authors declare no financial, commercial, legal, or professional relationships that could have influenced this research.

Ethical Approval

Ethical clearance was obtained from the Kwara State Ministry of Health Ethical Review Committee. Written informed consent was obtained from all participants before enrolment. Participation was voluntary, and respondents could withdraw at any point without penalty. Data were de-identified at the point of entry and stored on password-protected devices accessible only to the research team.

Author Contributions

EEE conceptualised and designed the study; OOS reviewed the manuscript; AAE participated in drafting the manuscript; and KFL participated in data collection and review of the final manuscript. All authors read and approved the final version.

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Data Availability

The de-identified datasets generated and analysed during this study are available from the corresponding author upon reasonable request. Household-level GPS coordinates have been aggregated to the ward level for reporting in order to protect participant privacy and are not publicly shared.

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