

Malaria Vaccine: Knowledge, Acceptance and Barriers Among Mothers of Under- Five Children in Owerri, Nigeria: A Cross-Sectional Study

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Abstract

Background

Malaria remains a leading cause of childhood morbidity and mortality in sub-Saharan Africa, with Nigeria bearing the highest global burden. The phased introduction of the R21/Matrix-M malaria vaccine into Nigeria's routine immunization program since December 2024 necessitates data on knowledge, awareness, and acceptance to guide effective rollout strategies. This study assessed these parameters among mothers of under-five children in Owerri, Imo State, and identified associated sociodemographic factors.

Methods

A descriptive cross-sectional study was conducted among 311 mothers of children aged five years and below attending Federal Teaching Hospital Owerri, Nigeria. Data were collected using a structured, pretested, interviewer-administered questionnaire and analyzed with IBM SPSS version 27 using descriptive statistics, chi-square tests, Cramér's V, and the Mann-Whitney U test. Statistical significance was set at $p < 0.05$.

Results

The mean maternal age was 33.1 ± 6.8 years; 196(63.0%) held tertiary qualifications. Good vaccine knowledge (score $\geq 3/5$) was demonstrated by 265(85.2%) of mothers; however, only 136(43.7%) correctly identified the intramuscular route of administration. Vaccine awareness was reported by 140(45.0%), with health facilities as the dominant source of information reported by 98 (70.0%)mothers. Willingness to vaccinate was high at 285(91.6%), driven primarily by the desire to prevent serious malaria illness,238 (83.5%). Among the 26 (8.4%) mothers who declined, the requirement for spousal permission was the foremost barrier documented by the mothers, at 23 (88.5%), followed by concerns about inadequate vaccine testing at 16 (61.5%). Socioeconomic class was significantly associated with both knowledge ($p = 0.048$) and awareness ($p = 0.002$); maternal education was significantly associated with awareness ($p = 0.004$). No sociodemographic variable significantly predicted acceptance.

Conclusion

High knowledge and near-universal acceptance coexist with low awareness, reflecting the pre-rollout phase in Imo State. Spousal gatekeeping and vaccine safety concerns are the principal barriers. Targeted facility-based communication, systematic male partner engagement and sustained multi-platform community mobilisation are critical for translating population-level acceptance into actual vaccine uptake. Nigeria's rollout expansion should incorporate documented lessons from the Malaria

Vaccine Implementation Programme in Ghana, Kenya and Malawi, particularly regarding community pre-engagement and health worker training.

Introduction

Malaria a disease caused by the Plasmodium parasite transmitted via the bite of an infected female Anopheles mosquito. It remains one of the most consequential infectious diseases worldwide, exerting a disproportionate toll on children and communities in endemic regions. *P. falciparum* is responsible for the majority of the severe clinical outcomes.¹ The World Health Organization (WHO) reported an increase in malaria cases across 83 endemic regions from 252 million in 2022 to 263 million in 2023.¹ The African region bore approximately 95% of all malaria-related deaths, with children under five years of age disproportionately constituting 76% of all fatalities.^{1,2} Although several preventive strategies have been implemented over two decades, achieving measurable progress, malaria-related morbidity and mortality increased by 6% and 12% in 2019 and 2020, respectively, underscoring the inadequacy of existing preventive strategies and the urgent need for supplementary tools.²

Within sub-Saharan Africa (SSA), Nigeria carries the heaviest national disease burden. In 2023, the country recorded approximately 68 million cases and over 184,000 deaths, representing 25.9% of global cases and 30.9% of global malaria deaths, with approximately 80% of fatalities occurring among children under five years of age.^{1,3} Long-established preventive strategies, including long-lasting insecticide-treated nets (LLINs), artemisinin-based combination therapy, and seasonal malaria chemoprevention, have constrained but not eliminated transmission, with national malaria prevalence among children aged 6–59 months remaining at 22.3%.¹ In Imo State, southeastern Nigeria, the epidemiological trajectory is particularly concerning; a recent hospital-based longitudinal survey documented a rising malaria prevalence in Owerri from 42% in 2022 to 62% in 2025, with rural communities recording parasite densities exceeding 70–80% and children under 15 years of age disproportionately affected.⁴ Wider socioeconomic dimensions are equally significant, as Adebajo et al. have documented that inadequate vaccination coverage in Nigeria's most disadvantaged communities reflects structural inequities that extend beyond malaria to the entire immunization programme.⁵

The development and WHO endorsement of two malaria vaccines represent the most significant advance in decades. The RTS,S/AS01 vaccine received WHO recommendation for widespread use in October 2021, following a phase 3 trial across 11 sites in seven SSA countries demonstrating efficacy against clinical and severe malaria.⁶ Prospective evaluation of the Malaria Vaccine Implementation Programme (MVIP) confirmed a 32% reduction in severe malaria hospitalizations and a 9% reduction in all-cause mortality among vaccinated children under five years across Ghana, Kenya, and Malawi.⁷ A second vaccine, R21/Matrix-M, developed by the University of Oxford and the Serum Institute of India, demonstrated 77% efficacy in a phase 2b trial in Burkina Faso,⁸ and 78% average efficacy across four African countries in the subsequent phase 3 trial enrolling over 4,800 children.⁹ Nigeria approved malaria vaccination in April 2023 and received its first consignment of one million R21/Matrix-M doses in

October 2024, commencing a phased rollout in Bayelsa and Kebbi States in December 2024, with a four-dose schedule integrated into the routine national immunisation programme.¹⁰

The success of any vaccine programme is critically contingent on community/end user acceptance. The WHO SAGE Working Group defines vaccine hesitancy as the delay in acceptance or refusal of vaccination despite the availability of vaccination services, noting that it is complex, context-specific, and shaped by factors of complacency, convenience, and confidence.¹¹ Studies from Gombe and Kaduna States in Nigeria found that while willingness to vaccinate reached 92.5% and 94.0%, respectively, vaccine awareness remained markedly low at 46.1% and 28.5%. This is a persistent knowledge gap that threatens to undermine otherwise receptive communities.^{2,12} In a directly comparable study from Enugu State, Chinawa et al. similarly found that 72.1% of mothers were aware of the malaria vaccine and 92.9% willing to vaccinate, with knowledge gaps in vaccine delivery details identified as a key concern.¹³ Across SSA more broadly, poor community engagement, misinformation, limited health worker communication, and inadequate funding have been documented as structural barriers to scaling malaria vaccination programmes.¹⁴ Despite this growing evidence base, data from Owerri and southeastern Nigeria remain sparse. This study therefore aimed to assess the knowledge, awareness, acceptance, and perceived barriers to malaria vaccination among mothers of under-five children in Owerri, Nigeria, and to identify associated sociodemographic factors.

Methods

Study Design and Setting

This descriptive cross-sectional study was conducted from February 2026 to May 2026 among mothers attending the child health and immunization clinic of Federal Teaching Hospital (FTH) Owerri, the capital of Imo State, Southeastern Nigeria. FTHO is a 625-bed tertiary health facility that serves Owerri, its adjoining communities, and neighboring Abia, Rivers, and Anambra States. The immunization clinic, run by Doctors and nurses, is open on weekdays, except public holidays.

Study population and eligibility.

The study population comprised mothers of children aged five years and below attending FTHO. Owerri was purposively selected given its documented and worsening malaria burden, with prevalence rising from 42% in 2022 to 62% in 2025 and Anopheles vectors confirmed active across urban and peri-urban localities.^{4,15}

2.2 Inclusion and exclusion criteria.

Mothers who provided written informed consent and had resided in Owerri for at least six months before the study were eligible. Mothers who were healthcare professionals were excluded to avoid

overestimation of vaccine knowledge and awareness attributable to professional exposure. Also excluded were mothers who declined to provide consent.

2.3 Sample Size and Sampling

The minimum sample size was calculated using the formula for estimating sample size in cross-sectional studies¹⁶, $n = Z^2pq/d^2$, n = minimum sample size. Z = standard normal deviation at 95% confidence level = 1.96. P = 22% prevalence for malaria among children aged 6–59 months in Nigeria.¹⁷ $q = 1 - P$. d = level of precision = 5%. Calculated sample size = 264. Adding 10% attrition = 26. Sample size will be 264 + 26 = 290. However, 311 participants were consecutively enrolled.

2.4 Data Collection

Data were collected using a pretested, structured, interviewer-administered questionnaire comprising five sections: (i) sociodemographic characteristics (age, religion, area of residence, socioeconomic class, maternal education) (ii) malaria burden and prevention practices; (iii) knowledge of the malaria vaccine (five items, each scored 0 or 1, composite score 0–5); (iv) awareness and sources of information (v) vaccine acceptance, perceived benefits and barriers. A score of three or above was classified as good knowledge, consistent with the scoring approach used in comparable Nigerian studies.^{3,12} Socioeconomic class was determined using the Oyediji classification into lower, middle, or upper class using parental education level and occupation.¹⁸

2.5 Statistical Analysis

Data were analysed using IBM SPSS Statistics version 27. Categorical variables are presented as frequencies and percentages; continuous variables as means with standard deviations (SD). Bivariate associations between sociodemographic variables and good knowledge, vaccine awareness, and vaccine acceptance were examined using the chi-square test with Cramér's V as a measure of effect size. Maternal age was compared across acceptance groups using the Mann-Whitney U test. Statistical significance was set at $p < 0.05$.

Ethical considerations

Ethical approval

was obtained from the Health Research Ethics Committee (HREC) of Federal Teaching Hospital, Owerri, Nigeria (FTHO), with approval number: FTH/OW/HREC/ Vol. 2/100. The study was conducted in accordance with the Declaration of Helsinki and national ethical guidelines for research involving human participants. Written informed consent was obtained from all participants before enrolment.

Results

3.1 Sociodemographic Characteristics

A total of 311 mothers were enrolled with a mean age of 33.1 ± 6.8 years (range 18–63 years). The vast majority, 306 (98.4%), identified as Christian; more than half, 176 (56.6%), resided in urban areas, with 78 (25.1%) living in rural areas and 57 (18.3%) in semi-urban settings. Most of the participants 180 (57.9%) belonged to the middle socioeconomic class. A high proportion, 196 (63.0%), had attained tertiary-level education and the mean age of the index child was 4.1 ± 4.2 years. Full sociodemographic details are presented in Table 1.

Table 1
Sociodemographic characteristics of study participants (n = 311)

Characteristic	n	Percentage (%)
Age of mother (years)	Mean $\pm$ SD	33.1 ± 6.8
Range	Min–Max	18–63
Religion		
Christianity	306	98.4
Islam	2	0.6
Traditional / Others	3	1.0
Area of residence		
Urban	176	56.6
Rural	78	25.1
Semi-urban	57	18.3
Socioeconomic class		
Middle	180	57.9
Lower	66	21.2
Upper	65	20.9
Maternal education level		
Tertiary	196	63.0
Secondary	84	27.0
OND / HND / NCE	30	9.6

SD = standard deviation; OND = Ordinary National Diploma; HND = Higher National Diploma; NCE = Nigeria Certificate in Education. Percentages may not sum to 100% due to rounding.

Maternal Knowledge of the Malaria Vaccine

The mean composite knowledge score was 3.69 ± 1.08 out of five. Good knowledge was demonstrated by 265 (85.2%) mothers. Knowledge of malaria aetiology was near-universal, documented by 295 (94.9%) participants and most mothers 258 (83.0%), correctly identified the recommended vaccination age group, while 238 (76.5%) mothers recognized that the vaccine protects against malaria. Knowledge of the route of administration was the weakest domain, correctly identified by only 136 (43.7%) mothers. This is shown in Table 2 below.

Table 2
Maternal knowledge of the malaria vaccine: item-level performance and overall classification (n = 311)

Knowledge item	Correct (n)	%
Knows malaria aetiology (mosquito bite with fever)	295	94.9
Knows the recommended age group for vaccination	258	83.0
Knows the vaccine protects against malaria	238	76.5
Knows the vaccine can reduce malaria-related illness and deaths	222	71.4
Knows route of administration (intramuscular injection)	136	43.7
Mean knowledge score (SD)	3.69 (1.08)	—
Good knowledge (score ≥ 3 out of 5)	265	85.2
Poor knowledge (score < 3 out of 5)	46	14.8

SD = standard deviation. Knowledge score range: 0–5. Good knowledge is defined as a score ≥ 3 .

Vaccine Awareness and Sources of Information

Fewer than half, 140 (45.0%), of all mothers had heard of the malaria vaccine before this study. Among those aware, 98 (70.0%) mothers most frequently cited health facilities as the source, followed by the internet by 62 (44.3%) and friends or family by 55 (39.3%) participants. A large majority, 216 (69.5%), were uncertain whether the vaccine was readily available, reflecting the nascent stage of the national rollout at the time of data collection. This is described in Table 3.

Table 3
Vaccine awareness and sources of information among aware mothers (n = 140)

Variable	n	Percentage (%)
Heard of malaria vaccine (n = 311)		
Yes	140	45.0
No	171	55.0
Source of information (n = 140, multiple response)*		
Hospital/health facility	98	70.0
Internet	62	44.3
Friends or family	55	39.3
Social media / WhatsApp	45	32.1
Radio/television	33	23.6
Billboard	17	12.1
Community engagement	14	10.0
Church	12	8.6
Vaccine readily available (n = 311)		
Yes	54	17.4
No	41	13.2
Don't know	216	69.5

**Percentages for sources of information exceed 100% as multiple responses were permitted.*

Vaccine Acceptance, Perceived Benefits, and Barriers

The overwhelming majority, 285 (91.6%) mothers, expressed willingness to vaccinate their child against malaria. The principal motivation was the desire to prevent serious malaria, documented by 238 (83.5%) participants, followed by the vaccine being free of charge, reported by 77 (27.0%) mothers, and its inclusion in the routine immunization schedule by 75 (26.3%) participants. Among the 26 (8.4%) mothers who declined, the dominant barrier was the requirement for spousal permission reported by 23 (88.5%) mothers, followed by concerns that the vaccine had not been adequately tested, documented by 16 (61.5%) mothers, and the perceived decision-making authority of the mother-in-law by 8 (30.8%) mothers. Regarding perceived benefits, 284 (91.3%) participants believed the vaccine would reduce household expenditure on malaria treatment. This is depicted in Table 4.

Table 4
Vaccine acceptance, reasons for acceptance and refusal, and perceived benefits (n = 311)

Variable	n	Percentage (%)
Willing to vaccinate the child	285	91.6
Reasons for acceptance (n = 285, multiple response)		
To prevent serious malaria	238	83.5
The vaccine is free of charge	77	27.0
Part of the routine immunization schedule	75	26.3
Compulsory/mandatory	12	4.2
Reasons for refusal (n = 26, multiple response)		
Husband's permission needed	23	88.5
Vaccine not fully tested	16	61.5
Mother-in-law's role in decision-making	8	30.8
Fear of side effects	7	26.9
Lack of trust in the vaccine	6	23.1
Religion prohibits vaccination	2	7.7
Culture prohibits vaccination	1	3.8
Vaccine is expensive	1	3.8
Perceived benefits (n = 311)		
Vaccine can reduce illness/deaths - Yes	222	71.4
Vaccine can reduce illness/deaths - Maybe/Don't know	83	26.7
Vaccine reduces household malaria expenditure — Yes	284	91.3

Multiple responses permitted for acceptance and refusal reasons; percentages therefore exceed 100%. Percentages for perceived benefits are of all 311 respondents.

Factors Associated with Knowledge, Awareness and Acceptance

Bivariate analysis revealed that socioeconomic class was significantly associated with good knowledge ($\chi^2=6.09$, $df = 2$, $p = 0.048$, $V = 0.140$), with the highest proportion of good knowledge in the upper class (93.8%), followed by middle (84.4%) and lower (78.8%) classes. Vaccine awareness was significantly

associated with socioeconomic class ($\chi^2=12.97$, $df = 2$, $p = 0.002$, $V = 0.204$), maternal education ($\chi^2=8.26$, $df = 1$, $p = 0.004$, $V = 0.163$) and good knowledge ($\chi^2=3.97$, $df = 1$, $p = 0.046$, $V = 0.113$). No sociodemographic variable was significantly associated with vaccine acceptance; a Mann-Whitney U test comparing maternal age between acceptors and refusers approached but did not reach significance ($U = 4541$, $p = 0.057$). This is shown in Table 6.

Table 5
Bivariate analysis of factors associated with good knowledge, vaccine awareness, and vaccine acceptance

Factor	Outcome	χ^2	df	p-value	V
Socioeconomic class	Good knowledge	6.09	2	0.048*	0.140
Maternal education	Good knowledge	0.18	1	0.668	0.024
Area of residence	Good knowledge	0.44	2	0.802	0.038
Malaria history (child)	Good knowledge	1.29	1	0.256	0.064
Socioeconomic class	Vaccine awareness	12.97	2	0.002**	0.204
Maternal education	Vaccine awareness	8.26	1	0.004**	0.163
Good knowledge	Vaccine awareness	3.97	1	0.046*	0.113
Area of residence	Vaccine awareness	0.16	2	0.922	0.023
Good knowledge	Vaccine acceptance	2.35	1	0.126	0.087
Vaccine awareness	Vaccine acceptance	0.25	1	0.620	0.028
Maternal education	Vaccine acceptance	0.00	1	1.000	0.000
Socioeconomic class	Vaccine acceptance	1.51	2	0.470	0.070
Area of residence	Vaccine acceptance	1.15	2	0.564	0.061

* $p < 0.05$; ** $p < 0.01$. V = Cramér's V . Maternal education dichotomised as higher (HND/Tertiary) vs. secondary and below. Maternal age: awareness ($U = 12924$, $p = 0.226$, ns); acceptance ($U = 4541$, $p = 0.057$, ns).

Discussion

This study investigated the knowledge, awareness, acceptance, and perceived barriers to malaria vaccination among mothers of under-five children in Owerri, Imo State, Nigeria. The findings are contextualized within the broader Nigerian and sub-Saharan African literature and carry direct relevance to the ongoing phased rollout of the R21/Matrix-M vaccine in Nigeria.

The proportion of mothers demonstrating good vaccine knowledge was 85.2%, with a mean composite score of 3.69 ± 1.08 out of five. This considerably exceeds findings from Kaduna, Nigeria, where Yusuf et

al. found that only 19.5% of caregivers demonstrated good vaccine-specific knowledge despite the majority correctly identifying malaria as a mosquito-borne disease.³ Similarly, Adamu et al. found that while 87.7% of caregivers in Gombe had general malaria awareness, detailed knowledge of the malaria vaccine remained limited, particularly regarding its schedule and dosing.¹² The comparatively superior knowledge profile of the Owerri cohort is most plausibly attributable to its markedly higher educational attainment; 63.0% of respondents held a tertiary level of education compared with 16.5% in the Kaduna study.³ This interpretation is corroborated by Adebajo et al., who established that maternal educational attainment is a significant determinant of vaccination knowledge and uptake in Nigeria.⁵ Kolawole et al. similarly documented an inverse relationship between educational level and malaria prevalence across Nigerian settings, reflecting the broader association between health literacy and preventive health behaviour.² The statistically significant association between socioeconomic class and good knowledge ($\chi^2=6.09$, $p = 0.048$) is further consistent with the documented influence of socioeconomic position on health literacy across SSA.⁵

Notwithstanding the overall favourable knowledge profile, a clinically important gap was identified in the knowledge of the intramuscular route of administration, correctly identified by only 43.7% of respondents. A comparable gap in knowledge of vaccine delivery details was observed by Chinawa et al. in Enugu, Nigeria, even among mothers with otherwise good general vaccine awareness.¹³ This finding aligns with observations from Ghana, where the MVIP rollout revealed that healthcare workers themselves expressed uncertainty about operational details of the vaccine schedule, leading to eligible children being denied vaccination.¹⁰ In Tanzania, a study on the RTS,S vaccine introduction found that only 38% of caregivers could correctly identify all aspects of the vaccination schedule, with route of administration being the most frequently misunderstood component.¹⁹ This deficit carries practical significance as incomplete knowledge of the dosing schedule, route of administration, number of doses, and age of eligibility is a documented contributor to non-completion of multi-dose vaccine series and has been observed to generate uncertainty among healthcare workers during the MVIP rollout in Ghana, where misunderstanding of the schedule led to eligible children being denied vaccination.¹⁰ Targeted health communication that addresses these operational specifics is therefore an essential complement to broader disease-focused messaging. Health worker training programs should place particular emphasis on these technical details to ensure that providers can confidently and accurately communicate them to caregivers.

Only 45.0% of mothers had heard of the malaria vaccine before study participation, and 69.5% remained uncertain about its availability. These figures are consistent with awareness levels documented at comparable stages of vaccine introduction elsewhere in Nigeria. Adamu et al. found that 46.1% of Gombe caregivers had heard of the vaccine, while Yusuf et al. reported markedly lower awareness of 28.5% in Kaduna and 26.7% documented in Cameroon.^{3, 12, 20} In the most directly comparable study conducted in Enugu Nigeria, Chinawa et al. documented awareness of 72.1%, which is higher than the present finding and may reflect Enugu's longer history of concentrated tertiary health facility

utilisation.¹³ The variable findings in awareness of malaria vaccine prior to study participation may be reflective of methodological differences. Caregivers who are surveyed in the hospital are more likely to have better health-seeking behaviour than those in the community.²¹ Across the broader national landscape, Odis et al., surveying internet users across Nigeria, identified lack of awareness as a leading projected barrier to vaccine uptake, with awareness significantly associated with educational attainment and income level.²² A systematic review and meta-analysis by Sulaiman et al. of 11 LMIC studies noted that insufficient awareness was among the key impediments to translating acceptance into actual uptake despite a confirmed pooled malaria vaccine acceptance rate of 95.3%.²¹

Health facilities were the dominant source of vaccine information at 70.0%, among aware mothers, mirroring findings from Adamu et al. in Gombe, where 91.5% of caregivers identified healthcare workers as their most trusted information source.¹² Our findings are also consistent with studies that documented healthworkers as vital influencers of vaccine information provision and uptake.^{23, 24} This underscores the central and irreplaceable role of frontline health workers in communicating new vaccines. The low citation of radio and television at 23.6%, social media at 32.1%, and community-level channels below 13% signals a structural deficit in multi-platform public communication, consistent with Olawade et al.'s identification of minimal media attention and insufficient public education campaigns as significant contributors to low vaccine awareness across SSA.¹⁴ The experience of Cameroon, the first non-pilot country to integrate the malaria vaccine into its routine immunisation programme, demonstrates that pre-launch engagement of community leaders and frontline health workers is more effective than mass media reliance in achieving community understanding and acceptance at rollout.¹⁰ This finding underscores the need for integration of emerging platforms such as the internet and social media as efficient tools for mass awareness, while strengthening the capacity of health workers as communication agents will boost awareness for the introduction of new products.

The vaccine acceptance rate of 91.6% represents substantial population-level readiness for malaria vaccination and is consistent with comparable Nigerian cohorts where Adamu et al. documented 92.5% willingness in Gombe, Yusuf et al. reported 94.0% in Kaduna, and Chinawa et al. found 92.9% in Enugu, Nigeria.^{3, 12, 13} It also aligns with studies from Kenya and Cameroon with documented acceptability surpassing 85%.^{20, 25}

This convergence across geographically, educationally and religiously heterogeneous Nigerian and African populations indicates that high acceptance is a broad characteristic rather than a population-specific phenomenon and that the principal obstacle to vaccine uptake is not community resistance but logistical and structural deficits linked to limited availability, inadequate awareness, and incomplete rollout coverage. A systematic review by Sulaiman et al. reinforces this interpretation, reporting a pooled acceptance rate of 95.3% (95% CI: 93.0-97.2%) across LMICs, with Nigeria specifically recording the highest country-level acceptance at 97.6%.²¹

The perceived economic benefit of vaccination was notably high, with 91.3% of mothers believing it would reduce household malaria treatment expenditure. This perception is well grounded as malaria imposes a substantial economic burden through direct treatment costs, lost productivity, and school absenteeism, with the impact across Africa estimated at 1.2 billion US dollars annually.¹⁵ Framing the malaria vaccine as a household cost-saving intervention, therefore, represents a potentially powerful and under-utilized strategy for community mobilization. The dominant motivator for acceptance was prevention of serious malaria illness (83.5%), which similarly reflects the direct lived experience of disease burden in children, a salience also documented by Adamu et al. in Gombe, where 73.0% of caregivers cited confidence in the vaccine's protective benefit as their primary driver.¹² This disease salience should be a cornerstone of vaccination counseling. Adebajo et al. further caution that inadequate vaccination coverage in Nigeria's most disadvantaged communities reflects structural access barriers rather than attitudinal resistance. This finding should explicitly inform the equity considerations of Imo State's rollout planning.⁵

Among the 26 mothers who declined vaccination, spousal permission at 88.5% was the primary barrier, followed by concerns about inadequate vaccine testing at 61.5% and the perceived gatekeeping role of the mother-in-law at 30.8%. This contrasts with barriers noted in a qualitative study in Plateau State, Nigeria, where inadequate information, cultural and religious beliefs, accessibility and logistical barriers, and trust in health workers emerged.²⁶ The dominance of intra-household power dynamics in a predominantly Christian, educationally advantaged, southeastern cohort where religious or cultural prohibitions were minor concerns demonstrates that gender-based power asymmetries in healthcare decision-making transcend geopolitical and religious boundaries. This aligns with findings by Adebajo et al., who documented that socioeconomic factors systematically disadvantaging female caregivers, extend to vaccination behaviors in Nigeria and that closing gender-based disparities requires interventions explicitly addressing women's health decision-making autonomy.⁵ Maduka similarly noted that gender-specific sociocultural barriers persistently undermine malaria intervention uptake in Nigeria even where access and knowledge are not limiting factors.²⁷

The concern that the vaccine had not been adequately tested, expressed by 61.5% of refusers, reflects a documented global pattern of hesitancy toward newly introduced vaccines amplified by limited local exposure.

The WHO SAGE Working Group has characterized this as a confidence deficit shaped particularly by the absence of proactive, accurate information from trusted sources.¹¹ Olawade et al. identified inadequate community engagement and insufficient provider communication as the mechanisms through which misinformation proliferates in SSA vaccine introduction contexts.¹⁴ Yusuf et al. similarly cautioned that the absence of pre-rollout public education creates conditions for rumors that could significantly limit uptake beyond the pilot states.³ Osuntoye et al.'s analysis of the MVIP in Ghana reinforced this concern, documenting that low initial acceptance was attributable to insufficient community and stakeholder engagement at launch, with healthcare workers inadvertently communicating uncertainty by presenting

the vaccine as optional, unlike other routine vaccines.¹⁰ Kolawole et al. further emphasized that in the absence of reliable public health information in endemic settings, communities revert to traditional explanatory models and resist biomedical interventions.²

The absence of any statistically significant sociodemographic predictor of vaccine acceptance in this study markedly contrasts with the significant associations observed with younger caregivers (18-35years) and formal education reported in the Gombe study.¹² The Cameroonian and Kenyan studies also noted that education and generational differences predicted vaccine acceptance.^{25, 28} Our finding of absent significant predictor of knowledge equally contrasts with findings for both knowledge and awareness, key analytical findings of this study. It confirms that the high acceptance documented here is not concentrated among educated or higher-income subgroups but constitutes a broadly distributed disposition across all social strata. This aligns with Adamu et al.'s finding of uniformly high willingness across caregiver age and education categories in Gombe, and with the conclusion of Sulaiman et al. that Nigerian communities consistently exhibit the highest acceptance rates among LMIC populations reviewed.^{12, 21}

Implications for Policy and Practice

The findings of this study carry several implications for Nigeria's ongoing malaria vaccine rollout. First, the high acceptance rate of 91.6% coupled with low awareness of 45.0% indicates that the primary challenge is not persuading communities to accept the vaccine but ensuring that they are adequately informed about its availability and benefits. This suggests that communication efforts should prioritize awareness creation over persuasion, focusing on factual information about vaccine safety, efficacy, and operational details. Second, the dominance of health facilities as information sources at 70.0% implies that strengthening health worker communication skills and ensuring consistent messaging from providers will be critical to successful rollout. Third, the role of male partners and mothers-in-law in vaccine decision-making, 88.5% and 30.8% of refusers, respectively, necessitates a shift from targeting mothers alone to engaging entire households and communities in vaccination discussions. This is particularly important in the Nigerian context, where extended family structures and patriarchal decision-making norms influence health behaviours. Fourth, safety concerns cited by 61.5% of refusers indicate a need for transparent communication about vaccine development, testing, and monitoring processes, as well as rapid response systems to address adverse events following immunization.

Study Limitations

The facility-based recruitment strategy likely introduced selection bias toward mothers with more regular healthcare contact and higher health literacy than the general Owerri population, potentially overestimating knowledge and awareness. The cross-sectional design precludes causal inference. The small number of vaccine refusers $n = 26$ out of 311 limits statistical power for analyses of barriers. Notwithstanding these limitations, this study provides important baseline data for a geopolitical zone

under-represented in the malaria vaccine literature, with direct operational relevance to Nigeria's rollout expansion.

Conclusion and Recommendations

This study demonstrates that mothers of under-five children in Owerri, Imo State, possess high malaria vaccine knowledge and near-universal willingness to vaccinate their children. However, this readiness is constrained by factors that are logistical and sociocultural in nature rather than attitudinal, including low awareness, widespread uncertainty about vaccine availability, and the social barrier of spousal gatekeeping. The absence of any sociodemographic predictor of acceptance confirms that the malaria vaccine commands broad cross-strata community support, and that the gap between acceptance and actual uptake is predominantly structural. These findings align with the national pattern documented by Sulaiman et al., in which Nigerian communities consistently demonstrate the highest LMIC acceptance rates yet remain under-vaccinated due to access deficits.²¹

The following recommendations are proposed. Facility-based health worker communication should be prioritized and strengthened as the dominant, most trusted information channel, with training that extends to operational details including route, dosing schedule and age eligibility. Furthermore, male partner and mother-in-law engagement must be incorporated as an explicit component of vaccination counselling strategies, given that intra-household decision-making authority constitutes the single greatest identified barrier to uptake in this cohort. Multi-platform community sensitization integrating radio, community leaders, religious institutions and social media is required to close the awareness gap and proactively counter vaccine safety misconceptions before they consolidate into entrenched hesitancy, consistent with WHO SAGE guidance on addressing confidence deficits.¹¹ Nigeria's rollout expansion to Imo State should draw on documented lessons from the MVIP across Ghana, Kenya, Malawi and from Cameroon's non-pilot introduction, particularly regarding community and stakeholder pre-engagement and cold chain infrastructure adequacy.

Future research should employ community-based sampling, longitudinal follow-up to measure actual uptake post-rollout, and qualitative methods to further elucidate intra-household vaccine decision-making dynamics.

Declarations

Ethics approval and consent to participate:

Ethical approval was obtained from the Health Research Ethics Committee (HREC) of Federal Teaching Hospital, Owerri, Nigeria (FTHO), with approval number: FTH/OW/HREC/ Vol. 2/100. The study was conducted in accordance with the Declaration of Helsinki and national ethical guidelines for research involving human participants. Written informed consent was obtained from all participants before enrolment.

Consent to participate

Individual written informed consent was obtained from all participants before enrolment.

Competing interests:

The authors declare no competing interests.

Consent for publication

All participants gave consent to have their anonymized data published.

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Author Contribution

JE, CNO AK conceptualized the study, CNO collected data, CTC cleaned and entered data, FCE analysed data, JE, AK CNO, CTC and FCE were involved in manuscript writing. All authors reviewed the manuscript.

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Data Availability

Generated data is available from the corresponding author upon reasonable request.

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