**Understanding Caregiver Readiness and Awareness of Malaria Vaccination for Under-Five Children in A High-Burden Region**

**ABSTRACT**

**Background:** The malaria vaccine has proven effective in preventing malaria alongside other preventive methods. This study aimed to assess caregivers' knowledge, willingness, and barriers to malaria vaccination in a tertiary healthcare facility in southeast Nigeria. It also explored factors influencing willingness to vaccinate.

**Methods:** A cross-sectional descriptive study was conducted at the Institute of Child Health (ICH), UNTH, with 350 caregivers of children under five from a period of March to May 2025. Data were collected using interviewer-administered questionnaires developed by researchers with validation from WHO studies on malaria vaccine and simple random sampling. Analysis was done using SPSS v26, with Chi-square tests and a significance level of p<0.05.

**Results:** The study involved 350 caregivers (mean age 35 ± 9 years); most were female (94.6%), urban residents (61.7%), and Igbo (95.7%). Awareness of malaria was high (97.4%), and 71.4% had heard of the malaria vaccine. However, only 44% knew about the RTS,S vaccine, and 60.3% were aware of the recommended age of administration. About 82.9% correctly identified the vaccine as preventive, and 61.5% had good overall understanding. While only 27.1% were willing to enroll their child in a vaccine study, 96% were willing to receive the malaria vaccine, with 82.3% willing to vaccinate their child and 84.3% encouraging others. Key barriers included cultural beliefs, misinformation, and cost. No significant associations were found between knowledge or willingness and sociodemographic factors (p>0.05) as a satisfactory number seemed to be accommodating of the vaccine.

**Conclusion:** Despite strong willingness to vaccinate, knowledge gaps and sociocultural challenges persist among caregivers. For the malaria vaccine rollout in Nigeria to succeed, efforts must focus on improving public education, building trust in health systems, and addressing financial and informational obstacles. These findings are crucial for health policymakers, educators, and program developers focused on malaria eradication through immunization.

**Keywords:** Malaria, Awareness, willingness, barriers, caregivers, under-fives, malaria vaccine

**INTRODUCTION**

**BACKGROUND**

Malaria is a serious but avoidable public health issue brought on by the Plasmodium parasite, which is mainly spread by the bite of a female Anopheles mosquito carrying the infection.1 This disease continues to be a serious health concern, especially in underdeveloped areas of the world. The World Health Organization (WHO) estimates that between 300 and 500 million new cases of malaria occur each year, making it one of the top causes of death in underdeveloped nations. Unfortunately, more than 200 million of these cases end in death, with children under five making up the majority of those affected.1,2

Malaria continues to be a severe health concern, especially in undeveloped areas of the world. According to estimates from the World Health Organization (WHO), between 300 and 500 million new cases of malaria are reported annually, making it one of the leading causes of death in developing countries. Sadly, over 200 million of these cases result in death, with the majority of those impacted being children under five.3

Africa is the most impacted region in the world by malaria, with a disproportionate number of cases and fatalities. In particular, Nigeria is responsible for around 25% of all malaria infections and deaths worldwide.2 An estimated 241 million cases of malaria were recorded globally in 2020, with the majority of these cases happening in Africa and resulting in about 627,000 deaths.4

Insecticide-treated nets (ITNs), indoor residual spraying (IRS), and chemoprevention have all been used as malaria prevention techniques. However, significant developments in malaria control efforts are offered by the recent advent of malaria vaccines, such as the Oxford R21, RTS, and S/AS01 (Mosquirix), which offer extra layers of protection against the disease. The World Health Organization (WHO) approved the RTS,S/AS01 vaccine in 2021 because it has been shown to lower the number of malaria-related fatalities among children. Developed by Oxford University and manufactured by the Serum Institute of India and Novavax, the Oxford R21 vaccine has demonstrated a 75% efficacy rate for at least the first year and continues to be successful with a booster shot.5 Despite their potential, the uptake of malaria vaccines is influenced by caregivers' knowledge, attitudes, and willingness to accept them, necessitating research to better understand these factors.

Recent studies have explored various aspects of malaria vaccine acceptance. For instance, a study in Ghana found that caregivers' acceptance of the malaria vaccine was influenced by factors such as perceived vaccine efficacy, recommendations from health workers, and concerns about potential side effects.6 Similarly, research in Kenya demonstrated that vaccine hesitancy was linked to misinformation and distrust in healthcare systems.7 The malaria vaccine is meant to be given 4 times which is meant to be synchronized with the Extended Program on Immunization (EPI) with two additional booster doses given subsequently. 1

To be willing to accept the vaccine involves the emotional stand of caregivers towards malaria vaccination encompasses attitudes, beliefs, and perceptions influencing their engagement in the vaccination process.8 Factors like the ease of accessing vaccination services, resource availability, and logistical considerations contribute to caregivers' willingness to comply with vaccination schedules for their children.9

Malaria continues to be a leading cause of disease and mortality in children, especially in areas where it is highly endemic. If malaria in Nigeria is to be controlled, it is critical to comprehend the behavioral hurdles affecting caregivers' acceptance of a novel intervention such as the malaria vaccine.

The goal of the study is to identify obstacles to vaccine adoption so that specific initiatives can be developed to raise awareness, clear up misconceptions, and improve caregivers' acceptance of the malaria vaccine. Additionally, by formulating policies for the introduction of malaria vaccinations, the results of this study will address concerns regarding myths and misconceptions.

**LITERATURE REVIEW**

Malaria remains a significant public health challenge globally, particularly in sub-Saharan Africa. It is particularly concerning because of its impact on children under five years of age. Globally, there has been massive efforts to curb its morbidity and mortality through use of preventive measures like insecticide-treated nets (ITNs), indoor residual spraying, and prompt diagnosis and treatment, but unfortunately, the scourge has persisted. The World Health Organization's approval and recommendation of the RTS,S/AS01 (Mosquirix) malaria vaccine in 2021 and the subsequent approval of R21/Matrix-M in 2023 represent landmark developments in malaria prevention strategies (WHO, 2023).10

While this is a great step and welcome development in malaria prevention, the success of the vaccination programs would significantly depend on uptake rates by the under-fives in healthcare facilities. The uptake rate is influenced directly by the caregivers’ knowledge and willingness regarding malaria vaccine.

This review synthesizes peer-reviewed articles published between 2014 and 2025 addressing knowledge, perceptions, attitudes, and willingness regarding malaria vaccines among caregivers of children under five years. The search was conducted using databases including PubMed, Malaria Journal, Web of Science, and Google Scholar. Keywords included combinations of "malaria vaccine," "RTS,S," "R21," "caregiver knowledge," "vaccine acceptance," "vaccine hesitancy," "under-five children," and "tertiary facility."

**2.3 CAREGIVERS' KNOWLEDGE ABOUT MALARIA VACCINES**

Multiple studies have demonstrated variable levels of awareness about malaria vaccines among caregivers across different geographical regions. For instance, Mwingira et al.11 in a 2025 study conducted in Dar es Salaam, Tanzania, revealed that only 14.7% of the recruited caregivers were aware of the malaria vaccine. This contrasts with the findings of Ajayi and Emeto12 who reported a higher awareness level of 40.3% in a cross-sectional study conducted two years earlier across four states in Northern Nigeria. In a related study, Ojakaa et al.13 in 2021 investigated caregivers of sick children at 695 randomly selected healthcare facilities across Kenya and found awareness levels ranging from 25–40%, closely aligning with the findings from Northern Nigeria.

Furthermore, a number of studies indicate good understanding of the malaria vaccine's efficacy among caregivers. For example, Mohammed et al.14 found that 86.4% of the population believed that the malaria vaccine offered protection for children and would improve their ability to fight diseases. However, as Meñaca et al.15 noted in 2024, detailed knowledge of specific vaccines and their mechanisms remained limited among many caregivers.

In addition, sources of information play a crucial role in shaping awareness and understanding. Health facilities (47.6%) and television (45.2%) were identified by Mwingira et al.11 as the most common sources of malaria vaccine information. Among those exposed to vaccine messages, 67.4% correctly identified the vaccine’s target population as children under five, though 53.5% mistakenly believed it was meant for pregnant women. In Northern Nigeria, Alagbe et al.16 found that friends (47.1%), healthcare workers (19.1%), and antenatal clinics (15.2%) were the main sources of information. Other channels included social media (8.7%), relatives (5.9%), news/advertisements (2.9%), and radio (1.1%).

Finally, several factors have been associated with knowledge of the malaria vaccine. Ajayi and Emeto12 observed that awareness was significantly influenced by level of education, previous exposure to vaccines, and employment. Similarly, Ojakaa et al.13 reported that higher levels of education and socioeconomic status were positively correlated with better awareness.

**2. 4 WILLINGNESS TO ACCEPT MALARIA VACCINATION**

Acceptance rates for malaria vaccination among caregivers show considerable variability across studies. For instance, the aggregate acceptance rate was 95.3% in a study by Suleiman et al.17 with rates of 96.3% among the general population and 94.4% among mothers. When broken down by country, Nigeria had the highest acceptance rate at 97.6%, followed by Ghana at 94.6%, and Tanzania at 92.5%.

Moreover, studies conducted in tertiary healthcare facilities generally reported higher acceptance rates compared to community-based studies. For example, an acceptance rate of 96.3% was observed in Sierra Leone, whereas a considerably lower rate of 88% was reported in an older Kenyan study by Ojakaa et al.13 conducted in 2014. Additionally, a remarkably high acceptance rate of 99.3% was reported in a 2018 study18 conducted in Peru. However, Musa et al.19 noted that mothers from the Igbo and other ethnic groups were significantly less likely to express acceptance of the malaria vaccine.

In relation to demographic and socioeconomic factors, several studies have identified associations with willingness to accept vaccination. According to Nyalundja et al.,20 respondents with a monthly income of USD 200–500 had higher odds (aOR: 1.87) of accepting the vaccine, and those whose religion supported vaccination were also more likely to accept (aOR: 1.54), compared to those with lower income and religions that did not. Similarly, Alagbe et al.16 found that younger mothers (aged 15–34 years) were 1.2 times more likely to vaccinate their children compared to older mothers, and those earning more than ₦30,000 monthly were marginally more likely to accept vaccination. Furthermore, Röbl et al.21 reported that caregiver education level was positively associated with vaccine acceptance in Sierra Leone, with caregivers having secondary education or higher being 95% more likely to accept the vaccine compared to those with no formal education.

Additionally, health beliefs and perceived risk significantly influenced vaccination decisions. According to Bam et al.,22 perceptions of the severity of malaria and children’s vulnerability to infection were strong predictors of willingness to vaccinate.

Finally, trust in healthcare providers and systems consistently emerged as a critical factor in vaccine acceptance. Menaca et al.15 found that communities placed high value on vaccines and often cited them as a primary reason for attending Child Welfare Clinics. In the same vein, Ajayi and Emeto12 noted that positive prior experiences with childhood immunization services increased the likelihood of accepting the malaria vaccine.

**2.5 BARRIERS TO ACCEPTANCE**

Several barriers to malaria vaccine acceptance have been identified in the literature. Concerns about vaccine safety and potential side effects represent the most commonly cited barrier. Adigwe and Onovbavba23 showed that 2/3rds of his respondent's which was about 69.9% were worried about the potential side effects that may be associated with the newly approved malaria vaccine.

According to Röbl et al.,21 there is an association between the reported number of preventive measures against malaria taken at the household level and vaccine acceptance. The odds of willingness to vaccinate were significantly lower (aOR: 0.55, 95% CI: 0.32–0.94) for caregivers living in households where three preventive measures were taken, than those households with two or fewer preventive measures.

For Taylor et al.,24 they found that the role of religion played no influence with the propensity to refuse the OPV vaccine. However, this contrasted with Mollema et al.25 who found that individuals without religious beliefs were less like to hesitate to vaccinate than those with religious beliefs.

Religious and cultural beliefs have been identified as barriers in some contexts. Afolabi and Ilesnmi26 found that certain religious beliefs, particularly those suspecting vaccines of containing forbidden substances or being developed with ulterior motives, negatively influenced acceptance rates in some Nigerian communities.

**2.6 INTERVENTIONS TO IMPROVE KNOWLEDGE AND WILLINGNESS**

Targeted educational interventions have shown promise in improving caregivers' knowledge and willingness to accept malaria vaccination. For instance, Abdulkadir et al.27 reported that more than half of the caregivers had good knowledge of childhood vaccination, which may be attributed to intensified and long-standing campaigns promoting such immunization efforts.

In addition to educational interventions, integrating malaria vaccination with existing child health services has also been associated with improved uptake. Ajayi and Emeto12 suggested that the link between childhood vaccination and malaria vaccine awareness could be explained by the fact that caregivers who routinely take their children for vaccination are more likely to receive information on general health matters, including updates on new vaccines, from healthcare providers.

Furthermore, combining messages about the forthcoming malaria vaccine with current malaria prevention strategies should be implemented. They include the use of long-lasting insecticidal nets (LLINs) and Seasonal Malaria Chemoprevention. These efforts are best driven by healthcare workers operating at both community and facility levels to ensure consistent and effective communication.

**2.7 KNOWLEDGE GAPS AND FUTURE RESEARCH DIRECTIONS**

Despite growing research in this area, several knowledge gaps remain. Limited research exists on the sustainability of vaccine acceptance over time, particularly as children require multiple doses over several months. Longitudinal studies examining patterns of acceptance and completion of the full vaccination schedule are needed.

The relationship between knowledge, attitudes, and actual behavior requires further investigation. Most existing studies measure stated willingness rather than actual vaccine uptake. Research linking knowledge and stated willingness to actual vaccination behavior would provide valuable insights for implementation strategies.

The unique dynamics of tertiary healthcare settings compared to primary healthcare facilities or community-based vaccination programs remain understudied. Research specifically examining how the tertiary facility context influences caregiver knowledge and willingness would be valuable for tailoring interventions.

**RESEARCH METHODOLOGY**

**3.1 STUDY AREA**

The study was conducted at the University of Nigeria Teaching Hospital (UNTH), Ituku-Ozalla, in Enugu State, Nigeria, located in the southeastern geopolitical zone. UNTH is located in Ituku-Ozalla, Enugu State, Nigeria, which has a population of about 3.8 million and is known as the "Coal City." UNTH is a federal tertiary healthcare facility, established in the early 20th century, covering 200 acres with over 500 beds and 41 departments. It provides specialized services in various medical fields and sees about 700 outpatients daily, catering to both local and out-of-state patients. The hospital employs between 1,000 and 5,000 staff members. The study was done at the Immunization Clinic of the Institute of Child Health (ICH), UNTH.

**3.2 STUDY DESIGN**

This study adopted a cross-sectional survey design to assess caregivers' knowledge and willingness regarding malaria vaccination.

**3.3 STUDY POPULATION**

The study focused on caregivers of children under five attending a tertiary healthcare facility.

**3.4 SAMPLE SIZE**

In this study, the sample size was determined using the Cochrane’s formula

, where:

n= the minimum sample size required

zα = the standard normal deviation usually set at 1.96, which corresponds to the 95% confidence level

p = the prevalence rate obtained from a literature review from a previous study

d = the degree of accuracy desired, usually set at 0.05

From a previous study28 conducted on Knowledge and acceptance of malaria vaccine among parents of under-five children of malaria endemic areas, p = 70 % (or 0.7)

The sample size (n) for this study is hence:

n = (1.96)^2 \* 0.7 \* (1 - 0.7) / (0.05)^2

n = 0.806736 / 0.0025

n = 322.69

Rounded up: n ≈ 323

To account for dropout or non-response, 10% attrition rate is considered for the sample size as follows:

n / (1 - r)

= 323 / (1 - 0.10)

= 323 / 0.90

= 358.89

≈ 359

Hence, a sample size of **359** was be used for the study.

* 1. **SAMPLING TECHNIQUE**

A simple random sampling technique was employed to select caregivers attending the Institute of Child Health for participation in the study. A comprehensive daily attendance register of caregivers accompanying children to the facility served as the sampling frame. Each eligible caregiver (those who meet the study inclusion criteria) was assigned a unique identification number.

Using a random number generator, numbers corresponding to selected caregivers was drawn without replacement until the required sample size of 30 per day was attained. Recruitment continued across multiple clinic days, with the sampling process repeated every immunization day from the updated list of eligible caregivers, to ensure that the final total reaches the target of 359 participants.

This approach ensures that each eligible caregiver has an equal and independent chance of being selected, thereby minimizing selection bias and enhancing the representativeness of the sample.

**3.6 INCLUSION AND EXCLUSION CRITERIA**  
Inclusion Criteria:

* Caregivers of children under five attending the ICH clinic.
* Aged 18 years and above.
* Willing to participate and provide informed consent.

Exclusion Criteria:

* Caregivers who declined consent.
* Those critically ill or unable to respond appropriately.
* Health professionals or caregivers already participating in similar studies.
  1. **DATA COLLECTION TOOL**

A semi-structured interviewer-administered questionnaire was used for data collections

The sections included:

* Section A: Socio-Demographic Data.
* Section B: Knowledge of malaria vaccine among Caregivers of Under-five children attending the ICH at UNTH
* Section C: Willingness to uptake of malaria vaccine among Caregivers of Under-five children attending ICH at UNTH
* Section D: Barriers associated with the uptake of malaria vaccine among Caregivers of Under-five children attending ICH at UNTH
  1. **PRETESTING OF INSTRUMENT**

Prior to the main data collection, the questionnaire was pretested among 20 caregivers of under-five children attending a different outpatient clinic within the same teaching hospital to ensure clarity, relevance, and appropriateness of the items. Feedback from the respondents helped to identify ambiguous or confusing questions, which were subsequently revised for better understanding. The pretest also enabled the research team to estimate the average time required to complete the questionnaire and to evaluate the flow of questions for logical consistency.

* 1. **RELIABILITY OF QUESTIONNAIRE**

The draft questionnaire was pre‑tested on 20 caregivers. Items were recoded so that higher scores uniformly reflected greater knowledge or willingness. Reliability was then assessed with Cronbach’s alpha in SPSS v26; the final α for the knowledge scale was 0.81, indicating good internal consistency.

* 1. **STUDY DURATION**

The study lasted for a period of 3 months from March to May 2025.

* 1. **DATA MANAGEMENT AND ANALYSIS**

The data from this study was first be entered into Excel and cleaned up. Subsequently, the data will be exported into Statistical Package for the Social Sciences (SPSS) version 26. Data in SPSS was subsequently analyzed. Relevant tables and figures were created from the data to allow for easy analysis and interpretation.

Data on socio-demographic characteristics was presented in frequency distribution tables. Continuous variables such as age were presented in ranges and the mean age and standard deviation calculated.

Scores will be assigned to each knowledge question where a correct answer is scored 1 and an incorrect or uncertain response scored 0. A modified Bloom’s cut-off was adapted using a score of above 60% of correct answers to indicate good knowledge and a score of below 60% to indicate poor knowledge.29

Willingness to uptake of malaria vaccine among Caregivers of Under-five children was assessed with Yes, no, and Don’t Know. It was then graded using the questions and score of 1 point awarded to the correct option and 0 point for incorrect option. A score of 50% and above is graded willingness and <50% is unwillingness.

For the barrier section, responses to the affirmative and negative statements was scored from strongly agree (score of 5), agree (score of 4), neutral (score of 3), disagree (score of 2), and to strongly disagree (score of 1), according to the Likert scale. After the responses will be totaled and each respondent was assigned a total score; the mean score was then determined, and responses with scores higher than or equal to the mean deemed accepted barriers while those with scores lower than the mean were deemed rejected barriers. This holds for positive statements. Negative statements were first reversed before total score calculated.

To examine the relationships between knowledge, willingness and barriers and socio demographic profile, Chi-square tests was carried out at statistical significance p < 0.05.

**4.1 RESULTS**

**4.1.1 RESPONSE RATE**

Table 1: Questionnaire Response Rate

|  |  |  |
| --- | --- | --- |
| Questionnaire Status | Number | Percentage (%) |
| Returned | 350 | 97.5% |
| Not Returned | 9 | 2.5% |
| Total Distributed | 359 | 100% |

Participants in the study were given a total of 359 questionnaires. 350 of which were recovered, yielding a response rate of 97.5%.

**4.1.2 SOCIODEMOGRAPHIC CHARACTERISTICS**

Table 2: Socio-Demographic Characteristics of Caregivers of under-five Children attending Institute of Child Health, UNTH

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variables | | Frequency | Percentage (%) | Mean | Standard Deviation |
| Sex | Male | 19 | 5.4 |  |  |
| Female | 331 | 94.6 |  |  |
| Age | <20 | 31 | 8.9 | 35 | 9 |
| 21-30 | 97 | 27.7 |  |  |
| 31-40 | 116 | 33.1 |  |  |
| >40 | 106 | 30.3 |  |  |
| Residence | Urban | 216 | 61.7 |  |  |
| Rural | 134 | 38.3 |  |  |
| Religion | Pentecostal | 141 | 40.3 |  |  |
| Catholic | 128 | 36.6 |  |  |
| Muslim | 3 | .9 |  |  |
| Others | 78 | 22.3 |  |  |
| Ethnicity | Igbo | 335 | 95.7 |  |  |
| Hausa | 5 | 1.4 |  |  |
| Yoruba | 10 | 2.9 |  |  |

Table 2 shows that the majority of respondents were female (94.6%) with a mean age of 35 years and a standard deviation of 9. Most were within the 31–40 age group. A greater proportion resided in urban areas (61.7%), and the predominant religion was Pentecostal (40.3%), followed by Catholic (36.6%). The sample was largely Igbo (95.7%), reflecting the ethnic composition of the study location.

**4.1.3 KNOWLEDGE OF MALARIA VACCINE**

Table 3a: General Knowledge of Malaria among caregivers of under-fives at the Institute of Child Health, UNTH

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | | Frequency | Percentage (%) |
| Have you heard about malaria? | Yes | 341 | 97.4 |
| No | 9 | 2.6 |
| How is malaria transmitted? | Mosquito bite | 340 | 97.1 |
| Dirty water | 5 | 1.4 |
| Contact with infected person | 2 | 0.6 |
| Don't know | 3 | 0.9 |

Table 3a shows that majority of respondents (97.4%) reported having heard about malaria. When asked about the mode of transmission, 97.1% correctly identified mosquito bites as the source, while only a few selected incorrect options such as dirty water (1.4%), contact with an infected person (0.6%), or indicated they did not know (0.9%).

Table 3b: Knowledge of Malaria Vaccine among caregivers of under-fives at the Institute of Child Health, UNTH

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | | Frequency | Percentage (%) |
| Have you heard about malaria vaccine? | Yes | 250 | 71.4 |
| No | 100 | 28.6 |
| Do you know the purpose of malaria vaccine? | Prevent malaria | 290 | 82.9 |
| Cure malaria | 32 | 9.1 |
| Don't know | 28 | 8.0 |
| Should everyone receive a malaria vaccine? | Yes | 313 | 89.4 |
| No | 37 | 10.6 |
| Do you know the recommended age for administering the malaria vaccine to children? | Yes | 211 | 60.3 |
| No | 139 | 39.7 |
| Do you believe malaria is a serious health issue that needs vaccination? | Yes | 331 | 94.6 |
| No | 19 | 5.4 |

Table 3b shows that majority of respondents (71.4%) had heard about the malaria vaccine, and 82.9% correctly identified its purpose as preventing malaria. A large proportion (89.4%) agreed that everyone should receive the malaria vaccine, and 94.6% believed malaria is a serious health issue requiring vaccination. However, only 60.3% were aware of the recommended age for administering the vaccine to children, indicating a gap in specific knowledge despite overall positive awareness and perception.

Table 3b: Knowledge of Malaria Vaccine among caregivers of under-fives at the Institute of Child Health, UNTH (Contd…)

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | | Frequency | Percentage (%) |
| Have you heard of RTS,S vaccine? | Yes | 153 | 44 |
| No | 197 | 56 |
| Are you confident in the effectiveness of malaria vaccine? | Yes | 265 | 76 |
| No | 85 | 24 |
| Have you heard that the WHO will recommend (RTS, S) malaria vaccine in Nigeria for children by mid-2024 to early 2025? | Yes | 100 | 29 |
| No | 250 | 71 |
| Do you believe that malaria vaccine will have a negative effect on a child? | Yes | 46 | 13 |
| No | 304 | 87 |

From table 3b, less than half of the respondents (44%) had heard of the RTS,S malaria vaccine, and only 29% were aware that the World Health Organization plans to recommend it for children in Nigeria by mid-2024 to early 2025. Despite this limited awareness, a strong majority (76%) expressed confidence in the effectiveness of the malaria vaccine, and 87% did not believe it would have a negative effect on children, indicating generally positive perceptions despite gaps in specific knowledge.

Figure 1: Source of Information on Malaria Vaccine among Caregivers of Under-fives at Institute of Child Health, UNTH

The most common source of information about the malaria vaccine was hospitals or health workers (28.7%), followed by television (24.0%). Community outreach programs accounted for 15.6%, while social media contributed 12.5%. Other sources made up 19.2%, indicating a diverse mix of information channels accessed by respondents.

Figure 2: Overall knowledge level of malaria and malaria vaccine among Caregivers of Under-fives at Institute of Child Health, UNTH

The results show that 61.5% of respondents demonstrated good knowledge overall about the malaria vaccine, while 34.9% had poor knowledge. Hence, although over half of the participants are well-informed, a significant proportion still lack adequate knowledge.

**4.1.4 WILLINGNESS TOWARDS UPTAKE OF MALARIA VACCINE**

Table 4: Willingness towards Uptake Malaria Vaccine among Caregivers of under-five Children attending ICH, UNTH

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variables | Yes | | No | | I don't know | |
| Frequency | (%) | Frequency | (%) | Frequency | (%) |
| Will you vaccinate your child against malaria vaccine? | 288 | 82.3 | 31 | 8.9 | 31 | 8.9 |
| Will you spend money for your child to receive malaria vaccine? | 279 | 79.7 | 43 | 12.3 | 28 | 8.0 |
| Should every child receive malaria vaccine? | 292 | 83.4 | 38 | 10.9 | 20 | 5.7 |
| Will you encourage your other family members and neighbors to vaccinate their child against malaria? | 295 | 84.3 | 34 | 9.7 | 21 | 6.0 |

The findings of Table 4 show strong parental acceptance of the malaria vaccine. About 82.3% are willing to vaccinate their child, 79.7% are ready to spend money for it, and 83.4% believe every child should receive it. Additionally, 84.3% would encourage others to vaccinate their children, reflecting overall positive attitudes toward the malaria vaccine among respondents.

Table 4: Willingness towards Uptake Malaria Vaccine among Caregivers of under-five Children attending ICH, UNTH (Contd..)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variables | Yes | | No | | I don't know | |
| Frequency | (%) | Frequency | (%) | Frequency | (%) |
| Do you think the newly discovered WHO recommended (RTS, S) malaria vaccine for children in 2021 is safe to take? | 247 | 70.6 | 26 | 7.4 | 77 | 22.0 |
| Would you allow your child to be a volunteer for malaria vaccine trial? | 95 | 27.1 | 179 | 51.1 | 76 | 21.7 |
| Would you recommend that malaria vaccine be made part of the National Program on Immunization? | 248 | 70.9 | 36 | 10.3 | 66 | 18.9 |
| Would you be interested in receiving more information about the malaria vaccine? | 286 | 81.7 | 11 | 3.1 | 53 | 15.1 |

Table 4 shows that a majority of respondents (70.6%) believe the WHO-recommended RTS,S malaria vaccine is safe, and 70.9% support its inclusion in the National Program on Immunization. However, only 27.1% would allow their child to participate in a vaccine trial, while 51.1% opposed it. Notably, 81.7% expressed interest in receiving more information about the vaccine, indicating a high demand for further awareness and education despite mixed perceptions about direct participation in trials.

Figure 3: Overall Level of Willingness towards Uptake of Malaria Vaccine among Caregivers of under-five Children attending ICH, UNTH

Figure 3 shows that there is a high level of willingness to accept malaria vaccination with willingness levels recorded as 96% and unwillingness levels only 4% of the population.

**4.1.5 BARRIERS TO MALARIA UPTAKE**

Table 5: Barriers to Malaria Vaccine Uptake Among Caregivers at the Institute of Child Health, UNTH

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | SD | | D | | N | | A | | SA | | X | Decision |
| F | % | F | % | F | % | F | % | F | % |  |  |
| Lack of awareness of the malaria | 46 | 13.1 | 85 | 24.3 | 95 | 27.1 | 88 | 25.1 | 36 | 10.3 | 2.95 | Reject |
| Misinformation and misconception about vaccines | 27 | 7.7 | 91 | 26.0 | 107 | 30.6 | 91 | 26.0 | 34 | 9.7 | 3.04 | Accept |
| Access to healthcare services | 42 | 12.0 | 85 | 24.3 | 120 | 34.3 | 64 | 18.3 | 39 | 11.1 | 2.92 | Reject |
| Cost of the vaccine | 32 | 9.1 | 84 | 24.0 | 93 | 26.6 | 104 | 29.7 | 37 | 10.6 | 3.09 | Accept |
| Cultural beliefs and practices | 26 | 7.4 | 92 | 26.3 | 120 | 34.3 | 74 | 21.1 | 38 | 10.9 | 3.02 | Accept |
| Safety/Fear of Side effects | 27 | 7.7 | 114 | 32.6 | 105 | 30.0 | 80 | 22.9 | 24 | 6.9 | 2.89 | Reject |
| Religion | 47 | 13.4 | 78 | 22.3 | 117 | 33.4 | 79 | 22.6 | 29 | 8.3 | 2.90 | Reject |
| Effectiveness | 35 | 10.0 | 106 | 30.3 | 88 | 25.1 | 91 | 26.0 | 30 | 8.6 | 2.93 | Reject |
| Opinion of husband | 32 | 9.1 | 88 | 25.1 | 105 | 30.0 | 92 | 26.3 | 33 | 9.4 | 2.91 | Reject |
| Opinion of mother-in-law | 24 | 6.9 | 88 | 25.1 | 99 | 28.3 | 101 | 28.9 | 38 | 10.9 | 2.99 | Reject |

Table 5 summarizes respondents’ views on factors affecting malaria vaccine uptake, revealing that only three factors exceeded the acceptance threshold of 3.0: cost of the vaccine (mean = 3.09), misinformation/misconception (mean = 3.04), and cultural beliefs (mean = 3.02). These emerged as the most significant perceived barriers. Other factors such as lack of awareness, access to healthcare, and concerns about vaccine safety and effectiveness fell just below the threshold, suggesting moderate influence on vaccine acceptance.

**4.1.6 ASSOCIATIONS BETWEEN KNOWLEDGE AND WILLINGNESS AND SOCIODEMOGRAPHIC CHARACTERISTICS**

Table 6a: Association between knowledge and sociodemographic characteristics Among Caregivers at the Institute of Health, UNTH

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | | Overall Knowledge Level | | | |  |  |
| Bad knowledge | | Good knowledge | | X2 | P |
| Freq | % | Freq | % |  |  |
| Age | <20 | 13 | 10.7% | 18 | 9.2% | 1.184 | 0.757 |
| 21-30 | 30 | 24.6% | 58 | 29.7% |  |  |
| 31-40 | 41 | 33.6% | 65 | 33.3% |  |  |
| >40 | 38 | 31.1% | 54 | 27.7% |  |  |
| Sex | Male | 3 | 2.5% | 12 | 6.2% | 2.273 | 0.132 |
| Female | 119 | 97.5% | 183 | 93.8% |  |  |
| Residence | Urban | 82 | 67.2% | 117 | 60.0% | 1.671 | 0.196 |
| Rural | 40 | 32.8% | 78 | 40.0% |  |  |
| Religion | Pentecostal | 50 | 41.0% | 76 | 39.0% | 2.877 | 0.411 |
| Catholic | 39 | 32.0% | 77 | 39.5% |  |  |
| Muslim | 2 | 1.6% | 1 | 0.5% |  |  |
| Others | 31 | 25.4% | 41 | 21.0% |  |  |
| Ethnicity | Igbo | 117 | 95.9% | 186 | 95.4% | 0.530 | 0.767 |
| Hausa | 2 | 1.6% | 2 | 1.0% |  |  |
| Yoruba | 3 | 2.5% | 7 | 3.6% |  |  |

Statistical significance is set at p<0.05

Table 6a presents the relationship between sociodemographic factors and overall knowledge of the malaria vaccine. Most respondents were aged 31–40, female, urban residents, and predominantly Igbo. While good knowledge was more common among females, urban dwellers, and those aged 31–40, none of the associations with age, sex, residence, religion, or ethnicity were statistically significant (p > 0.05).

Table 6b: Association between Willingness and sociodemographic characteristics Among Caregivers at the Institute of Health, UNTH

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | | Overall Willingness level | | | |  |  |
| Unwillingness | | Willingness | | X2 | P |
| Freq | % | Freq | % |  |  |
| Age | <20 | 0 | .0 | 31 | 9.2 | 2.924 | 0.404 |
| 21-30 | 4 | 28.6 | 93 | 27.7 |  |  |
| 31-40 | 7 | 50.0 | 109 | 32.4 |  |  |
| >40 | 3 | 21.4 | 103 | 30.7 |  |  |
| Sex | Male | 0 | .0 | 19 | 5.7 | 0.837 | 0.360 |
| Female | 14 | 100.0 | 317 | 94.3 |  |  |
| Residence | Urban | 10 | 71.4 | 206 | 61.3 | 0.582 | 0.445 |
| Rural | 4 | 28.6 | 130 | 38.7 |  |  |
| Religion | Pentecostal | 4 | 28.6 | 137 | 40.8 | 1.038 | 0.792 |
| Catholic | 6 | 42.9 | 122 | 36.3 |  |  |
| Muslim | 0 | .0 | 3 | .9 |  |  |
| Others | 4 | 28.6 | 74 | 22.0 |  |  |
| Ethnicity | Igbo | 13 | 92.9 | 322 | 95.8 | 1.158 | 0.560 |
| Hausa | 0 | .0 | 5 | 1.5 |  |  |
| Yoruba | 1 | 7.1 | 9 | 2.7 |  |  |

Statistical significance is set at p<0.05

The table summarizes the association between sociodemographic characteristics and overall willingness to accept the malaria vaccine. Willingness was highest among females, those aged 31–40, urban residents, Pentecostals, and the Igbo ethnic group. However, none of the associations with age, sex, residence, religion, or ethnicity were statistically significant (p > 0.05).

**4.2 DISCUSSION**

The majority of caregivers in this study were female (94.6%) and between the ages of 31 and 40, with a mean age of 35 (±9 SD). They were primarily Igbo (95.7%), urban (61.7%), and Christian, particularly Catholic (36.6%) and Pentecostal (40.3%). These results are consistent with those of Mwingira et al.,11 who also found that women made up the majority of caregivers. This suggests that women bear the majority of the responsibility for child health in a variety of African contexts. This study's ethnic and religious makeup may restrict generalizability because it represents the local demography of the study site (UNTH in southeast Nigeria).

Nearly all respondents (97.4%) were aware of malaria, and most (97.1%) correctly identified mosquito bites as the method of transmission. A comparatively high 71.4% of people were aware of the malaria vaccine, and 82.9% of them correctly identified its goal as preventing sickness. These numbers represent a significant increase over those seen in a number of prior studies. For example, Ajayi and Emeto12 reported 40.3% awareness of the malaria vaccine in Northern Nigeria, while Mwingira et al.11 reported only 14.7% awareness in Tanzania. Similarly, Ojakaa et al.13 observed awareness levels ranging from 25–40% among healthcare facilities in Kenya.

The study's location at a tertiary healthcare center, which frequently offers greater access to health education and vaccine promotion than community-based or rural contexts, may be the reason for the increased knowledge seen in this study. Literature such as that of Sulaiman et al.,17 who observed greater knowledge and acceptance rates in facility-based research, lends credibility to this idea.

Although the general level of awareness was high, just 44% of those surveyed had heard of the specific RTS,S malaria vaccine, and only 29% knew that the WHO would soon recommend its use in Nigeria by 2024–2025. This finding is in line with Meñaca et al.,15 who pointed out that although thorough knowledge of individual vaccines was still lacking, broad vaccine efficacy was understood.

The study also revealed that the most popular information sources were health facilities (28.7%) and television (24%). These findings are in line with those of Mwingira et al.11 who indicated that hospitals (47.6%) and television (45.2%) were the preferred channels. The current study identified social media and community outreach initiatives as secondary sources, in contrast to Alagbe et al.,16 who pointed out that friends and prenatal clinics were important sources in Northern Nigeria. These disparities might be a reflection of geographical differences in access to the media and levels of faith in medical institutions.

96% of caregivers in this study expressed general willingness to accept the malaria vaccine, which is a remarkably high level of willingness. To be more precise, 82.3% of respondents stated that they would vaccinate their child, 79.7% said they would be ready to pay for it, and 84.3% said they would urge others to do the same. These numbers are in line with, or slightly below, those reported by Musa et al.,19 (97.6% in Nigeria), Sulaiman et al.17 (acceptance rate: 95.3%), and Ojakaa et al.13 in Kenya (94.4%). Given that 94.6% of respondents viewed malaria as a serious health issue that required vaccination, these high acceptance levels may once more be ascribed to the tertiary care setting and high perceived severity of malaria, which supports findings by Bam et al.,22 who highlighted that perceived risk and severity are important predictors of vaccine acceptance.

Just 27.1% of parents were willing to let their kids take part in malaria vaccine trials, despite a high level of general willingness. This reluctance may be due to safety concerns and a fear of the unknown, which is in line with research by Adigwe and Onovbavba,23 which found that almost 70% of parents were concerned about the negative effects of new vaccines.

It is noteworthy that the study did not identify religion, vaccine safety, or effectiveness as significant barriers because their mean scores were below the 3.0 criterion. This finding is slightly at odds with the findings of Afolabi and Ilesanmi26, who highlighted the importance of religious mistrust, and Röbl et al.,21 who mentioned safety as a prominent worry. The disparity can be a result of regional variations in religious perspectives on vaccination and trust in the healthcare system. Notably, the current study found no significant correlation between religion and either willingness or knowledge, which is consistent with the findings of Taylor et al.,24 who came to the conclusion that religion had no bearing on OPV refusal.

The most significant barriers among those evaluated were cost (mean = 3.09), misinformation (3.04), and cultural beliefs (3.02), which are consistent with previous findings by Afolabi and Ilesanmi,26 who found that religious and traditional beliefs could have a negative impact on vaccine acceptance. Misinformation is a particularly prevalent barrier, as noted in the literature (e.g., Adigwe and Onovbavba23) and the current study, underscoring the need for focused health education campaigns.

In this study, no meaningful correlations between knowledge levels and sociodemographic factors were discovered. This stands in contrast to research by Ajayi and Emeto12 and Ojakaa et al.,13 who found that vaccination awareness was positively correlated with both education level and employment position. Given that the majority of the study's participants were educated, urban-dwelling women, the sample may have been rather homogeneous, which could have obscured disparities that would otherwise be more noticeable in a population with a wider range of socioeconomic backgrounds.

Although none of the sociodemographic factors were substantially associated with willingness in this investigation, earlier studies have shown otherwise. Younger age and higher wealth were found to predict increased willingness by both Nyalundja et al.20 and Alagbe et al.16 In a similar vein, Röbl et al.21 discovered a correlation between acceptance and higher education levels. Again, the absence of significant connections in this study could be the result of a ceiling effect caused by the high willingness across the board or sample homogeneity.

Overall, the outcomes of this study show better levels of malaria vaccination awareness and willingness than most of the literature evaluated. These favorable results were probably influenced by the tertiary healthcare center setting, the majority of urban and educated caregivers, and trust in healthcare systems. Reluctance to take part in vaccine studies, persisting disinformation, and knowledge gaps about particular vaccines (such RTS and S) are still concerns that need to be addressed. To achieve widespread and long-term uptake of the malaria vaccine, interventions aimed at closing these gaps will be essential, particularly when conducted through reliable sources like the media and medical professionals.

**4.3 CONCLUSION**

This study evaluated caregivers of children under five at the Institute of Child Health, University of Nigeria Teaching Hospital (UNTH), Enugu, about their knowledge, willingness, and obstacles regarding the uptake of the malaria vaccine. The results demonstrated that respondents had a high degree of general awareness about malaria and a comparatively high level of awareness of the malaria vaccine. The majority of caregivers showed a solid understanding of the function of the malaria vaccine and the way it helps prevent malaria. But there were still certain knowledge gaps, especially with regard to the RTS,S vaccine and the ideal age to administer it, indicating the need for more focused educational initiatives.

Given that 96% of respondents had a favorable view regarding vaccination their children against malaria, willingness to accept the vaccine was determined to be exceptionally high. Indicating widespread community readiness for vaccine deployment, the majority were also eager to spend money on immunization and to persuade others to become involved. These acceptance levels support the importance of institutional health settings in promoting healthy behaviors and are in line with results from facility-based research conducted throughout Africa, especially in Nigeria. However, reluctance to take part in vaccine studies and mild safety concerns point to areas that require greater transparency and community involvement.

Although a number of potential obstacles to the adoption of the malaria vaccine were investigated, just a few—cost, disinformation, and cultural beliefs—came to light as serious issues. This study population did not strongly approve other barriers that are frequently mentioned in the literature, such as fear of side effects and religious views. Strong faith in the healthcare system and religious tolerance in the area may be the reasons for these characteristics' comparatively modest impact in the current study. However, maintaining high vaccination acceptance rates and guaranteeing fair access for all socioeconomic groups still depend on clearing up inaccurate information and enhancing affordability.

According to the study's findings, parents in a tertiary healthcare setting are prepared to vaccinate their children against malaria, but it also highlights important information gaps and persistent sociocultural issues. Enhancing public education, bolstering confidence in health institutions, and addressing informational and financial obstacles are all critical to the successful deployment of the malaria vaccine, particularly as it gets ready for its WHO-backed launch in Nigeria. Policymakers, health educators, and program designers aiming to eradicate malaria through vaccination techniques can learn a lot from these findings.

### **4.4 RECOMMENDATIONS**

Based on the findings of this study, the following recommendations are made to promote knowledge, acceptance, and adoption of the malaria vaccination among caregivers, particularly as Nigeria prepares for the countrywide rollout of the RTS,S vaccine:

1. **Boost Campaigns for Public Health Education and Awareness**

In particular, the RTS,S vaccine's purpose, safety, effectiveness, and recommended age of administration should be covered in more detail in public health campaigns that emphasize malaria vaccine education. Even with widespread awareness, there are still large gaps in some knowledge. To prevent misconceptions, health promotion campaigns should incorporate culturally relevant, simplified messaging that explains the advantages and limits of the malaria vaccination.   
According to this study, the most efficient information sources for health education are community outreach initiatives, hospitals, health professionals, and media. It may also be possible to reach caregivers early and often by incorporating these messages into prenatal and vaccination clinic visits.

1. **Address Cultural Illusions and Misinformation**

Through community discussions and stakeholder participation, health officials must aggressively address rumors, misconceptions, and vaccination reluctance, as disinformation and cultural beliefs were found to be major obstacles to vaccine uptake. Involving traditional influencers, religious leaders, and community leaders in sensitization campaigns can help dispel misconceptions and foster trust, especially among conservative and rural groups.   
Creating focused communication plans with the use of regional languages and early adopters' testimonies could also aid in clearing up misconceptions and anxieties. These campaigns should specifically highlight the RTS,S vaccine's safety and make it clear that it is a supplement to other malaria prevention measures rather than a replacement for them.

1. **Increase the affordability and accessibility of vaccines**

The cost of the malaria vaccine was shown to be a major deterrent. To enhance fairness in vaccination access, the government should consider financing or fully integrating the malaria vaccine into the National Program on Immunization (NPI), as supported by over 70% of the survey participants. It will help guarantee that children from low-income households are not excluded if the vaccine is made freely available through primary healthcare centers.   
A sufficient supply and distribution of the vaccine, particularly to underprivileged rural communities, should also be guaranteed by logistical planning. Healthcare personnel must be properly trained in vaccination delivery, storage, and community outreach as part of a gradual deployment.

1. **Encourage Participation in Research and Community Engagement**

The low percentage of respondents (27.1%) who are prepared to let kids take part in vaccine trials points to a persistent fear or mistrust of medical research. Future vaccine-related research and pilot projects should address this by include caregivers early in the design phase through feedback sessions, community advisory boards, and open communication.   
Future study participation may progressively rise as a result of enhancing research literacy and emphasizing the value of clinical trials in enhancing public health outcomes. Providing safety guarantees, informed consent, and ethical standards can all help to boost caregiver confidence.

1. **Track and Assess Vaccine Rollout Developments**

Mechanisms for ongoing monitoring and evaluation should be put in place as Nigeria is ready to incorporate the malaria vaccine into national policy. Regular input from healthcare professionals and caregivers will assist in identifying new issues and areas that could use improvement. Continuous knowledge levels, acceptance patterns, and obstacles over time can be evaluated using surveys, focus groups, and digital reporting tools. The information acquired by these systems will guide future plans and guarantee that the malaria vaccine is implemented in a way that is effective, inclusive, and responsive.

**ETHICAL APPROVAL and CONSENT:**

Ethical approval was obtained from the Ethical Clearance Committee, UNTH. Participants were informed about the study's purpose and verbal consent obtained before participation. Confidentiality and anonymity were maintained throughout the study.

**Disclaimer (Artificial intelligence)**

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1.

2.

3.

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