KNOWLEDGE, PERCEPTION AND ACCEPTANCE OF MALARIA VACCINE AMONG CAREGIVERS OF UNDER-FIVE CHILDREN IN BENIN CITY, EDO STATE

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DECLARATION

We hereby declare that this project work is original and was carried out by the under-listed students under the supervision of **Dr. (Mrs.) O.E Obarisiagbon** and **Dr. G. Oko-Oboh** and has not been published elsewhere for the award of a degree or certificate.

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CERTIFICATION

This is to certify that this research work titled "knowledge, Perception and Acceptance of Malaria Vaccine among Caregivers of under-five Children in Benin City, Edo State**."** Was carried out in the Department of public Health and Community Medicine, School of Medicine, College of Medical Sciences, University of Benin, Benin City, Edo State, Nigeria as part of the requirements for the award of Bachelor of Medicine, Bachelor of Surgery (MBBS) by **OKOTETE EMMANUEL** with matriculation number MED1807460 and **OMOROGBE WISDOM OSAHENRUMWEN** with matriculation number **MED1807473.**

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DEDICATION

We dedicate this work to God Almighty, who has brought us this far in our pursuit of becoming Medical Doctors. This project is also dedicated to our families and teachers, who have been our pillars over the years and have contributed immensely to our project. We also dedicate this to our colleagues, friends, and well-wishers

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LIST OF ABBREVIATION

ATR	African Traditional Religion
COVID-19	Coronavirus disease 2019
EPI	Expanded Programme on Immunization
NMCP	National Malaria Control Program
NMEP	National Malaria Elimination Program
NPHCDA	National Primary Health Care Development Agency
RBM	Roll Back Malaria
RDTs	Rapid Diagnostic Tests
SEC	Socio- Economic Class
WHO	World Health Organization

DEFINITION OF TERMS

Malaria: A life- threatening disease caused by parasites that are transmitted to people through the bites of infected mosquitoes.

Notifiable diseases: A disease that, when diagnosed, requires health providers (usually by law) to report to state or local public health officials.

Vaccine: A product that stimulates a person's immune system to produce immunity to a specific disease, protecting the person from that disease.

Vaccination: The act of introducing a vaccine into the body to produce immunity to a specific disease.

Vaccine hesitancy: Delay in acceptance or refusal of vaccines despite the availability of vaccine service

ABSTRACT

Background: Malaria remains a leading cause of morbidity and mortality among under-five children in Nigeria. The introduction of malaria vaccines (RTS,S/AS01 and R21/Matrix-M) offers a promising complementary intervention. However, vaccine acceptance is critically dependent on caregivers' knowledge and perceptions—factors that remain poorly characterized in Benin City, Edo State.

Objective: To assess the knowledge, perception, acceptance, and factors influencing acceptance of malaria vaccines among caregivers of under-five children in Benin City, Edo State, Nigeria.

Methods: A community-based descriptive cross-sectional study was conducted from May 2024 to May 2026 among 426 caregivers of under-five children selected through a multi-stage sampling technique in Ekosodin community, Ovia North-East Local Government Area, Benin City. Data were collected using a pretested, structured, interviewer-administered questionnaire. Knowledge was assessed using a 12-point scoring system (categorized as good: ≥50%), perception using a 10-item Likert scale (positive: >60%), and acceptance as willingness to vaccinate. Data were analyzed using IBM SPSS version 27.0; bivariate and multivariate logistic regression analyses were performed with statistical significance set at $p<0.05$.

Results: The mean age of respondents was 35.2±10.4 years; the majority were female (68.1%), married (67.1%), and had secondary education (43.7%). While awareness of malaria was universal (99.8%), only 44.1% had heard of the malaria vaccine, and overall good knowledge of the vaccine was poor (20.2%). Positive perception toward the malaria vaccine

was high (84.7%). Willingness to accept the vaccine was 73.5%, although actual uptake remained low (11.5%). Fear of adverse reactions (82.3%) was the predominant reason for refusal. Significant predictors of good vaccine knowledge included tertiary education (AOR=4.84; 95% CI: 2.67–8.77; p=0.001) and ever-married status (AOR=2.40; 95% CI: 1.09–5.26; p=0.030). Positive perception was strongly associated with Christian religious affiliation (AOR=7.37; 95% CI: 3.10–17.54; $p<0.001$). The strongest independent predictor of willingness to accept the malaria vaccine was positive perception (AOR=7.39; 95% CI: 3.87–14.12; $p<0.001$), followed by good knowledge of the vaccine (AOR=2.87; 95% CI: 1.24–6.63; p=0.014). Increasing age was associated with reduced willingness (AOR=0.97; 95% CI: 0.95–1.00; p=0.046).

Conclusion: Despite favorable perception and high willingness to accept malaria vaccines among caregivers in Benin City, significant gaps exist in knowledge and awareness. Perception emerged as the strongest driver of acceptance, while educational status and marital status influenced knowledge. These findings underscore the urgent need for targeted health education interventions, particularly leveraging healthcare professionals as trusted information sources, to bridge the knowledge-practice gap and optimize malaria vaccine uptake in this setting.

Keywords: Malaria vaccine, knowledge, perception, acceptance, caregivers, under-five children, Benin City, Nigeria.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of Study

Malaria remains a significant global health issue, particularly in tropical countries, despite concerted efforts to combat it and according to the World Health Organization (WHO), there were 219 million malaria cases and 435,000 deaths worldwide in 2017.[1]

The WHO's latest report indicates a worsening trend, with 241 million cases and 627,000 deaths in 2020, representing a 14 million increase in cases and a 69,000 increase in fatalities from 2019.[2]

Malaria disproportionately affects vulnerable populations, particularly children under five, who account for over 200,000 annual deaths in Africa due to *falciparum* malaria, and significant morbidity and mortality in Asia and Oceania due to *vivax* malaria.[3] In Nigeria, malaria is responsible for approximately 400,000 deaths annually, mostly among young children.[4]

Plasmodium falciparum and *Plasmodium vivax* are the most common causes of human malaria, with distinct geographic distributions.[5] Human infection occurs during the blood meal of an infected female mosquito belonging to the Anopheles genus.[6]

The development and introduction of malaria vaccines represent a crucial step towards malaria elimination and eradication.[7] However, the success of these vaccines depends on their acceptance by caregivers, particularly those of children under five.[8]

Research has shown that caregivers' awareness and knowledge of malaria vaccines significantly influence their acceptance and uptake.[7,9] However, gaps in knowledge and awareness about malaria vaccines among caregivers persist, underscoring the need for targeted education and communication efforts.[10]

Several factors influence caregivers' knowledge and acceptance of malaria vaccines, including ethnicity, education, age, employment status, and exposure to malaria messages.[11, 12] Additionally, healthcare provider strikes, vaccine stock-outs, and negative provider attitudes can impact vaccine uptake.[13]

Effective communication about the science of vaccination is critical to addressing public skepticism and ensuring public health.[14] Policymakers must prioritize awareness-raising efforts among mothers and caregivers to improve immunization services and reduce the risk of disease outbreaks.[15]

Malaria remains a significant global health issue, particularly among vulnerable populations. The development and introduction of malaria vaccines offer a crucial step towards malaria elimination and eradication. However, the success of these vaccines depends on their acceptance by caregivers, which in turn requires targeted education and communication efforts to address gaps in knowledge and awareness.

1.2 Problem Statement

The effectiveness of malaria vaccines depends on both clinical efficacy and community knowledge and perceptions. However, caregivers' acceptance and compliance with malaria vaccination programs are influenced by various factors, including awareness, knowledge, socio-economic status, and cultural beliefs. Misinformation, historical distrust, and accessibility issues further complicate vaccine acceptance. A critical gap exists in understanding caregivers' perspectives on malaria vaccines, hindering the effective implementation of vaccination programs.

Despite the availability of malaria vaccines, caregivers' lack of knowledge and awareness about the vaccine poses a significant challenge to its uptake, thereby hindering efforts to reduce the burden of malaria among children under five. Studies have shown that awareness

of malaria vaccine among caregivers is low, with only 30% of respondents aware of the malaria vaccine in some studies and 20% in others. This lack of knowledge and awareness can lead to misconceptions about the vaccine.[16, 7]

Caregivers' perceptions of malaria vaccines are crucial to their acceptance and uptake. While some studies have reported good perceptions of malaria vaccines among caregivers, others have found mixed perceptions or negative attitudes towards the vaccine. These varying perceptions can impact the acceptance and uptake of the vaccine.[17]

The acceptance of malaria vaccines among caregivers is critical to the success of vaccination efforts. However, acceptance rates vary widely, and factors influencing acceptance are complex. The lack of knowledge and awareness about malaria vaccines, combined with these factors, poses a significant challenge to the acceptance and uptake of malaria vaccines, thereby hindering efforts to reduce the burden of malaria among children under five.[12, 18]

Factors influencing acceptance of malaria vaccines are complex and multifaceted, including ethnicity, education, age, employment status, and exposure to malaria messages, as well as healthcare provider recommendations and experiences with the malaria vaccine program. The dynamic nature of these factors over time further complicates efforts to promote vaccine acceptance. Understanding these factors is crucial for developing targeted education and communication efforts to improve the uptake of malaria vaccines.[12, 7]

1.3 Justification of Study

The development of vaccines against malaria is very necessary to fight drug-resistant forms and the use of malaria vaccines is the most viable option that could address the burden of malaria infection.[19] A good knowledge of caregivers' attitudes to receiving malaria vaccine will help in the development, delivery, implementation and possibly payment of the vaccine.[16] Given the negative impact of the lack of awareness and knowledge,

misinformation and conspiracy theories on immunization programs, the awareness of residents about the availability of lifesaving and disease-preventative measures and public perception of these measures are critical to health outcomes expected from advancements in controlling the malaria epidemic in sub-Saharan Africa.[20] Policy-makers must consider the socio-cultural environment of the region to ensure widespread community approval. [21]

1.4 Research Questions

1. What is the knowledge of malaria vaccine among caregivers of under-5 children in Benin City, Edo state?
2. What is the perception of malaria vaccine among caregivers of under-5 children in Benin City, Edo state?
3. What is the acceptance of malaria vaccine among caregivers of under-5 children in Benin City, Edo state?
4. What are the factors that affect the acceptance of the malaria vaccine among caregivers of under-5 children in Benin City, Edo state?

1.5 Objectives/Aims of Study

1.5.1 General Objectives

To assess the knowledge, perception, acceptance and factors that affect the acceptance of malaria vaccine among caregivers of under-5 children in Benin City, Edo state with an aim to reduce morbidity and mortality rate.

1.5.2 Specific Objectives

1. To assess the knowledge of malaria vaccine among caregivers of under-5 children in Benin City.

2. To ascertain the perception of malaria vaccine among caregivers of under-5 children in Benin City.

3. To determine the acceptance of malaria vaccine among caregivers of under-5 children in Benin City.

4. To identify factors that affect the acceptance of malaria vaccine among caregivers of under-5 children in Benin-City.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 MALARIA

Malaria is a life-threatening infectious disease, with its largest impact being due to *Plasmodium falciparum* infection in Africa; its symptoms are non-specific and its management depends on awareness of the diagnosis and early recognition and treatment.[22] It threatens nearly half of the world's population and led to hundreds of thousands of deaths in 2015, predominantly among children in Africa.[23] In 2021, malaria cases and deaths surged to 247 million and 619,000, respectively, across 84 endemic countries, exacerbated by the spread of artemisinin-resistant *Plasmodium falciparum* strains and evolving insecticide resistance in Anopheles mosquito vectors.[24] Malaria affects majorly children under the age of 5 years; with 67% death from the total death in 2019 and underdeveloped immunity thought to be the major reason that makes children under 5 years of age vulnerable to malaria.[25]

2.1.1 Transmission of Malaria

The malaria parasite's complex life cycle involves both vertebrate hosts and mosquito vectors and includes both sexual and asexual reproduction.[4] Human infection occurs during the blood meal of an infected female mosquito belonging to the Anopheles genus.[6]

The female Anopheles mosquito ingests gametes during a blood meal, which form sporozoites that replicate in its gut, then get released into a human host's bloodstream through its saliva during subsequent blood meals, reaching the liver within 60 minutes, invading hepatocytes, and eventually infecting erythrocytes.[23] After invading erythrocytes as merozoites, these merozoites reproduce into trophozoites and then into schizonts which erupt from the erythrocytes to release merozoites and reinvade new RBCs and continue the asexual replication cycle.[4]

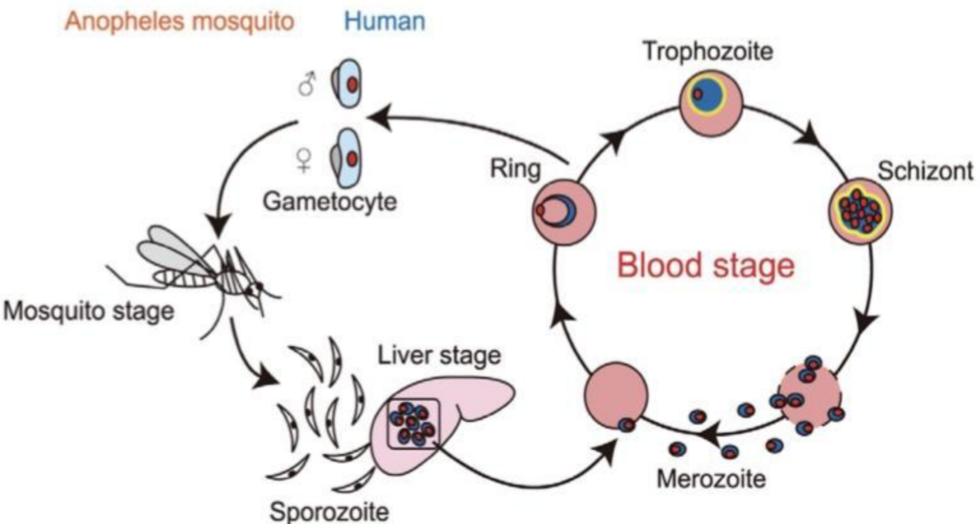

Fig 1: Life Cycle of malaria parasite.[24]

Five Plasmodium species possess the ability to infect humans: *P. falciparum, P. ovale, P. vivax, P. malariae, and P. knowlesi.*[18] Of the five Plasmodium species that cause malaria in humans, *P. falciparum* causes severe malaria.[26]While younger erythrocytes are targeted favorably by *P. vivax* and *P. ovale*, erythrocytes of any age are invaded by *P. falciparum* and *P. knowlesi* with *P. malariae* preferring senescent erythrocytes.[24]

Table 1: Species of human malaria parasites.[27]

Plasmodium Species	Endemic Regions	Typical Drug Resistance
P. falciparum	Sub-Saharan Africa Haiti Dominican Republic Southeast Asia	Chloroquine Sulfadoxinepyrimethamine ACT therapies (in Southeast Asia)
P. vivax	Indian subcontinent Central and South America Southeast Asia	Chloroquine (some areas)

P. ovale	Most cases reported in West Africa May also be present in Asia	—
P. malariae	Less common Wide global distribution	
P. knowlesi	Rare Cases in forested regions of Southeast Asia, associated with long-tailed macaques	

The gold standard for laboratory confirmation of malaria is blood smear detection by microscopy while antigen-detecting rapid diagnostic tests (RDTs) are becoming increasingly available for diagnosis in both resource-limited and non-endemic settings.[5]

2.1.2 Symptoms of Malaria

Malaria's symptoms overlap with those of various febrile diseases, including dengue fever, typhoid fever, and pneumonia, requiring parasitological tests, such as microscopic examinations and rapid diagnostic tests (RDTs), for accurate diagnosis.[1]

Fever, particularly when persisting for seven days or more, is a dominant and highly indicative symptom of malaria, especially in individuals who reside in or have recently traveled to endemic regions, thereby warranting immediate evaluation.[9]

Malaria's symptoms, especially fever[24], occur when malaria parasites break down red blood cells, triggering the body's immune response, which releases a chemical called tumor necrosis factor α (TNF-α), as the parasites and infected cells are processed in the spleen and bloodstream.[6]

Seven key symptoms (fever duration, headache, nausea and vomiting, heartburn, severe symptoms, dizziness, and joint pain), along with a patient's malaria history, are the most critical factors in diagnosing malaria, with fever duration being more significant than temperature or fever in distinguishing malaria from other febrile diseases, whereas shivering, fever, and sweating are less significant indicators in endemic regions[1]. There are also some cases where malaria patients are asymptomatic and do not have any identifiable symptoms.[28] Two disease presentations are described, uncomplicated or severe.[26]

Uncomplicated malaria presents nonspecifically with fever, chills, headache, myalgias, cough, vomiting and diarrhea, thus making clinical diagnosis unreliable with a high index of suspicion in all travelers to endemic areas presenting with fever being crucial for establishing the diagnosis, which is accomplished by laboratory testing.[28]

Severe malaria can manifest through one or more of the following six syndromes: cerebral malaria, characterized by altered mental status and increased intracranial pressure; blackwater fever, marked by acute renal failure and hemoglobinuria; severe anemia, defined as hemoglobin below 7g/dL; acute respiratory distress syndrome; hyperparasitemia, involving infection of over 5% of circulating red blood cells; and metabolic complications, including severe metabolic acidosis and life-threatening hypoglycemia.[26]

Management and prognosis of malaria depend on establishing the diagnosis in patients who have a history of travel from endemic areas, the ability of early detection, and effective and timely treatment[29]. Good quality malaria diagnostic techniques are essential to diagnose malaria and a timely diagnosis of malaria has the potential to save the patient.[28, 29]

2.1.3 Treatment of Malaria

Understanding Plasmodium species variation, epidemiology, and drug-resistance patterns in the geographic area where infection was acquired is important for determining treatment

choices.[5] Malaria has the potential to be fatal. In cases where the index of suspicion is high, treatment can be started before testing results are available or even before they are performed, so that there is no delay in therapy.[5]

Malaria is managed through a combination of vector control measures (such as insecticide spraying and the use of insecticide-treated bed nets) and medications, with artemisinin-based combination therapies significantly reducing malaria-related deaths, although the growing threat of drug resistance jeopardizes this progress.[23]

Prevention and treatment of malaria rely on identifying the parasite species and its drug sensitivity, specific to the region where the infection was acquired, with intravenous artesunate being the first-line treatment for severe cases.[30, 29] Chloroquine is still a viable option for *P.falciparum* infections acquired in chloroquine-sensitive areas, but for chloroquine-resistant cases, alternative treatments include atovaquone-proguanil, quinine plus clindamycin, or artemisinin-based combination therapies when available.[31]

2.2 MALARIA VACCINE

A vaccine is a biological product that can be used to safely induce an immune response that confers protection against infection and/or disease on subsequent exposure to a pathogen.[32] Vaccination (Active Immunization) stimulates the host's immune system to respond to a specific pathogen, triggering humoral and cellular immune responses, and resulting in adaptive immunity against that particular pathogen.[32, 30] Vaccination has been relatively successful in preventing many childhood-related infections and saving millions of lives.[33] Being a cornerstone of public health policy, it is demonstrably highly cost-effective when used to protect child health.[34] In the past 15 years, renewed malaria control efforts have cut the disease's prevalence in half, raising hopes for eventual elimination and eradication, which will require developing new tools, including innovative antimalarial drugs and more

efficacious vaccines, as well as a deeper understanding of the disease and parasite biology, prompting significant progress, including the development and approval of the first malaria vaccine and the identification of novel drug targets and antimalarial compounds now in human clinical trials.[35]

The need for an effective malaria vaccine has arisen due to parasite resistance to antimalarial agents with toxicity associated with chemoprophylaxis and recently, researchers have focused on designing vaccines, and one candidate, RTS, S/AS01, has emerged and reached a large Phase III trial while other promising candidates, including PAMAVAC, a blood-stage malaria vaccine, are under investigation.[36] RTS, S and R21 which are the first licensed malaria vaccines will be widely deployed in 2024 and should substantially reduce childhood deaths.[37] Malaria vaccines can be broadly categorized into three groups based on their target in the malaria parasite life cycle: pre-erythrocytic, erythrocytic, and transmission-blocking vaccines.[36]

The RTS, S/AS01 vaccine, which consists of "RTS" (repeat T epitopes from the circumsporozoite protein), "S" (S antigen from hepatitis B surface antigen), and the proprietary adjuvant AS01, is the first approved malaria vaccine and has demonstrated promising results.[38] The RTS, S/AS01 initiates an immune response against the circumsporozoite protein (PfCSP) covering the surface of sporozoites,[39] promoting immunoglobulin G (IgG) antibody response and potent T-cell (CD4+) response.[33] It gives partial protection against *falciparum* malaria and is being evaluated in large pilot studies in Ghana, Malawi, and Kenya as a complementary tool to other preventive measures.[3] Most malariologists agree that while pre-erythrocytic stage vaccines like RTS, S represent a crucial step forward, a multi-stage vaccine that induces both anti-sporozoite and anti-blood stage immune responses would have the greatest impact on malaria infection, morbidity, and transmission, with several additional candidate vaccines currently in development.[28]

RTS, S/AS01 is currently recommended by the WHO for use in children in sub-Saharan Africa and other regions with moderate-to-high transmission of *P. falciparum*, administered in a 4-dose schedule starting at 5 months of age, based on the results of ongoing pilot programs in Ghana, Kenya, and Malawi, which have covered 800,000 children since 2019.[39]

The R21/Matrix-M malaria vaccine is the next-generation pre-erythrocytic*P.falciparum* vaccine to be more immunogenic than the RTS, S/ASO1.[38] The vaccine offers a significant breakthrough in the fight against malaria, with 75% efficacy in protecting young children against clinical malaria in diverse settings, and is recommended by the WHO for use alongside RTS, S/ASO1 and other effective interventions.[39] It is a virus-like particle vaccine comprising the amino acid repeats and C-terminal sequence of circumsporozoite protein fused to hepatitis B surface antigen, differing from RTS, S in its fusion design (CSP-HBsAg fusion protein), and is administered with the saponin adjuvant Matrix-M at a low 5 µg dose to maximize durable antibody response to the circumsporozoite protein antigen.[40]

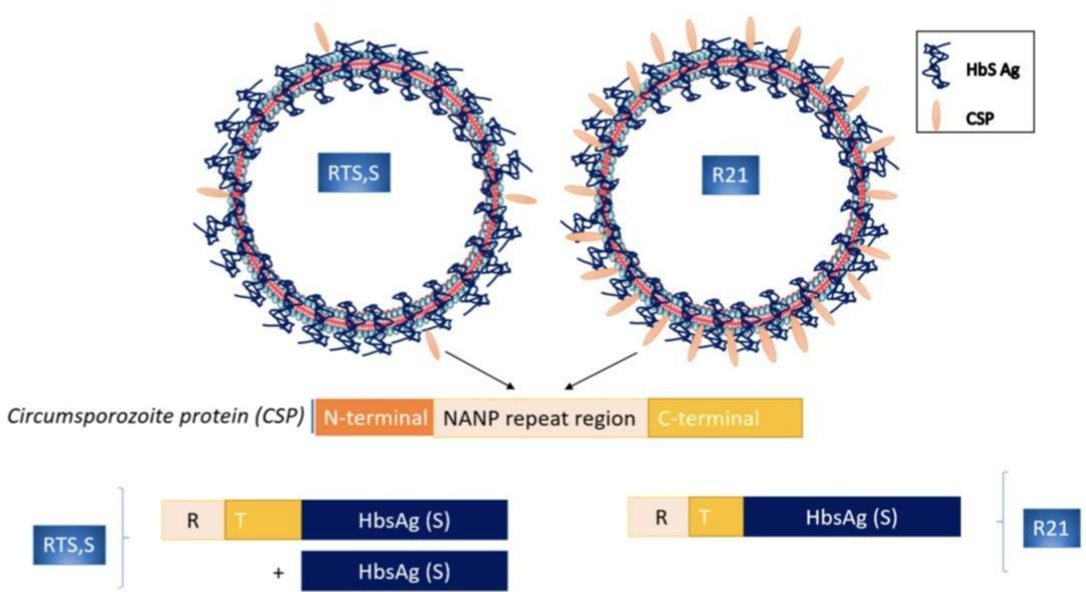

Fig 2: Schematic representation of the circumsporozoite protein subunit vaccines RTS, S and R21 structure.[40]

The recent approval of the more cost-effective R21 vaccine and the expected reduction of costs of the vaccines over time could improve the supply, availability, and accessibility of the vaccines to more endemic countries over time as the R21 has already been licensed for use in several countries, including countries Burkina Faso and Ghana, as well as Nigeria.[41] The R21/Matrix-M vaccine is recommended by the World Health Organization (WHO) for children aged five months and older.[39] Ongoing research continues to explore optimal dosing strategies and the potential for seasonal administration to enhance its effectiveness.[39]

Malaria vaccine development has been hindered by the parasite's complex biology, the intricate host immune response required for protection, and the evolution of resistant parasites, which is further complicated by the adaptability and evolution of the parasite in response to changing socioeconomic factors and climate change.[41]

Although two malaria vaccines are currently recommended, they fall short of the desired efficacy and durability, prompting ongoing development of next-generation vaccines, which include novel approaches such as live attenuated sporozoite inoculations, RNA-based platforms, and combination vaccines, with the ultimate goal of achieving the WHO's preferred product characteristics of a 90% reduction in blood stage infection and clinical malaria over 12 months.[42]

2.3 KNOWLEDGE, PERCEPTION AND ACCEPTANCE OF MALARIA VACCINE AMONG CAREGIVERS

Caregivers serve as a critical extension of a healthcare system, and the demand for family caregivers is expected to increase during the next few decades.[43] In fact, most caregivers gained satisfaction and felt supported in caregiving.[44]They offer key linkages to care for vulnerable patients.[45]

Caregiving encompasses the nurturing, tasks, resources, and services that meet the day-to-day

needs of children and youth with special health care needs at home.[46]The readiness and willingness of the family caregiver is often overlooked as they are expected to assume a complex caregiving role.[47]

The work of caregivers is known to be extensive, but it is so poorly understood that it has been described as "invisible."[46] Top priorities for caregivers include guidance on their new role, time for self-care and rest, personalized healthcare, better support systems, access to helpful information, easy access to resources and financial help.[48]

Understanding caregivers' insights is crucial to providing patients' needs from the caregiver perspective, what they believe, assume and accept all play a role in patients' unique requirements.[44]

Communicating effectively about the science of vaccination to a skeptical public is a challenge for all those engaged in vaccine immunology but is urgently needed to realign the dialogue and ensure public health.[49] This can only be achieved by being transparent about what we know and do not know, and by considering the strategies to overcome our existing knowledge gaps.[32] Malaria vaccine availability does not necessarily mean it will be accepted by the public and this is why the knowledge, perceptions and acceptance of the vaccine among mothers of these children are worth exploring.[50]

2.3.1 Knowledge of Malaria Vaccine among Caregivers

A study sought to assess mothers' knowledge, attitude, and practices to malaria and its prevention as well as mothers' willingness to accept the RTS, S/AS01 malaria vaccine. In this study, they reported that Knowledge of malaria preventive measures does not correlate with knowledge of its vaccine. Out of 180 caregivers only 30% (36/180) of respondents were aware of the malaria vaccine. Five percent (8/180) knew what a malaria vaccine was used for and only four percent (7/180) had heard of RTS, S.[11]

In Bangladesh's malaria-endemic areas knowledge and acceptance of malaria vaccination among parents of children under five were assessed. About one-fourth (25%) had knowledge about the malaria vaccine and 48% of them mentioned health professionals as the source of information.[8]

A study also reported low knowledge of the malaria vaccine in women of the reproductive age group in North-West Nigeria.[9]

Another study reported that there exists a poor knowledge of the malaria vaccine among mothers presenting in nine hospitals in Enugu metropolis when they studied the knowledge of malaria vaccine and factors militating against willingness to accept the vaccine among these mothers.[16]

A total of 66.2% of the respondents demonstrated good knowledge about malaria and the RTS, S malaria vaccines in a study in 2024 to determine the knowledge, attitudes, and willingness to accept the RTS, S malaria vaccine among mothers and caregivers of children under five years of age.[12]

Caregivers' awareness and willingness to accept the malaria vaccine were assessed in order to provide vital information for policymakers, health workers, and social mobilizers on critical areas to focus on promoting the new vaccine uptake before its arrival for use in Nigeria. They found that caregivers' knowledge or awareness of the new malaria vaccine was insufficient suggesting the need to intensify efforts on social and behavioral communication change activities tailoring messages on the vaccine to address uptake hesitancy.[10]

Another study found that awareness of malaria as a public health problem was high (89.8%), but awareness about a prospective malaria vaccine was not high (48.2%).[50]

A study done in Ibadan, southwest Nigeria revealed that only 20% of caregivers had heard of malaria vaccine suggesting low awareness of malaria vaccines among caregivers of children under 5.[51, 16]

2.3.2 Perception 0f Malaria Vaccine among Caregivers

Making malaria vaccine available for routine use is a major achievement, but the level of its acceptability, especially in the developing countries, could pose another considerable challenge that needs to be addressed in order to achieve a successful implementation of the program.[7] A qualitative study explored the perceptions of the malaria vaccine among 10 mothers in Ghana. The results showed that caregivers had positive views of the vaccine, citing benefits such as reduced hospital admissions and cost savings.[9]

Another study summarized the recent empirical evidence on the efficacy, safety, and community perception of malaria vaccines in Africa. The study found mixed perceptions of malaria vaccines in African communities. In their literature search, ten of the seventeen studies that assessed community perception reported their overall perception of malaria vaccines, and were of below and above-average quality.[15]

A study reported 88.2% of positive perceptions toward malaria vaccine, of which 65.2% had good perception.[17]

163 of 180 of caregivers agreed or strongly agreed that vaccines were important in managing malaria and 21% (38 of 180) disagreed or strongly disagreed that immunization with malaria vaccine provide lifelong protection from malaria. It was suggested that this positive perception of the vaccine was influenced by the mother's experience with the malaria vaccine program.[11]

A descriptive cross-sectional survey design was employed, involving 405 participants who visited two major tertiary hospitals in Enugu State, Nigeria. This study investigated the knowledge, attitudes, and willingness to accept the RTS, S malaria vaccine among mothers and caregivers of children under five years of age. 55.1% exhibited a positive attitude toward vaccination.[12]

Another study aimed to determine the awareness, perception and acceptance of malaria vaccine among women of the reproductive age group in a rural community in Soba Local Government Area of Kaduna State, North-West Nigeria. The perception of the malaria vaccine was good.[17]

An analysis explored RTS, S/AS01 vaccination barriers and identified potential motivators among caregivers in three sub-counties in western Kenya. Caregivers in this study believed the RTS, S/AS01 to be effective and were motivated to have their children vaccinated.[13]

2.3.3 Acceptance of Malaria Vaccine among Caregivers

A cross-sectional household survey was conducted in three regions per Guinea and Sierra Leone from May 2022 to August 2022, using lot quality assurance sampling. A household member responsible for childcare shared their likelihood of accepting a malaria vaccine for their children under 5 years and details about children's health. The survey found that in Guinea and Sierra Leone 76% and 81% of caregivers, respectively, were willing to vaccinate their children against malaria.[52, 48]

A study reported that approximately 87% of caregivers were willing to accept the vaccine and almost 50% of the caregivers did not think the vaccine would be accepted if it was not given orally.[51]

Among 180 caregivers, 98% were reported to agree to allow their child to be immunized with malaria vaccine, 99% of respondents were willing to bring their child four times to receive the vaccine and 98% would accept malaria vaccination for their child even if given by injection.[9]

A survey found that 91.9% of caregivers were willing to accept the malaria vaccine for their child, citing protection of the child (64.4%) and general vaccine acceptance (16.6%) as main reasons. However, 56.2% of unwilling caregivers feared adverse reactions, while 26.8% cited spousal refusal. Notably, 89.7% of respondents were willing to pay for the vaccine.[10]

Another study reported high level of intent to comply with the prospective malaria vaccine among selected consenting care givers (mostly mothers). In this study 95.6% of positive acceptance was reported.[52] Participants to a study were particularly motivated to vaccinate their children seeing the positive effects they believe the vaccine had on their children's health.[51]

From January to March 2022, a cross-sectional study was conducted in five malaria-endemic districts of Bangladesh, involving 405 parents of children under the age of 5. 70% of the study participants reported that they would accept malaria vaccination independently.[8]

Acceptability of malaria vaccines was reported to be high in reproductive age women in Nigeria.[17]

Another study reported that close to one-third of the caregivers in a pioneering study which investigated malaria vaccine hesitancy among caregivers were hesitant to accept a malaria vaccine for their under-five children.[9]

In a study evaluating the knowledge, attitude, perception, and readiness of caregivers of under 5-year-old children to accept malaria vaccine in Nigeria, an overall acceptance rate of 78.4% and 21.6% resistance rate was reported for malaria vaccine usage. This was out of 347 respondents, which included men, women, transgender, rural settlers, and urban settlers.[17]

51.6% of participants were willing to accept the RTS, S malaria vaccine for their children.[12]

A study aimed to determine the knowledge of malaria vaccine and factors militating against willingness to accept the vaccine among mothers presenting in nine hospitals in Enugu metropolis. Among 491 mothers who presented with their children in nine hospitals in Enugu metropolis, South-East Nigeria. A pre-tested and interviewer-administered questionnaire was used. They found that the study documented a high vaccine acceptance among the mothers.[16, 12]

2.4 FACTORS THAT AFFECT THE ACCEPTANCE OF MALARIA VACCINE AMONG CAREGIVERS

Vaccines have led to a significant decrease in rates of vaccine-preventable diseases and have made a significant impact on the health of children but still, some parents express concerns about vaccine safety and the necessity of vaccines with concerns of parents ranging from hesitancy about some immunizations to refusal of all vaccines.[52]

While malaria vaccine adoption is likely to be a welcome development, proper consideration should be given to factors that are likely to influence people's perceptions about vaccines in the plans/process of malaria vaccine development and vaccination programs.[50]

Factors identified to influence knowledge and acceptance of preventive measures of malaria including vaccines were ethnicity, education, age, employment status and number of malaria messages respondents were exposed to.[11, 12]

The media is a major tool for influencing the awareness on malaria vaccines among caregivers.[9]

Health Workers significantly influence vaccine acceptance, but their own fears about unknown side effects may hinder their recommendation of the vaccine to other caregivers.[52]

A bivariate logistic regression analysis was conducted using various factors, including health-related characteristics, previous experience with childhood vaccination, awareness of the malaria vaccine, and socio-demographic characteristics. Awareness of the malaria vaccine and previous experience with childhood vaccinations were found to be significantly associated with willingness to accept the malaria vaccine.[10]

Acceptance of malaria vaccine in Guinea and Sierra Leone was reported to be varied by factors such as location, socioeconomic status, and education level. Key findings included in the study included lower acceptance in remote areas compared to urban areas in both countries. In Guinea, lower acceptance among caregivers in richest households, those who

tested their children for malaria, and those who took more preventative measures and also better knowledge of malaria's causes increased acceptance. In Sierra Leone, higher education levels among caregivers increased vaccine acceptance.[48]

Acceptance and knowledge of malaria vaccination were also associated with various socioeconomic factors, including residence, education, occupation, income, and family size, and also with housing conditions, such as structure, wall, and window, as well as knowledge of malaria, testing for malaria, and being diagnosed with malaria.[45]

A study reported that religion was a factor affecting vaccine acceptance although this was inconsistent with their literature search showing Christian mothers were more likely to accept the vaccine than Muslim mothers in Tanzania, while in Ghana and Nigeria, Christian mothers showed lower odds of accepting the vaccine. They also reported that free provision significantly increased vaccine acceptance while increased costs decreased acceptance.[15]

A pioneering study investigated malaria vaccine hesitancy among caregivers with key findings including:

1. Receiving vaccine information from healthcare workers reduced hesitancy.
2. Higher income and larger family size increased hesitancy.
3. Main reasons for hesitancy were fear of adverse effects and availability of other preventive measures.[52]

Another study recorded that the age group between 21–30 years had the highest acceptance rate for malaria vaccine citing that age could play a factor in the acceptance of malaria vaccine. They also reported that a significant number of participants in their study held at least a higher or post-secondary certificate, out of which demonstrated strong readiness to accept the malaria vaccine citing education as another factor.[53]

Despite positive perceptions of the malaria vaccine in a study, uptake was substantially hindered by factors such as persistent health system constraints (e.g., healthcare provider

strikes, vaccine stock-outs) and negative provider attitudes. Lack of awareness, previous negative experiences with routine childhood immunizations and the burden of getting to the health facility also contributed to caregivers' initially delaying uptake of the vaccine.[45] This emerged as a powerful deterrent to attending immunization services and hampered uptake of the vaccine in Kenya.[13]

The implementation of the malaria vaccine policy is a unified global endeavor, garnering widespread support and collaboration from international health organizations, governments, and local communities and this concerted effort has already borne fruit, with the malaria vaccine being successfully administered to a substantial number of children in pilot countries, including Ghana, Kenya, and Malawi.[52, 4] Factors influencing acceptance or uptake of malaria vaccines are not static but dynamic over time.[13] There are giant steps taken in the introduction of the novel malaria vaccine poised towards reducing mortality and morbidity associated with malaria.[16]. However, understanding the factors that influence malaria vaccination acceptance among caregivers is crucial for identifying policies that would help policy-makers develop methods of educating populations, increase awareness of the acceptability of the vaccine and ensure that an affordable malaria vaccine program is implemented in the population.[4]

CHAPTER THREE

METHODOLOGY

3.1 STUDY AREA

The study was conducted in a community, located within Ovia-North East Local Government Area (LGA) in Benin City, Edo State, Nigeria. Edo State; one of Nigeria's 36 states, is situated in the South-South region, with Benin City as its capital. The state; established in 1991, covers approximately 19,743 square kilometers, with a projected population of 4,921,058 based on the 2006 National population census.[54, 55]

Benin City, the state capital, had an estimated population of 1,147,188 in 2006, projected to increase to 1,745,976 by 2021.[56]The dominant ethnic group in the region is the Benin tribe.

3.2 STUDY DESIGN

A descriptive cross-sectional study design was used for this research.

3.3 STUDY POPULATION

The study was conducted among adult caregivers of children in the selected community and constituted about the number of participants obtained from sample size calculated.

Inclusion criteria

1. Adults who are caregivers (parents, guardians, or relatives) of under-5children living in the selected community in Benin City.
2. Adult caregivers who are willing to participate in the study, provide informed consent and are available at the time of the study.
3. Adult caregivers who have heard about the malaria vaccine.
4. Adult caregivers who are residents in Benin City for at least 6 months.

Exclusion Criteria

1. Adults who are not caregivers (parents, guardians, or relatives) of children living in the selected community in Benin City.

2. Adult caregivers who have not heard about the malaria vaccine.
3. Adult caregivers who are not willing to participate in the study or provide informed consent.
4. Adult caregivers who are not resident in Benin City.
5. Caregivers who are unable to communicate in the local language (e.g., Pidgin, Benin or English.
6. Adults who have cognitive or serious medical conditions as at the time of this study may influence their responses.

3.5 STUDY DURATION

The study was carried out within a period of one year from May 2025 to May 2026.

3.6 SAMPLE SIZE DETERMINATION

This is calculated based on a few assumptions based on past research.

1. Prevalence of acceptance: A previous study found that 51.6% of caregivers in Enugu State accepted the malaria vaccine.[12]

2. Confidence level: A 95% confidence level was used, which corresponds to a Z-score of 1.96.

Using Cochran's formula for calculating sample size for a proportion in cross sectional studies

$$n = \frac{z^2pq}{e^2}$$

Where:

n = sample size

Z = Z-score (1.96 for 95% confidence)

p = prevalence of acceptance (0.6)

E = margin of error (0.05)

Putting in the values:

$$n = \frac{(1.96^2 \times 0.516 \times (1-0.516))}{0.05^2}$$

$$n = \frac{3.8416 \times 0.516 \times 0.484}{0.0025}$$

n = 383.8

To make room for non-response rate, 10% non-response was added to the minimum sample size utilizing the formula for non-response rate.

$$n_f = \frac{n}{1-n_r}$$

n = Minimum sample size

n_r= Non-response rate 0.10

n_f= Final minimum sample size

$$\frac{383.8}{1-0.1} = \frac{383.8}{0.9} = 426.$$

Thus, the final minimum sample size that was used for this study is 426.

3.7 SAMPLING TECHNIQUE

A multi-stage sampling technique was used for this study.

Stage 1: Selection of Local Government Area

There are eighteen (18) Local Government Areas in Edo State, of which Ovia North-East Local Government Area was chosen via a simple random sampling technique by balloting.

Stage 2: Selection of Ward

Ovia North-East Local Government Area is made up of 13 political wards. These include; Okada West, Okada East, Uhen, Adolor, Ofumwengbe, Oluku, Uhiere, Isiuwa, Okokhuo,

Oghede, Oduna, Iguoshodin and Utoka. Out of these wards, Oluku was selected using simple random sampling technique by balloting.

Stage 3: Selection of the Community

The Oluku ward area comprises several key communities and localities, including; Oluku (Main Town), Ekosodin, Eguavoen, Elaba, Idunmwomina, Okhumwun, Ugbowo and Isiohor, from which Ekosodin community was selected via simple random sampling technique by balloting.

Stage 4: Selection of Household

Ekosodin community was divided into two clusters (A and B) using Newton Street as the major geographical boundary. Cluster B was selected using a simple random sampling technique by balloting. The required sample of 426 was selected from Household located within Cluster B.

3.8 DATA MANAGEMENT

3.8.1 Method of Data Collection

Data were collected using a self-administered questionnaire containing both open and close ended questions.

Sections

The questions will be grouped under 4 sections as follows:

Section A: Socio-demographic Characteristics of respondents.

Section B: Knowledge of Malaria and Malaria vaccine among respondents

Section C: Perception towards Malaria vaccine among respondents

Section D: Level of acceptance and factors affecting the level of acceptance of the Malaria vaccine.

Pretesting

The questionnaire was pretested among caregivers of under- five children residing in Uselu, Egor Local Government area, Benin City, Edo State. Ten percent (43) of the questionnaire were tested for correctness and appropriate understanding and response by respondents to the questions. This was done to identify and fix any issues, improving the questionnaire and ensuring it is clear, effective and accurate.

3.9 STATISTICAL ANALYSIS

The filled questionnaires was checked for completeness, appropriate and correct filling before the data were coded and entered into Statistical Package for the International Business Machines Corporation Social Science (IBM SPSS) version 27.0 software. The inputted data were cleaned and analyzed using IBM SPSS version 27.0 software.

Generally, descriptive statistics was performed to summarize the data. Univariate analysis was also performed in which categorical variables were analyzed in frequency tables and bar charts and continuous variables analyzed using means, median, measures of dispersion and histogram.

Bivariate and multivariate analysis was carried out to establish relationship between socio-demographic factors and other influencing factors, and level of uptake of Malaria vaccines.

Socio-demographic characteristics

This was obtained using thirteen (13) questions. Characteristics obtained include age, gender, ethnicity etc.

The occupation of respondents was coded into skill levels according to International Labour Organization (ILO) classification and modified to include skill level 0.[57]

Skill level 0 includes retirees, housewives, unemployed and students.

Skill level 1 includes labourers, cleaners, gardeners and kitchen assistants.

Skill level 2 includes civil servants, traders, receptionists, bus drivers, farmers, butchers, hair dressers, police officers, shop sales assistants, building electricians and tailors.

Skill level 3 includes medical laboratory technicians, shop managers, legal, secretaries, commercial sales representatives, broadcasting and recording technicians.

Skill level 4 includes doctors, lawyers, engineers, teachers, nurses, accountants and managers.

Knowledge about Malaria and the vaccine

The knowledge about malaria and malaria vaccine was assessed using 12 questions. These questions on knowledge were scored; each correct answer is scored one (1) while each wrong answer or each unanswered question is scored zero (0). The percentage of knowledge score was computed as follows:

$$\text{Percentage of knowledge score} = \frac{\text{Total correct score}}{\text{Total possible score}} \times 100$$

The percentage of knowledge score was categorized into poor knowledge (0%-49.9%), and good knowledge (50.0%-100.0%).

Perception towards Malaria and the vaccine

The perception towards malaria and the vaccine were assessed with ten (10) questions using 3-point Like scale namely: Agree, Neutral and Disagree. The questions answered is scored as follows: Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2 and Strongly Disagree = 1.

The respondents' scores were computed as percentages of the maximum attainable score.

Respondents who score above 50% will have a positive perception while those who score below 50% will have negative perception.

Level of acceptance and factors affecting the level of acceptance of the Malaria vaccine.

Seven (7) questions were asked to ascertain the number of the respondents that have had their children receive the malaria vaccine. The number of those that received the malaria vaccine

were expressed as percentage or proportion of the total number of the respondents and presented in charts and tables.

In addition, questions were asked about the side effects and reasons for having their child take the malaria vaccine, and their response were presented in charts and tables.

A bivariate analysis was done to determine the association between the acceptance of malaria vaccine (the dependent variable) and the explanatory (or the independent) variables such as age, gender, and other socio-demographic characteristics of the respondents. Those explanatory variables with p value < 0.2 on the bivariate analyses was further analyzed in a multivariate logistic regression model and adjusted odds ratio (AOR) at p value < 0.05 and 95% confidence intervals will be used to determine the strength and precision of the association between the explanatory variables and the dependent variable.

In addition, responses about hindrances to the acceptance of malaria vaccine were analyzed and presented in frequency table and chart.

A p-value < 0.05 was considered statistically significant.

3.10 ETHICAL CONSIDERATION

Ethical approval with protocol number ADM/E 22/A/VOL.VII/1486549127273 was obtained from the Health Research Ethics Committee of University of Benin Teaching Hospital (UBTH). Informed consent was obtained at the point of administering of questionnaire from respondents and confidentiality was maintained as no names or addresses were requested. Participation in the study was purely voluntary as the participant can withdraw from participating in the study at any time.

3.11 STUDY LIMITATIONS

1. The study depends entirely on data supplied by the respondents. Thus, the reliability of the information acquired from this study depends on the sincerity and honesty of the respondents.
2. Recall bias may limit the accuracy of some data supplied by the respondents.

CHAPTER FOUR

RESULTS

A total of 426 caregivers participated in this study. The results are presented in the following sections in line with the specific objectives:

SECTION A: Socio-demographic characteristics of respondents

SECTION B: Knowledge about malaria and the vaccine among the respondents

SECTION C: Perception towards malaria vaccine among respondents

SECTION D: Level of acceptance and factors affecting the level of acceptance of malaria vaccine

SECTION A: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

TABLE 1A: SOCIODEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

Variables	Frequency (n = 426)	Percent
Age group (years)		
< 20	2	0.5
20 – 29	163	38.3
30 – 39	125	29.3
40 – 49	87	20.4
50 – 59	34	8.0
≥ 60	15	3.5
Mean age (SD) 35.2 (10.4)		
Sex		
Female	290	68.1
Male	136	31.9
Ethnic group		
Benin	161	37.8
Igbo	82	19.2
Esan	69	16.2
Yoruba	56	13.1
Urhobo	16	3.8
Tiv	7	1.6
Ijaw	7	1.6
Etsako	6	1.4
Isoko	5	1.2
Efik	5	1.2
Itsekiri	5	1.2
Ora	4	0.9
Others	3	0.7
Religion		
Christian	392	92.0
Islam	28	6.6
ATR	6	1.4
Marital Status		
Married	286	67.1
Single	98	23.0
Widowed	16	3.8
Co-habiting	19	4.5
Separated	4	0.9
Divorced	3	0.7

***Others: Akoko-Edo, Igala, Hausa, Okpe,**

The age distribution of the respondents revealed that the largest proportion fell within the 20–29 years age bracket, accounting for 163 (38.3%) of the sample, followed by the 30–39 years group with 125 (29.3%). Participants aged 40–49 years numbered 87 (20.4%), while those aged 50–59 and ≥ 60 years represented 34 (8.0%) and 15 (3.5%) respectively. The smallest group consisted of those under 20 years of age at 2 (0.5%). The mean age of the participants was 35.18 ± 10.426 years. Regarding sex, a majority of the respondents were female, totaling 290 (68.1%), while males accounted for 136 (31.9%).

Analysis of the ethnic composition showed that the Benin ethnic group was the most represented with 161 (37.8%) participants. This was followed by the Igbo 82 (19.2%), Esan 69 (16.2%), and Yoruba 56 (13.1%). Other ethnicities with lower representation included Urhobo 16 (3.8%), Tiv 7 (1.6%), Ijaw 7 (1.6%), Etsako 6 (1.4%), Isoko 5 (1.2%),Itshekiri 5 (1.2%), Efik 5 (1.2%)andOra 4 (0.9%). A small percentage of the sample, 3 (0.7%), identified with other ethnic groups including Akoko-Edo, Igala, Hausa and Okpe.

In terms of religious affiliation, a vast majority of the respondents identified as Christian, representing 392 (92.0%) of the total sample. Those identifying with Islam accounted for 28 (6.6%), while 6 (1.4%) of the participants practiced African Traditional Religion (ATR).

The marital status of the participants indicated that more than two-thirds of the respondents were married, totaling 286 (67.1%). Single respondents comprised 98 (23.0%) of the sample, while 19 (4.5%) were co-habiting. Those who were widowed, separated, or divorced accounted for 16 (3.8%), 4 (0.9%), and 3 (0.7%) of the population, respectively.

TABLE 1B: SOCIODEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

Variables	Frequency (n = 426)	Percent
Family type		
Monogamous	388	91.1
Polygamous	38	8.9
Household size		
2 – 5	351	82.4
≥ 6	75	17.6
Highest LOE		
No formal education	11	2.6
Primary	53	12.4
Secondary	186	43.7
Tertiary	176	41.3
ILO Skill Level		
Level 0	36	8.5
Level 1	18	4.2
Level 2	212	49.8
Level 3	61	14.3
Level 4	99	23.2
Monthly Income		
<70,000	118	27.7
70,000-139,999	150	35.4
140,000-209,000	94	22.1
2100,000-279,000	43	10.1
≥ 280,000	19	4.5

Regarding family structure, a vast majority of the respondents, 388 (91.1%), belonged to monogamous families, while 38 (8.9%) were from polygamous homes. In terms of household size, most participants resided in households consisting of 2 to 5 members, totaling 351 (82.4%), whereas 75 (17.6%) lived in households with 6 or more members.

The assessment of educational attainment revealed that 186 (43.7%) of the respondents had completed secondary education, while 176 (41.3%) had attained tertiary education. A smaller proportion had only primary education, 53 (12.4%), or no formal education, 11 (2.6%). Regarding skill level, nearly half of the respondents were of skill level 2, 212 (49.8%), 99 (23.2%) were of skill level 4, respondents with skill levels 3 numbered 61 (14.3%), while respondents with skill level 0 and 1 numbered 36 (8.5%) and 18 (4.2%) respectively.

Analysis of monthly income showed that the largest group of respondents earned between 70,000 and 139,999, totaling 150 (35.4%). This was followed by those earning less than 70,000, who numbered 118 (27.7%). Participants earning between 140,000 and 209,000 accounted for 94 (22.1%), while 43 (10.1%) earned between 210,000 and 279,000. The smallest proportion of the sample, 19 (4.5%), reported a monthly income of 280,000 or higher.

TABLE 1B: SOCIODEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS'S CHILD

Variables	Frequency (n = 426)	Percent
Child's age (months)		
<6	9	2.1
6 – 11	27	6.3
12 – 23	96	22.5
24 – 35	109	25.6
36 – 47	102	23.9
48 – 59	83	19.5
Mean age (SD) 31.0 (14.2)		
Sex of Child		
Female	241	56.6
Male	185	43.4
Relationship to child		
Mother	205	48.1
Father	111	26.1
Grandparent	71	16.7
Guardian	39	9.2

The age distribution of the respondents' children revealed that the highest proportion was in the 24–35 months category, accounting for 109 (25.6%), followed closely by those aged 36–47 months at 102 (23.9%). Children aged 12–23 months and 48–59 months represented 96 (22.5%) and 83 (19.5%) of the sample, respectively. The smaller age groups included infants aged 6–11 months at 27 (6.3%) and those under 6 months at 9 (2.1%). The mean age of the children was 31.00 ± 14.203 months.

In terms of sex, more than half of the children were female, 241 (56.6%), while 185 (43.4%) were male.Regarding the relationship to the child, nearly half of the respondents were mothers, totaling 205 (48.1%). Fathers constituted 111 (26.1%) of the respondents, while grandparents and guardians accounted for 71 (16.7%) and 39 (9.2%) of the caregivers, respectively.

SECTION B: KNOWLEDGE ABOUT MALARIA AND THE VACCINE AMONG THE RESPONDENTS

TABLE 2: AWARENESS OF MALARIA AMONG RESPONDENTS

Variables	Frequency (n = 426)	Percent
Awareness		
Yes	425	99.8
No	1	0.2
Source of information*	(n = 425)	
Television	317	74.6
Health professional	283	66.6
Radio	249	58.6
Social media	200	47.1
Friends	100	23.5
Government	94	22.1
Newspaper	83	19.5

***Multiple responses**

In assessing the level of awareness, nearly all respondents indicated they were aware of malaria, totaling 425 (99.8%). Only 1 (0.2%) respondent reported no prior awareness of the disease.

Among those aware of malaria (n = 425), the most frequently cited source of information was television, reported by 317 (74.6%) of the respondents. This was followed by health professionals at 283 (66.6%) and radio at 249 (58.6%). Social media served as a source of information for 200 (47.1%) participants. Other sources included friends 100 (23.5%), government communications 94 (22.1%), and newspapers 83 (19.5%).

TABLE 3: KNOWLEDGE OF MALARIA AMONG RESPONDENTS

Variables	Frequency (n = 425)	Percent
Major cause of malaria*		
Mosquito	410	96.2
Dirty environment	78	17.8
Evil spirit	1	0.2
Curse from God	1	0.2
Symptoms of malaria*		
Fever	405	95.1
Headache	349	81.9
Weakness	319	74.9
Nausea and vomiting	289	67.8
Stomach pain	32	7.5
Loss of consciousness	19	4.5
Watery stool	9	2.1
Prevention of malaria transmission*		
Sleeping under mosquito net	411	96.5
Use of insecticide spray	393	92.3
Clearing of bushes	321	75.4
Avoidance of social interaction	4	0.9
Washing of hands	2	4.8
Protected sexual intercourse	0	0.0

***Multiple responses**

In evaluating the perceived causes of malaria, a significant majority of respondents identified mosquitoes as the primary cause, 410 (96.2%). Other causes cited included a dirty environment 78 (17.8%), while a negligible number of respondents attributed the illness to evil spirits 1 (0.2%) or a curse from God 1 (0.2%). Regarding the symptoms of malaria, the most frequently recognized signs were fever 405 (95.1%), headache 349 (81.9%), weakness 319 (74.9%), and nausea or vomiting 289 (67.8%). Less frequently mentioned symptoms included stomach pain 32 (7.5%), loss of consciousness 19 (4.5%), and watery stool 9 (2.1%). The respondents demonstrated high levels of knowledge regarding malaria prevention. The most commonly identified methods were sleeping under a mosquito net 411 (96.5%), using insecticide sprays 393 (92.3%), and clearing bushes around the home 321 (75.4%). Misconceptions regarding prevention were minimal, with only 4 (0.9%) mentioning the avoidance of social interaction and 2 (0.5%) citing hand washing. No respondents (0.0%) incorrectly identified protected sexual intercourse as a method for preventing malaria transmission.

TABLE 4: OVERALL KNOWLEDGE OF MALARIA AMONG RESPONDENTS

Knowledge	Frequency (n = 426)	Percent
Good knowledge	400	93.9
Poor knowledge	26	6.1

The assessment of the participants' overall knowledge revealed that a vast majority of the respondents possessed a high level of knowledge regarding malaria. Specifically, 400 (93.9%) of the respondents were categorized as having good knowledge, while only 26 (6.1%) were found to have poor knowledge of the disease.

TABLE 5: AWARENESS OF MALARIA VACCINE AMONG RESPONDENTS

Variables	Frequency (n = 43)	Percent
Awareness		
Yes	188	44.1
No	238	55.9
Source of information*	**(n = 188)**	
Health professional	140	74.5
Social media	86	45.7
Television	55	29.3
Radio	30	16.0
Government	26	13.8
Newspaper	12	6.4
Friends	6	3.2

***Multiple responses**

In contrast to general malaria awareness, less than half of the participants were aware of the malaria vaccine. Specifically, 188 (44.1%) of the respondents reported being aware of the vaccine, while the majority, 238 (55.9%), indicated they had no prior knowledge of its existence.

Among the sub-sample of respondents who were aware of the malaria vaccine (n = 188), health professionals were the most prominent source of information, cited by 140 (74.5%) of the participants. Social media was the second most common source, utilized by 86 (45.7%), followed by television 55 (29.3%) and radio 30 (16.0%). A smaller proportion of respondents received information via government channels 26 (13.8%), newspapers 12 (6.4%), and friends 6 (3.2%).

TABLE 6: KNOWLEDGE OF MALARIA VACCINE AMONG RESPONDENTS

Variables	Frequency (n = 188)	Percent
Definition of Malaria vaccine*		
A vaccine that can confer protection against Malaria	140	74.5
A drug that can prevent Malaria virus	39	20.7
A drug that can stop Malaria virus	16	8.5
A drug that cures Malaria virus	5	2.7
I don't know	4	2.1
Classification of Malaria vaccine*		
I don't know	165	87.8
Pre-erythrocytic vaccine	12	6.4
Live-attenuated vaccine	5	2.7
Transmission blocking vaccine	2	1.1
Protein subunit vaccine	2	1.1
Nucleic acid vaccine	0	0.0
Availability of malaria vaccine in Nigeria*		
Yes	105	55.9
I don't know	81	43.1
No	2	1.1
Malaria vaccine available in Nigeria*		
I don't know	170	90.4
R21/Matrix-M	13	6.9
RTS, S/AS01	3	1.6
PAMAVAC	3	1.6
Full Length SCP	1	0.5
Route of administration		
IM	135	71.8
I don't know	53	28.2

***Multiple responses**

Among respondents aware of the vaccine (n = 188), 140 (74.5%) correctly identified it as a vaccine that confers protection against malaria. However, some respondents mischaracterized it as a drug that prevents 39 (20.7%), stops 16 (8.5%), or cures 5 (2.7%) a "malaria virus." A small number, 4 (2.1%), did not know what the vaccine was. Regarding availability, 105 (55.9%) believed the vaccine was available in Nigeria, while 81 (43.1%) were unsure, and 2 (1.1%) believed it was not available.

Technical knowledge regarding vaccine classification and specific types was notably low. A vast majority of respondents, 165 (87.8%), did not know the classes of the malaria vaccine, though 12 (6.4%) identified pre-erythrocytic vaccines. Similarly, 170 (90.4%) could not name the specific types available in Nigeria, with only 13 (6.9%) correctly identifying the R21/Matrix-M vaccine. Despite this, a majority of the sub-sample, 135 (71.8%), correctly identified the intramuscular (IM) route as the method of administration, while 53 (28.2%) remained unsure.

TABLE 7: OVERALL KNOWLEDGE OF MALARIA VACCINE AMONG RESPONDENTS

Knowledge	Frequency (n = 426)	Percent
Good knowledge	86	20.2
Poor knowledge	340	79.8

In evaluating the overall knowledge of the malaria vaccine among all participants (n = 426), the results showed a significant gap in understanding compared to general malaria knowledge. Only 86 (20.2%) of the respondents were categorized as having good knowledge of the vaccine. Conversely, the vast majority of the respondents, 340 (79.8%), were found to have poor knowledge regarding the malaria vaccine.

TABLE 8A: SOCIO-DEMOGRAPHIC CHARACTERISTICS AND KNOWLEDGE OF MALARIA VACCINE AMONG RESPONDENTS

Variables	Knowledge		Test Statistics	p-Value
	Good (n = 86) Freq (%)	Poor (n = 340) Freq (%)		
Age group (years)				
< 20	0 (0.0)	2 (100.0)		
20 – 29	25 (15.3)	138(84.7)	Fisher's exact	0.247
30 – 39	34 (27.2)	91 (72.8)	= 6.437	
40 – 49	18 (20.7)	69 (79.3)		
50 – 59	6 (17.6)	28 (82.4)		
≥ 60	3 (20.0)	12 (80.0)		
Sex				
Female	60 (20.7)	230 (79.3)		
Male	26 (19.1)	110 (80.9)	$\chi^2 = 0.142$	0.798
Religion				
Christian	83 (21.2)	309 (78.8)		
Islam	3 (10.7)	25 (89.3)	Fisher's exact	
ATR	0 (0.0)	6 (100.0)	= 2.513	0.249
Marital Status				
Married	68 (23.8)	218 (76.2)		
Single	10 (10.2)	88 (89.8)		
Widowed	5 (31.3)	11 (68.8)		
Co-habiting	2 (10.5)	17 (89.5)	Fisher's exact	
Separated	1 (25.0)	3 (75.0)	= 11.480	**0.026**
Divorced	0 (0.0)	3 (100.0)		

In relation to age, the 30–39 age group demonstrated the highest frequency of good knowledge at 34 (27.2%), while all respondents under the age of 20 (n = 2, 100.0%) possessed poor knowledge; however, age was not significantly associated with knowledge levels (Fisher's exact = 6.437, p = 0.247). In terms of gender, females had a slightly higher rate of good knowledge at 60 (20.7%) compared to males at 26 (19.1%), but this difference was not statistically significant (χ^2= 0.142, p = 0.798).

Religious affiliation did not show a significant association (Fisher's exact = 2.513, p = 0.249), with Christians exhibiting a good knowledge rate of 83 (21.2%) compared to Muslims at 3 (10.7%) and those practicing African Traditional Religion at 0 (0.0%). Marital status was significantly associated with knowledge of the malaria vaccine (Fisher's exact = 11.480, p = 0.026). Widowed respondents (31.3%) and married respondents (23.8%) reported higher rates of good knowledge compared to those who were single (10.2%) or co-habiting (10.5%).

TABLE 8B: SOCIO-DEMOGRAPHIC CHARACTERISTICS AND KNOWLEDGE OF MALARIA VACCINE AMONG RESPONDENTS

Variables	Knowledge		Test Statistics	p-Value
	Good (n = 86) Freq (%)	Poor (n = 340) Freq (%)		
Family type				
Monogamous	80 (20.6)	308 (79.4)		
Polygamous	6 (15.8)	32 (84.2)	$\chi^2 = 0.501$	0.535
Household size				
2 – 5	74 (21.1)	277 (78.9)		
≥ 6	12 (16.0)	63 (84.0)	$\chi^2 = 0.991$	0.347
Highest LOE				
No formal education	0 (0.0)	11 (100.0)		
Primary	3 (5.7)	5 (94.3)		
Secondary	21 (11.3)	165 (86.7)	$\chi^2 = 43.570$	**0.001**
Tertiary	62 (35.2)	114 (64.8)		
	3 (5.7)	11 (100.0)		
ILO Skill Level				
Level 0	2(5.5)	34(94.5)		
Level 1	1(5.5)	17(94.5)		
Level 2	31(14.6)	181(85.4)	$\chi^2 = 29.170$	**0.001**
Level 3	24(39.3)	37(60.7)		
Level 4	28(28.3)	71(71.7)		
Monthly Income				
<70,000	13 (11.0)	105 (89.0)		
70,000-139,999	25 (16.7)	125 (83.3)		
140,000-209,000	27 (28.7)	67 (71.3)	$\chi^2 = 19.790$	**0.001**
2100,000-279,000	15 (34.9)	28 (65.1)		
≥ 280,000	6 (31.6)	13 (68.4)		

Regarding domestic characteristics, neither family type nor household size was significantly associated with knowledge levels. Specifically, those in monogamous families had a good knowledge rate of 80 (20.6%) compared to 6 (15.8%) in polygamous families (χ^2= 0.501, p = 0.535). Similarly, respondents with smaller household sizes (2–5 members) showed a good knowledge rate of 74 (21.1%) compared to 12 (16.0%) for those with larger households of 6 or more members (χ^2 = 0.991, p = 0.347).

In contrast, socioeconomic indicators were strongly linked to vaccine knowledge. The highest level of education (LOE) was significantly associated with knowledge levels (χ^2 = 43.570, p = 0.001), with tertiary-educated respondents exhibiting a notably higher rate of good knowledge at 62 (35.2%) compared to those with secondary (11.3%), primary (5.7%), or no formal education (0.0%).

Skill level also showed a significant association with knowledge levels (χ^2 = 29.170, p = 0.001). Respondents with skill level 3 demonstrated the highest rate of good knowledge at 24 (39.3%), followed by skill level 4 at 28 (28.3%), while skill level 0 and 1 respondents had lowest levels of good knowledge at 5.5% for both. Furthermore, a significant association was found between monthly income and knowledge of the malaria vaccine (χ^2 = 19.790, p = 0.001). Good knowledge rates generally increased with income, rising from 13 (11.0%) among those earning less than 70,000 to a peak of 15 (34.9%) for those in the 210,000–279,000 income bracket.

TABLE 8C: SOCIO-DEMOGRAPHIC CHARACTERISTICS AND KNOWLEDGE OF MALARIA VACCINE AMONG RESPONDENTS

Variables	Knowledge		Test Statistics	p-Value
	Good (n = 86)	Poor (n = 340)		
	Freq (%)	Freq (%)		
Child's age (months)				
<6	2 (22.2)	7 (77.8)		
6 – 11	4 (14.8)	23 (85.2)		
12 – 23	19 (19.8)	77 (80.2)		
24 – 35	26 (23.9)	83 (76.1)	χ^2=1.677	0.892
36 – 47	20 (19.6)	82 (80.4)		
48 – 59	15 (18.1)	68 (81.9)		
Sex of Child				
Female	42 (17.4)	199 (82.6)	χ^2 = 2.624	0.114
Male	44 (23.8)	141 (76.2)		
Relationship to child				
Mother	50 (24.4)	155 (75.6)	χ^2 = 5.313	0.149
Father	21 (18.9)	90 (81.1)		
Grandparent	10 (14.1)	61 (85.9)		
Guardian	5 (12.8)	34 (79.8)		

Regarding the child's age, the highest proportion of good knowledge was observed among respondents with children aged 24–35 months (23.9%), while the lowest was in the 6–11 month group (14.8%). However, no significant association was found between the child's age and the respondent's knowledge level ($\chi^2 = 1.677$, $p = 0.892$). Similarly, the sex of the child did not significantly influence knowledge ($\chi^2 = 2.624$, $p = 0.114$), although respondents with male children had a slightly higher rate of good knowledge (23.8%) compared to those with female children (17.4%).

Finally, the respondent's relationship to the child was not significantly associated with their knowledge level ($\chi^2 = 5.313$, $p = 0.149$). Mothers exhibited the highest frequency of good knowledge at 50 (24.4%), followed by fathers at 21 (18.9%), while grandparents (14.1%) and guardians (12.8%) reported lower rates of good knowledge.

TABLE 9: KNOWLEDGE OF MALARIA AND KNOWLEDGE OF MALARIA VACCINE AMONG RESPONDENTS

Knowledge Of Malaria	Knowledge Of Malaria Vaccine		Test Statistics	p-Value
	Good (n = 86) Freq (%)	Poor (n = 340) Freq (%)		
Good knowledge	84 (21.0)	316 (79.0)		
Poor knowledge	2 (7.7)	24 (92.3)	$\chi^2 = 2.683$	0.131

Respondents with good general knowledge of malaria exhibited a higher rate of good knowledge regarding the vaccine at 84 (21.0%), compared to those with poor general knowledge of malaria, of whom only 2 (7.7%) demonstrated good vaccine knowledge. Despite this descriptive difference, no statistically significant association was found between the two variables ($\chi^2 = 2.683$, p = 0.131).

TABLE 10: PREDICTORS OF KNOWLEDGE OF MALARIA VACCINE AMONG RESPONDENTS

Predictors	**B Regression co-efficient**	**OR**	**95% CI for OR**		**p-value**
			Lower	**Upper**	
Age	-0.021	0.979	0.947	1.013	0.217
Gender					
Male	-0.423	0.655	0.364	1.177	0.157
Female	1				
Family type					
Monogamous	-0.391	0.676	0.224	2.042	0.488
Polygamous	1				
Household size					
2-5	-0.459	0.632	0.263	1.515	0.304
>=6	1				
Child's age	0.000	1.000	0.981	1.019	0.981
Sex of Child					
Male	.401	1.494	0.889	2.509	0.129
Female	1				
Religion					
Christian	0.884	2.420	0.619	9.462	0.204
Islam, ATR, Atheist	1				
Marital status					
Ever Married	0.873	2.395	1.089	5.264	0.030
Never married	1				
LOE					
Tertiary	1.577	4.839	2.671	8.767	**0.001**
Not tertiary	1				
Income					
<140,000	0.391	1.479	0.833	2.624	0.181
>=140,00	1				
Knowledge of malaria					
Good knowledge	1.325	3.762	0.809	17.503	0.091
Poor knowledge	1				

Cox & Snell R^2: 0.134, Nagelkerke R^2: 0.211. CI: confidence interval, OR: odds ratio, * reference variable

The model explained between 13.4% (Cox & Snell R^2) and 21.1% (Nagelkerke R^2) of the variance in knowledge of the malaria vaccine.

Age was not significantly associated with the knowledge of malaria vaccine (OR = 0.98, 95% CI [0.95, 1.01], $p = .217$), indicating that with each additional year, the odds of the outcome slightly decreased, but this effect was not statistically significant. Similarly, gender was not a significant predictor; males had lower odds of the outcome compared to females (OR = 0.66, 95% CI [0.36, 1.18], $p = .157$).

Family type and household size were also not significantly associated with the knowledge of malaria vaccine. Individuals from monogamous families were less likely to experience the outcome compared to those from polygamous families (OR = 0.68, 95% CI [0.22, 2.04], $p = .488$), while those from households with 2–5 members had lower odds compared to households with ≥6 members (OR = 0.63, 95% CI [0.26, 1.52], $p = .304$); however, these associations were not statistically significant.

Child-related variables, including child's age (OR = 1.00, 95% CI [0.98, 1.02], $p = .981$) and child's sex (OR = 1.49, 95% CI [0.89, 2.51], $p = .129$), were not significant predictors of knowledge of malaria vaccine . Religion was also not significantly associated with the outcome, although Christians had higher odds compared to those practicing Islam, African Traditional Religion, or atheism (OR = 2.42, 95% CI [0.62, 9.46], $p = .204$).

Marital status was a significant predictor: individuals who were ever married were approximately 2 times more likely to have good knowledge of malaria vaccine as compared to those who were never married (OR = 2.40, 95% CI [1.09, 5.26], $p = .030$). Level of education was also a strong and statistically significant predictor. Respondents with tertiary education were about 5 times more likely to have good knowledge of malaria vaccine compared to those without tertiary education (OR = 4.84, 95% CI [2.67, 8.77], $p = .001$).

Income was not significantly associated with the outcome; individuals earning less than 140,000 had higher odds compared to those earning ≥140,000 (OR = 1.48, 95% CI [0.83, 2.62], p = .181), but this was not statistically significant. Knowledge of malaria was not a statistically significant predictor, although individuals with good knowledge were about 4 times more likely to have good knowledge of malaria vaccine compared to those with poor knowledge (OR = 3.76, 95% CI [0.81, 17.50], p = .091).

SECTION C: PERCEPTION TOWARDS MALARIA VACCINE AMONG RESPONDENTS

TABLE 11: PERCEPTION TOWARDS THE MALARIA VACCINEAMONG RESPONDENTS

Perception (n = 42)	Strongly Agree Freq (%)	Agree Freq (%)	Undecided Freq (%)	Disagree Freq (%)	Strongly Disagree Freq (%)
It is safe to take the Malaria vaccine	154 (36.2)	155 (36.4)	112 (26.3)	4 (0.9)	1 (0.2)
The Malaria vaccine can prevent the Malaria infection	123 (28.9)	173 (40.6)	106 (24.9)	22 (5.2)	2 (0.5)
The Malaria vaccine increases the occurrence of the Malaria infection	1 (0.2)	7 (1.6)	112 (26.3)	224 (52.6)	82 (19.2)
There is need for children to vaccinate with the Malaria Vaccine	75 (17.6)	227 (53.3)	109 (25.6)	15 (3.5)	0 (0.0)
Malaria vaccine protects children fully	48 (11.3)	125 (29.3)	204 (47.9)	43 (10.1)	6 (1.4)
Vaccination saves me the stress of wasting money to buy drugs or wasting working hours in visiting the hospital with my child	57 (13.4)	212 (49.8)	135 (31.7)	15 (3.5)	7 (1.6)
The Malaria vaccine is effective and is likely to work for everyone	41 (9.6)	149 (35.0)	208 (48.8)	25 (5.9)	3 (0.7)
Suspicion around the Malaria vaccine can negatively affect my willingness to vaccinate my child	38 (8.9)	121 (28.4)	138 (32.4)	104 (24.4)	25 (5.9)
It is against my religion to take any vaccine	3 (0.7)	9 (2.1)	22 (5.2)	214 (50.2)	178 (41.8)
It is against my culture to receive any vaccine	1 (0.2)	4 (0.9)	16 (3.8)	216 (50.7)	189 (44.4)

Regarding the safety of the malaria vaccine, 154 (36.2%) strongly agreed and 155 (36.4%) agreed it was safe, while 112 (26.3%) were undecided, and a small minority disagreed 4 (0.9%) or strongly disagreed 1 (0.2%). When asked if the vaccine can prevent infection, 123 (28.9%) strongly agreed and 173 (40.6%) agreed; 106 (24.9%) were undecided, while 22 (5.2%) and 2 (0.5%) disagreed and strongly disagreed respectively.

Regarding whether the vaccine protects children fully, 48 (11.3%) strongly agreed, 125 (29.3%) agreed, 204 (47.9%) were undecided, 43 (10.1%) disagreed, and 6 (1.4%) strongly disagreed. On the vaccine's effectiveness for everyone, 41 (9.6%) strongly agreed, 149 (35.0%) agreed, 208 (48.8%) were undecided, 25 (5.9%) disagreed, and 3 (0.7%) strongly disagreed.

A total of 75 (17.6%) strongly agreed and 227 (53.3%) agreed on the need for childhood vaccination, with 109 (25.6%) undecided and 15 (3.5%) in disagreement. On the utility of vaccination for saving money and time, 57 (13.4%) strongly agreed, 212 (49.8%) agreed, 135 (31.7%) were undecided, 15 (3.5%) disagreed, and 7 (1.6%) strongly disagreed.

Regarding whether suspicion affects willingness to vaccinate, 38 (8.9%) strongly agreed, 121 (28.4%) agreed, 138 (32.4%) were undecided, 104 (24.4%) disagreed, and 25 (5.9%) strongly disagreed. When presented with the misconception that the vaccine increases malaria occurrence, only 1 (0.2%) strongly agreed and 7 (1.6%) agreed, while 112 (26.3%) were undecided, 224 (52.6%) disagreed, and 82 (19.2%) strongly disagreed.

Religious objections were minimal, with 3 (0.7%) strongly agreeing and 9 (2.1%) agreeing that vaccines are against their religion, whereas 22 (5.2%) were undecided, 214 (50.2%) disagreed, and 178 (41.8%) strongly disagreed. Similarly, for cultural barriers, 1 (0.2%) strongly agreed, 4 (0.9%) agreed, 16 (3.8%) were undecided, 216 (50.7%) disagreed, and 189 (44.4%) strongly disagreed that vaccination was against their culture.

TABLE 12: OVERALL PERCEPTION TOWARDS THE MALARIA VACCINE AMONG RESPONDENTS

Perception	Frequency (n = 426)	Percent
Positive perception	361	84.7
Negative perception	65	15.3

The analysis of the overall perception of the participants toward the malaria vaccine indicated a largely favorable attitude. A significant majority of the respondents, 361 (84.7%), held a positive perception of the vaccine. Conversely, a smaller segment of the study population, 65 (15.3%), expressed negative perception towards the malaria vaccine.

TABLE 13A: SOCIO-DEMOGRAPHIC CHARACTERISTICS AND PERCEPTION TOWARDS MALARIA VACCINE AMONG RESPONDENTS

Variables	Perception		Test Statistics	p-Value
	Good (n = 361) Freq (%)	Poor (n = 65) Freq (%)		
Age group (years)				
< 20	1 (50.0)	1 (50.0)		
20 – 29	135 (82.8)	28 (17.2)	$\chi^2 = 5.071$	0.388
30 – 39	112 (89.6)	13 (10.4)		
40 – 49	72 (82.4)	15 (17.2)		
50 – 59	28 (82.4)	6 (17.6)		
≥ 60	13 (86.7)	2 (13.3)		
Sex				
Female	243 (83.8)	47 (16.2)		
Male	118 (86.8)	18 (13.2)	$\chi^2 = 0.632$	0.472
Religion				
Christian	346 (88.3)	46 (11.7)		
Islam	12 (42.9)	16 (57.1)	Fisher's exact	
ATR	3 (50.0)	3 (50.0)	= 35.061	**0.0001**
Marital Status				
Married	242 (84.6)	44 (15.4)		
Single	83 (84.7)	15 (15.3)		
Widowed	13 (81.3)	3 (18.8)		
Co-habiting	17 (89.5)	2 (10.5)	Fisher's exact	
Separated	3 (75.0)	1 (25.0)	= 1.424	0.982
Divorced	3 (100.0)	0 (0.0)		

Regarding age, respondents in the 30–39 age group demonstrated the highest rate of good perception at 112 (89.6%), whereas the youngest respondents (under 20 years) had the lowest at 1 (50.0%); however, age group was not significantly associated with perception levels (χ^2 = 5.071, p = 0.388). Sex also did not significantly influence perception (χ^2 = 0.632, p = 0.472), with males reporting a good perception rate of 118 (86.8%) and females reporting 243 (83.8%).

Marital status showed no statistically significant association (Fisher's exact = 1.424, p = 0.982), with good perception remains consistently high across categories, notably reaching 100.0% among divorced respondents and 89.5% among those co-habiting.

Conversely, religious affiliation was highly significantly associated with the respondents' perception of the malaria vaccine (Fisher's exact = 35.061, $p < 0.001$). Christians exhibited a strong favorable attitude with 346 (88.3%) having a good perception, which was markedly higher than the rates observed among Muslims at 12 (42.9%) and practitioners of African Traditional Religion (ATR) at 3 (50.0%).

TABLE 13B: SOCIO-DEMOGRAPHIC CHARACTERISTICS AND PERCEPTION TOWARDS MALARIA VACCINE AMONG RESPONDENTS

Variables	Perception		Test Statistics	p-Value
	Good (n = 361) Freq (%)	Poor (n = 65) Freq (%)		
Family type				
Monogamous	336 (86.6)	52 (13.4)		
Polygamous	25 (65.8)	13 (34.2)	$\chi^2 = 11.590$	0.002
Household size				
2 – 5	307 (87.5)	44 (12.5)		
≥ 6	54 (72.0)	21 (28.0)	$\chi^2 = 11.429$	0.001
Highest LOE				
No formal education	4 (36.4)	7 (63.6)		
Primary	36 (67.9)	17 (32.1)		
Secondary	163 (87.6)	23 (12.4)	$\chi^2 = 36.152$	**0.001**
Tertiary	158 (89.8)	18 (10.2)		
Occupation				
Level 0	32(88.9)	4(11.1)		
Level 1	12(66.7)	6(33.3)		
Level 2	173(81.6)	39(18.4)	$\chi^2 = 10.229$	**0.036**
Level 3	54(88.5)	7(11.5)		
Level 4	90(90.9)	9(9.1)		
Monthly Income				
<70,000	94 (79.7)	24 (20.3)		
70,000-139,999	126 (84.0)	24 (16.0)		
140,000-209,000	82 (87.2)	12 (12.8)	$\chi^2 = 5.458$	**0.241**
2100,000-279,000	40 (93.0)	3 (7.0)		
≥ 280,000	17 (89.5)	2 (10.5)		

Regarding family characteristics, family type was significantly associated with perception (χ^2 = 11.590, p = 0.002), with those in monogamous families reporting a higher rate of good perception at 336 (86.6%) compared to 25 (65.8%) for those in polygamous families. Similarly, household size showed a significant association (χ^2 = 11.429, p = 0.001); respondents with smaller households (2–5 members) had a more favorable perception at 307 (87.5%) than those with larger households of 6 or more members at 54 (72.0%).

Socioeconomic status also played a vital role in shaping attitudes. The highest level of education was strongly associated with vaccine perception (χ^2 = 36.152, p = 0.001). Good perception rates increased progressively with education, peaking among those with tertiary education at 158 (89.8%) and secondary education at 163 (87.6%), while respondents with no formal education reported the lowest rate of good perception at 4 (36.4%).

Skill level was also found to be significantly associated with perception (χ^2 = 10.229, p = 0.036). Respondents with skill level 4 had the highest proportion with good perception at 90 (92.6%), whereas those in skill level 1 reported the lowest rate of good perception at 12 (66.7%). While good perception generally increased with income reaching 93.0% in the 210,000–279,000 bracket, monthly income was not found to be a statistically significant factor in determining perception toward the vaccine (χ^2 = 5.458, p = 0.241).

TABLE 13C: SOCIO-DEMOGRAPHIC CHARACTERISTICS AND PERCEPTION TOWARDS MALARIA VACCINE AMONG RESPONDENTS

Variables	Perception		Test Statistics	p-Value
	Good (n = 361) Freq (%)	Poor (n = 65) Freq (%)		
Child's age (months)				
<6	6 (66.7)	3 (33.3)		
6 – 11	21 (77.8)	6 (22.2)		
12 – 23	87 (90.6)	9 (9.4)	$\chi^2 = 12.077$	0.034
24 – 35	91 (83.5)	18 (16.5)		
36 – 47	92 (90.2)	10 (9.8)		
48 – 59	64 (77.1)	19 (22.9)		
Sex of Child				
Female	201 (83.4)	40 (16.6)		
Male	160 (86.5)	25 (13.5)	$\chi^2 = 0.770$	0.417
Relationship to child				
Mother	172 (83.9)	33 (16.1)		
Father	97 (87.4)	14 (12.6)	$\chi^2 = 0.934$	0.828
Grandparent	60 (84.5)	11 (15.5)		
Guardian	32 (82.1)	7 (17.9)		

The age of the child was found to be significantly associated with the respondents' perception of the malaria vaccine (χ^2 = 12.077, p = 0.034). The most favorable perceptions were observed among respondents with children aged 12–23 months (90.6%) and 36–47 months (90.2%), whereas those with infants under 6 months old reported the lowest rate of good perception at 6 (66.7%).

In contrast, the sex of the child did not have a statistically significant impact on perception levels (χ^2 = 0.770, p = 0.417), with similar rates of good perception reported for those with male children (86.5%) and female children (83.4%). Furthermore, the respondent's relationship to the child was not significantly associated with their perception (χ^2 = 0.934, p = 0.828). Fathers reported the highest rate of good perception at 97 (87.4%), followed by grandparents at 60 (84.5%), mothers at 172 (83.9%), and guardians at 32 (82.1%).

TABLE 14: KNOWLEDGE OF MALARIA AND MALARIA VACCINE AND PERCEPTION TOWARDS AMONG RESPONDENTS

Variables	Perception		Test Statistics	p-Value
	Good (n = 361) Freq (%)	Poor (n = 65) Freq (%)		
Knowledge of malaria				
Good knowledge	337 (84.3)	63 (15.8)		
Poor knowledge	24 (92.3)	2 (7.7)	$\chi^2 = 1.226$	**0.4001**
Knowledge of malaria vaccine				
Good knowledge	80 (93.0)	6 (7.0)		
Poor knowledge	281 (82.6)	59 (17.4)	$\chi^2 = 40.285$	**0.0001**

General knowledge of malaria was not found to be significantly associated with the respondents' perception of the vaccine ($\chi^2 = 1.226$, $p = 0.400$). Interestingly, those with poor general knowledge of malaria reported a slightly higher rate of good perception at 24 (92.3%) compared to those with good general knowledge at 337 (84.3%).

Conversely, knowledge specifically regarding the malaria vaccine was highly significantly associated with perception levels ($\chi^2 = 40.285$, $p < 0.001$). Respondents with good knowledge of the vaccine demonstrated a substantially more favorable attitude, with 80 (93.0%) possessing a good perception. In contrast, among those with poor knowledge of the vaccine, the rate of good perception was notably lower at 281 (82.6%).

TABLE 15: PREDICTORS OF PERCEPTION TOWARDS MALARIA VACCINE AMONG RESPONDENTS

Predictors	B Regression co-efficient	OR	95% CI for OR		p-value
			Lower	Upper	
Age	0.013	1.013	0.978	1.049	0.468
Gender					
Male	0.285	1.330	0.684	2.584	0.400
Female	1				
Family type					
Monogamous	0.183	1.201	0.443	3.257	0.719
Polygamous	1				
Household size					
2-5	0.559	1.749	0.777	3.936	0.177
>=6	1				
Child's age	-0.009	0.991	0.970	1.012	0.402
Sex of Child					
Male	0.262	1.300	0.716	2.359	0.388
Female	1				
Religion					
Christian	1.998	7.371	3.098	17.538	**0.0001**
Islam, ATR, Atheist	1				
Marital status					
Ever Married	0.028	1.028	0.476	2.222	0.944
Never married	1				
LOE					
Tertiary	0.007	1.007	0.504	2.010	0.985
Not tertiary	1				
Income					
<140,000	0.221	1.248	0.624	2.495	0.532
>=140,00	1				
Knowledge of malaria					
Good knowledge	-0.916	0.400	0.084	1.908	0.250
Poor knowledge	1				
Knowledge of Vaccine					
Good knowledge	0.811	2.251	0.871	5.819	0.094
Poor knowledge	1				

Cox & Snell R^2: 0.103, Nagelkerke R^2: 0.179. CI: confidence interval, OR: odds ratio, * reference variable

The model accounted for between 10.3% (Cox & Snell R^2) and 17.9% (Nagelkerke R^2) of the variance in positive perception.

Age was not a significant predictor of having a positive perception towards the malaria vaccine (OR = 1.01, 95% CI [0.98, 1.05], p = .468). Likewise, gender did not significantly influence perception; although males had higher odds of having a positive perception compared to females (OR = 1.33, 95% CI [0.68, 2.58], p = .400), this difference was not statistically significant.

Family structure and household size were also not associated with having a positive perception towards the malaria vaccine. Respondents from monogamous families showed slightly higher odds of having a positive perception compared to those from polygamous families (OR = 1.20, 95% CI [0.44, 3.26], p = .719). Similarly, individuals from households with 2–5 members were more likely to report a positive perception than those from larger households (≥6 members) (OR = 1.75, 95% CI [0.78, 3.94], p = .177), although these findings were not statistically significant.

Child-related characteristics were not significant determinants. Neither the child's age (OR = 0.99, 95% CI [0.97, 1.01], p = .402) nor the child's sex (OR = 1.30, 95% CI [0.72, 2.36], p = .388) significantly influenced whether respondents had a positive perception towards the malaria vaccine.

Religion, however, was a strong and statistically significant predictor. Christians were approximately 7 times more likely to have a positive perception towards the malaria vaccine compared to respondents practicing Islam, African Traditional Religion, or atheism (OR = 7.37, 95% CI [3.10, 17.54], $p < .001$).

Marital status and level of education did not significantly predict perception. Ever-married respondents had nearly the same likelihood of having a positive perception as those who were never married (OR = 1.03, 95% CI [0.48, 2.22], p = .944). In the same vein, respondents with

tertiary education were not significantly more likely to have a positive perception towards the malaria vaccine compared to those without tertiary education (OR = 1.01, 95% CI [0.50, 2.01], p = .985).

Income level was not significantly associated with having a positive perception towards the malaria vaccine. Although respondents earning less than 140,000 were somewhat more likely to report a positive perception compared to higher earners (OR = 1.25, 95% CI [0.62, 2.50], p = .532), this difference was not statistically meaningful.

Knowledge variables also did not reach statistical significance. Respondents with good knowledge of malaria were less likely to have a positive perception towards the malaria vaccine (OR = 0.40, 95% CI [0.08, 1.91], p = .250), though this association was not significant. Conversely, those with good knowledge of the malaria vaccine were about 2 times more likely to have a positive perception compared to those with poor knowledge (OR = 2.25, 95% CI [0.87, 5.82], p = .094), but this did not achieve statistical significance.

SECTION D: LEVEL OF ACCEPTANCE AND FACTORS AFFECTING THE LEVEL OF ACCEPTANCE OF MALARIA VACCINE

TABLE 16: LEVEL OF ACCEPTANCE AND FACTORS AFFECTING LEVEL OF ACCEPTANCE OF THE MALARIA VACCINE AMONG RESPONDENTS

Variable	Frequency (n = 426)	Percent
Children who has received the Malaria vaccine		
Yes	49	11.5
No	377	88.5
Side effects (n = 49)		
Yes	18	36.7
No	31	63.3
Side effects noticed after receiving the vaccine (n = 18)*		
Fever	16	88.9
Headache	2	11.1
Rash	2	11.1
Joint pain	0	0.0
Vomiting	0	0.0

Regarding the actual uptake of the malaria vaccine, only a small proportion of the respondents reported that their children had received the vaccine, totaling 49 (11.5%). The vast majority of the participants, 377 (88.5%), indicated that their children had not yet received the malaria vaccine.

Among the subset of respondents whose children had received the vaccine (n = 49), 18 (36.7%) reported that their children experienced side effects, while 31 (63.3%) reported no

adverse reactions. Of those who noticed side effects (n = 18), fever was the most frequently reported symptom, affecting 16 (88.9%) children. Other reported side effects included headaches 2 (11.1%) and rashes 2 (11.1%). No cases of joint pain or vomiting (0.0%) were recorded among the vaccinated children.

TABLE 17: WILLINGNESS TO ACCEPT AND RECOMMEND THE MALARIA VACCINE AMONG RESPONDENTS

Variable	Frequency (n = 426)	Percent
Willingness to allow your child take the malaria vaccine		
Yes	313	73.5
No	113	26.5
Reasons for refusal (n=113)*		
Fear of adverse reaction	93	82.3
Personal bias against it	20	17.7
Spousal refusal	19	16.8
My culture is against it	3	2.7
My religion is against it	2	1.8
Willingness to recommend others to take the Malaria vaccine		
Yes	292	68.6
No	70	16.4
Not sure	64	15.1

***Multiple responses**

A significant majority of the respondents, 313 (73.5%), expressed a willingness to allow their children to receive the malaria vaccine, while 113 (26.5%) indicated they were unwilling. Among those who refused (n = 113), the most prominent reason cited was a fear of adverse reactions, reported by 93 (82.3%) participants. Other factors included personal bias 20

(17.7%) and spousal refusal 19 (16.8%). Cultural and religious objections remained the least common reasons for refusal, cited by 3 (2.7%) and 2 (1.8%) respondents, respectively.

In evaluating peer-to-peer advocacy, 292 (68.6%) of the respondents stated they were willing to recommend the malaria vaccine to others. Conversely, 70 (16.4%) were unwilling to recommend it, and 64 (15.1%) remained unsure about whether they would encourage others to take the vaccine.

TABLE 18A: SOCIO-DEMOGRAPHIC CHARACTERISTICS AND WILLINGNESS TO ACCEPT MALARIA VACCINE AMONG RESPONDENTS

Variables	Willingness To Accept		Test Statistics	p-Value
	Yes (n = 313) Freq (%)	No (n = 131) Freq (%)		
Age group (years)				
< 20	0 (0.0)	2 (100.0)		
20 – 29	126 (77.3)	37 (22.7)	$\chi^2 = 12.170$	0.030
30 – 39	96 (76.8)	29 (23.2)		
40 – 49	59 (67.8)	28 (32.20		
50 – 59	24 (70.6)	10 (29.4)		
≥ 60	8 (53.3)	7 (46.7)		
Sex				
Female	211 (72.8)	79 (27.2)		
Male	102 (75.0)	34 (25.0)	$\chi^2 = 0.239$	0.640
Religion				
Christian	295 (75.3)	97 (24.7)		
Islam	15 (53.6)	13 (46.4)	Fisher's exact	
ATR	3 (50.0)	3 (50.)	= 7.7671	0.019
Marital Status				
Married	213 (74.5)	73 (25.5)		
Single	74 (75.5)	24 (24.5)		
Widowed	11 (68.8.)	5 (31.3)		
Co-habiting	12 (63.8)	7 (31.3)	Fisher's exact	
Separated	2 (50.0)	2 (50.0))	= 5.573	0.310
Divorced	1 (33.3)	2 (66.7)		

Regarding age, a significant association was found between age group and willingness to accept the vaccine (χ^2 = 12.170, p = 0.030). Willingness was highest among the younger cohorts, specifically those aged 20–29 years (77.3%) and 30–39 years (76.8%), while all respondents under the age of 20 (n = 2, 100.0%) expressed a lack of willingness. In terms of sex, males reported a slightly higher willingness (75.0%) than females (72.8%), but this difference was not statistically significant (χ^2 = 0.239, p = 0.640).

Religious affiliation was significantly associated with willingness (Fisher's exact = 7.767, p = 0.019). Christians demonstrated a higher rate of acceptance at 295 (75.3%), whereas willingness was notably lower among Muslims (53.6%) and those practicing African Traditional Religion (50.0%). Marital status was not significantly associated with vaccine acceptance (Fisher's exact = 5.573, p = 0.310). Single (75.5%) and married (74.5%) respondents showed higher rates of willingness compared to those who were separated (50.0%) or divorced (33.3%).

TABLE 18B: SOCIO-DEMOGRAPHIC CHARACTERISTICS AND WILLINGNESS TO ACCEPT MALARIA VACCINE AMONG RESPONDENTS

Variables	Willingness To Accept		Test Statistics	p-Value
	Yes (n = 313) Freq (%)	No (n = 131) Freq (%)		
Family type				
Monogamous	293 (75.5)	95 (24.5)		
Polygamous	20 (52.6)	18 (47.4)	$\chi^2 = 9.300$	0.004
Household size				
2 – 5	269 (76.6)	82 (23.4)		
≥ 6	44 (58.7)	31 (41.2)	$\chi^2 = 10.241$	0.002
Highest LOE				
No formal education	5 (45.5)	6 (54.5)		
Primary	24 (45.3)	29 (54.7)		
Secondary	136 (73.1)	50 (26.9)	$\chi^2 = 36.234$	0.0001
Tertiary	148 (84.1)	28 (15.9)		
Occupation				
Level 0	30(83.3)	6(16.7)		
Level 1	9(50.0)	9(50.0)		
Level 2	144(67.9)	68(32.1		
Level 3	52(85.2)	9(14.8)	$\chi^2 = 16.006$	0.003
Level 4	78(78.8)	21(21.2)		
Monthly Income				
<70,000	75 (63.6)	43 (36.4)		
70,000-139,999	106 (70.7)	44 (29.3)		
140,000-209,000	74 (78,7)	20 (21.3)	$\chi^2 = 17.387$	0.002
2100,000-279,000	40 (93.0)	3 (7.0)		
≥ 280,000	16 (84.2)	3 (15.8)		

Regarding family structure, family type was significantly associated with willingness (χ^2 = 9.300, p = 0.004), with those in monogamous families showing a higher acceptance rate at 293 (75.5%) compared to 20 (52.6%) for those in polygamous families. Household size also exerted a significant influence (χ^2 = 10.241, p = 0.002); respondents with smaller households (2–5 members) were more likely to accept the vaccine (76.6%) than those with households of 6 or more members (58.7%).

Socioeconomic status emerged as a strong predictor of acceptance. The highest level of education (LOE) was highly significantly associated with willingness (χ^2 = 36.234, $p < 0.001$). Willingness increased progressively with educational attainment, from 45.5% among those with no formal education to 84.1% among those with tertiary education. Similarly, skill level was significantly associated with willingness (χ^2 = 16.006, p = 0.003). Skill levels 3 and 0 reported the highest acceptance rates at 85.2% and 83.3% respectively, while respondents with skill level 1 reported the lowest at 50.0%.

Finally, monthly income was significantly associated with the willingness to accept the vaccine (χ^2 = 17.387, p = 0.002). Acceptance rates generally trended upward as income increased, peaking at 93.0% for respondents in the 210,000–279,000 income bracket, compared to 63.6% for those earning less than 70,000.

TABLE 18C: SOCIO-DEMOGRAPHIC CHARACTERISTICS AND WILLINGNESS TO ACCEPT MALARIA VACCINE AMONG RESPONDENTS

Variables	Willingness To Accept		Test Statistics	p-Value
	Yes (n = 313) Freq (%)	No (n = 131) Freq (%)		
Child's age (months)				
<6	7 (77.8)	2 (22.2)		
6 – 11	10 (66.7)	9 (33.2)		
12 – 23	72 (75.0)	24 (25.0)		
24 – 35	85 (78.0)	24 (22.0)	$\chi^2 = 9.4261$	0.091
36 – 47	80 (78.4)	22 (21.6)		
48 – 59	51 (61.4)	32 (38.6)		
Sex of Child				
Female	175 (72.6)	66 (27.40		
Male	138 (74.6)	47 (25.4)	$\chi^2 = 0.211$	0.660
Relationship to child				
Mother	150 (73.2)	55 (26.8)		
Father	86 (77.5)	25 (22.5)	$\chi^2 = 7.329$	0.062
Grandparent	55 (77.5)	16 (22.5)		
Guardian	22 (56.4)	17 (43.6)		

Regarding the child's age, the highest rates of willingness were observed in the 36–47 month (78.4%) and 24–35 month (78.0%) categories, while the lowest rate was recorded among respondents with children aged 48–59 months (61.4%). However, these differences were not statistically significant (χ^2 = 9.426, p = 0.091). Similarly, the sex of the child was not significantly associated with acceptance (χ^2 = 0.211, p = 0.660), with 138 (74.6%) of those with male children and 175 (72.6%) of those with female children expressing a willingness to accept the vaccine.

Finally, the respondent's relationship to the child did not reach statistical significance regarding vaccine acceptance (χ^2 = 7.329, p = 0.062). Descriptive data showed that fathers and grandparents shared the highest willingness rate at 77.5%, followed by mothers at 73.2%. Guardians expressed the lowest level of willingness at 22 (56.4%).

TABLE 19: KNOWLEDGE OF MALARIA AND MALARIA VACCINE AND WILLINGNESS TO ACCEPT AMONG RESPONDENTS

Variables	Willingness To Accept		Test Statistics	p-Value
	Yes (n = 313) Freq (%)	No (n = 131) Freq (%)		
Knowledge of malaria				
Good knowledge	296 (74.0)	104 (26.0)		
Poor knowledge	17 (65.4)	9 (34.6)	$\chi^2 = 0.9305$	0.361
Knowledge of malaria vaccine				
Good knowledge	78 (90.7)	8 (9.3)		
Poor knowledge	235 (69.1)	105 (30.9)	$\chi^2 = 16.401$	**0.0001**

General knowledge of malaria did not show a statistically significant association with the respondents' willingness to accept the vaccine ($\chi^2 = 0.931$, $p = 0.361$). Among those with good general knowledge, 296 (74.0%) expressed willingness, which was slightly higher than the 17 (65.4%) reported by those with poor general knowledge.

In contrast, specific knowledge regarding the malaria vaccine was highly significantly associated with willingness to accept it ($\chi^2 = 16.401$, $p < 0.001$). Respondents with good vaccine knowledge demonstrated a much higher rate of acceptance at 78 (90.7%), compared to those with poor vaccine knowledge, where the willingness rate dropped to 235 (69.1%).

TABLE 20: PERCEPTION AND WILLINGNESS TO ACCEPT MALARIA VACCINE AMONG RESPONDENTS

Perception	Willingness To Accept		Test Statistics	p-Value
	Yes (n = 313) Freq (%)	No (n = 131) Freq (%)		
Positive perception	290 (80.3)	71 (19.7)		
Negative perception	23 (35.4)	42 (64.6)	$\chi^2 = 57.098$	**0.0001**

The analysis of the relationship between respondents' perceptions and their willingness to accept the malaria vaccine revealed a highly significant association ($\chi^2 = 57.098$, $p < 0.001$). Respondents with a positive perception of the vaccine demonstrated a substantially higher rate of willingness to accept it, with 290 (80.3%) indicating they would do so. In contrast, those with a negative perception were considerably less likely to accept the vaccine; only 23 (35.4%) expressed willingness, while the majority (64.6%) within that group indicated they would not accept it.

TABLE 21: PREDICTORS OF WILLINGNESS TO ACCEPT MALARIA VACCINE AMONG RESPONDENTS

Predictors	B Regression co-efficient	OR	95% CI for OR		p-value
			Lower	Upper	
Age	-0.028	0.972	0.945	0.999	0.046
Gender					
Male	-0.041	0.959	0.557	1.652	0.881
Female	1				
Family type					
Monogamous	0.541	1.718	0.704	4.193	0.235
Polygamous	1				
Household size					
2-5	0.103	1.108	0.549	2.238	0.774
>=6	1				
Child's age	0.000	1.000	0.983	1.018	.970
Sex of Child					
Male	-0.098	0.906	0.552	1.487	.697
Female	1				
Religion					
Christian	-0.567	0.567	0.213	1.510	0.256
Islam, ATR, Atheist	1				
Marital status					
Ever Married	-0.060	0.942	0.499	1.777	0.854
Never married	1				
LOE					
Tertiary	0.578	1.783	0.987	3.222	0.055
Not tertiary	1				
Income					
<140,000	-0.578	0.561	0.310	1.013	0.055
>=140,00	1				
Knowledge of malaria					
Good knowledge	0.655	1.924	0.761	4.866	0.167
Poor knowledge	1				
Knowledge of Vaccine					
Good knowledge	1.054	2.870	1.243	6.626	0.014
Poor knowledge	1				
Perception					
Positive perception	2.000	7.389	3.866	14.124	**0.0001**
Negative perception	1				

Cox & Snell R^2: 0.184, Nagelkerke R^2: 0.268. CI: confidence interval, OR: odds ratio, * reference variable

The model explained between 18.4% (Cox & Snell R^2) and 26.8% (Nagelkerke R^2) of the variance in willingness to accept the vaccine.

Age was significantly associated with willingness to accept the malaria vaccine. Specifically, increasing age was linked to a slight but statistically significant reduction in the odds of willingness to accept the vaccine (OR = 0.97, 95% CI [0.95, 1.00], $p = .046$), indicating that older respondents were less likely to be willing to accept the vaccine.

Gender was not a significant predictor of willingness to accept the malaria vaccine. Males had slightly lower odds of willingness compared to females (OR = 0.96, 95% CI [0.56, 1.65], $p = .881$), but this difference was not statistically meaningful.

Family type and household size were also not significantly associated with willingness to accept the vaccine. Respondents from monogamous families were 1.72 times more likely to be willing to accept the vaccine compared to those from polygamous families (OR = 1.72, 95% CI [0.70, 4.19], $p = .235$). Similarly, those from smaller households (2–5 members) had slightly higher odds of willingness compared to larger households (≥6 members) (OR = 1.11, 95% CI [0.55, 2.24], $p = .774$), though neither association reached statistical significance.

Child-related characteristics were not significant predictors. The child's age had no effect on willingness to accept the malaria vaccine (OR = 1.00, 95% CI [0.98, 1.02], $p = .970$), and the child's sex was also not associated with willingness (OR = 0.91, 95% CI [0.55, 1.49], $p = .697$).

Religion did not significantly predict willingness to accept the malaria vaccine. Christians were less likely to be willing compared to respondents practicing Islam, African Traditional Religion, or atheism (OR ≈ 0.57, 95% CI [0.21, 1.51], $p = .256$), although this was not statistically significant.

Marital status was also not a significant determinant. Ever-married respondents had slightly lower odds of willingness compared to never-married respondents (OR = 0.94, 95% CI [0.50, 1.78], p = .854), but the association was not significant.

Level of education showed a borderline effect. Respondents with tertiary education were about 1.8 times more likely to be willing to accept the vaccine compared to those without tertiary education (OR = 1.78, 95% CI [0.99, 3.22], p = .055), although this did not reach conventional statistical significance.

Income level also showed a borderline but non-significant association. Respondents earning less than 140,000 were less likely to be willing to accept the vaccine compared to higher-income respondents (OR = 0.56, 95% CI [0.31, 1.01], p = .055).

Knowledge-related variables showed mixed effects. Good knowledge of malaria was associated with higher odds of willingness to accept the vaccine (OR = 1.92, 95% CI [0.76, 4.87], p = .167), although this was not statistically significant. However, good knowledge of the malaria vaccine was a significant predictor: respondents with good knowledge were almost 3 times more likely to be willing to accept the vaccine compared to those with poor knowledge (OR = 2.87, 95% CI [1.24, 6.63], p = .014).

Perception towards the malaria vaccine was the strongest predictor in the model. Respondents with a positive perception were about 7 times more likely to be willing to accept the malaria vaccine compared to those with a negative perception (OR = 7.39, 95% CI [3.87, 14.12], p < .001), indicating a very strong and statistically significant association.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATION

DISCUSSION

The study revealed that although awareness and knowledge of malaria as a disease among caregivers in Benin City was very high, knowledge of malaria vaccines was considerably poor, with less than a quarter of respondents demonstrating good knowledge of the malaria vaccine while the majority had poor knowledge. This finding suggests that although caregivers are familiar with malaria and its preventive measures, awareness regarding newer preventive interventions such as malaria vaccines remains inadequate. Similar findings were reported in studies conducted in Enugu and Ibadan, Nigeria, where awareness and knowledge of malaria vaccines among caregivers were found to be low despite high knowledge of malaria as a disease.[16,51] A study conducted in Bangladesh also reported low awareness of malaria vaccines among caregivers of under-five children.[8] This poor level of knowledge may be attributed to the relatively recent introduction of malaria vaccines in Nigeria, inadequate public sensitization programmes, and insufficient dissemination of vaccine-related information through community health structures. From a public health perspective, poor knowledge of malaria vaccines may negatively affect vaccine uptake and reduce the effectiveness of malaria control programmes. There is therefore a need for intensified awareness campaigns specifically targeted at educating caregivers about malaria vaccines.

Another important finding from this study was that health professionals constituted the major source of information regarding malaria vaccines among respondents. This finding emphasizes the critical role healthcare workers play in influencing public health awareness

and vaccine acceptance. Similar findings were reported in studies conducted in North-West Nigeria and Kenya where healthcare workers served as the primary source of vaccine-related information among caregivers.[10,13] This may be because caregivers generally regard healthcare professionals as trusted and reliable sources of health information. The implication of this finding is that strengthening the knowledge and communication skills of healthcare workers could significantly improve public awareness and acceptance of malaria vaccines. Consequently, regular training and retraining programmes for healthcare workers on malaria vaccines should be encouraged.

The study further showed that although most respondents were aware of the existence of malaria vaccines, detailed technical knowledge regarding the classes, types, and availability of malaria vaccines was poor. The majority of respondents could not identify the specific types of malaria vaccines available in Nigeria or the classes of malaria vaccines. Similar findings were documented in studies conducted among mothers in Enugu and among women of reproductive age in North-West Nigeria where respondents had poor technical understanding of malaria vaccines.[9,16] This poor technical knowledge may stem from limited exposure to comprehensive health education on malaria vaccination. Inadequate technical understanding may contribute to misconceptions and uncertainty regarding vaccine efficacy and safety. Public health education programmes should therefore not only focus on creating awareness but should also provide simplified explanations regarding the mechanism, benefits, and availability of malaria vaccines.

The findings of this study also revealed that respondents generally demonstrated positive perceptions towards malaria vaccines. A majority agreed that the vaccine is safe and capable of preventing malaria infection. Similar positive perceptions were reported in studies conducted in Ghana, Kenya, and Kaduna State, Nigeria, where caregivers expressed

favorable attitudes towards malaria vaccines and recognized their potential benefits in reducing childhood malaria.[9,13,17] This positive perception may be attributable to the high burden of malaria in Nigeria and caregivers' willingness to embrace preventive measures capable of reducing morbidity and mortality among children. From a public health standpoint, positive perception towards malaria vaccines provides a strong foundation for successful vaccine implementation programmes.

However, despite the generally positive perception observed among respondents, a significant proportion remained undecided regarding the vaccine's effectiveness and ability to provide complete protection against malaria. Similar findings were observed in studies conducted in African communities where uncertainty regarding vaccine efficacy contributed to hesitancy among caregivers.[15] This uncertainty may be linked to limited understanding of the fact that currently available malaria vaccines provide partial rather than complete protection against malaria infection. The implication of this finding is that misconceptions and uncertainty may reduce confidence in the vaccine and negatively influence uptake. There is therefore a need for targeted communication strategies aimed at educating caregivers about the realistic benefits and limitations of malaria vaccines.

Another major finding of the study was that cultural and religious beliefs did not appear to significantly hinder acceptance of malaria vaccines among respondents. Most respondents disagreed with statements suggesting that vaccination was against their religion or culture. Similar findings were reported in studies conducted in Kaduna State and Ghana where caregivers generally accepted vaccination irrespective of religious or cultural background.[9,17] This finding may reflect increasing public trust in vaccination programmes and improved acceptance of modern healthcare practices. From a public health perspective, the minimal

influence of religion and culture on vaccine perception is encouraging, as these factors have historically posed barriers to immunization programmes in some settings.

The study also demonstrated that educational status was significantly associated with knowledge of malaria vaccines, with respondents who attained tertiary education being more likely to possess good knowledge compared to those with lower educational levels. Similar findings were reported in studies conducted in Nigeria and Sierra Leone where higher educational attainment significantly influenced awareness and acceptance of malaria vaccines.[12,48] This finding may be because educated individuals are more likely to access health information, understand public health messages, and engage with healthcare services. The implication of this finding is that individuals with lower educational status may be at increased risk of misinformation and poor vaccine uptake. Public health campaigns should therefore be tailored to accommodate individuals with lower educational backgrounds through the use of simple language and culturally appropriate communication methods.

The findings further revealed that marital status was significantly associated with knowledge of malaria vaccines, with married respondents demonstrating better knowledge compared to unmarried respondents. This finding is similar to reports from previous studies where married caregivers were more likely to possess better health-related knowledge due to increased exposure to maternal and child health services.[12] This association may result from greater involvement of married individuals in childcare activities and routine healthcare visits. From a public health perspective, unmarried caregivers may require additional targeted interventions to improve awareness and understanding of malaria vaccines.

Although respondents demonstrated high knowledge of malaria generally, no statistically significant association was found between knowledge of malaria and knowledge of malaria vaccines. This finding suggests that awareness of malaria as a disease does not necessarily

translate into awareness of preventive innovations such as vaccination. Similar observations have been reported in studies where caregivers possessed good knowledge of malaria prevention measures but poor knowledge of malaria vaccines.[11] This highlights the need for public health interventions specifically focused on malaria vaccination rather than relying solely on general malaria education campaigns.

The study also highlighted the important role socioeconomic factors play in influencing knowledge of malaria vaccines. Respondents with higher income levels and formal employment demonstrated better knowledge compared to those with lower income levels and unemployment. Similar findings were reported in studies conducted in Guinea, Sierra Leone, and Bangladesh where socioeconomic status significantly influenced knowledge and acceptance of malaria vaccines.[8,48] This may be because individuals with better socioeconomic status generally have improved access to healthcare services, media, and educational resources. The implication is that economically disadvantaged populations may experience poorer access to health information and preventive healthcare interventions. There is therefore a need for equitable public health programmes that ensure all population groups receive adequate information and access to malaria vaccines irrespective of socioeconomic status.

Overall, the findings of this study suggest that although caregivers in Benin City generally possess positive perceptions toward malaria vaccines and may be willing to accept them, poor knowledge and persistent uncertainty regarding vaccine efficacy remain major challenges. Addressing these gaps through comprehensive public health education, improved healthcare communication, and strengthened vaccination programmes will be essential for improving uptake and supporting malaria elimination efforts in Nigeria.

CONCLUSION

Despite the high level of awareness and knowledge regarding malaria as a disease among caregivers in Benin City, knowledge of malaria vaccines was generally poor among respondents. The study revealed significant gaps in awareness and understanding of malaria vaccines, particularly regarding their availability, classes, and effectiveness. However, respondents generally demonstrated positive perceptions toward malaria vaccines, especially regarding their safety and usefulness in preventing malaria infection among children.

Educational status and marital status were identified as significant predictors of knowledge of malaria vaccines, highlighting the influence of socioeconomic and demographic factors on vaccine awareness. The study further showed that healthcare workers play a critical role in disseminating information regarding malaria vaccines, as they constituted the major source of information among respondents.

Although cultural and religious beliefs did not appear to significantly hinder vaccine perception, uncertainty regarding vaccine effectiveness and misconceptions about malaria vaccines remain important concerns that could negatively affect vaccine uptake. Overall, the findings suggest that while acceptance of malaria vaccines among caregivers may potentially be high, inadequate knowledge and limited public sensitization may hinder optimal utilization of the vaccine.

Strengthening awareness campaigns, healthcare communication, and community-based health education programmes will therefore be essential in improving caregivers' knowledge, perception, and acceptance of malaria vaccines, ultimately contributing to malaria control and reduction in childhood morbidity and mortality in the study area.

RECOMMENDATIONS

On account of the findings of this study, the following recommendations have been made and when properly implemented will help improve knowledge, perception, and acceptance of malaria vaccines among caregivers of under-five children in Benin City and Nigeria at large.

RECOMMENDATIONS FOR THE FEDERAL GOVERNMENT

1. Increase funding for malaria vaccine awareness campaigns and public sensitization programmes across the country.
2. Ensure adequate procurement, equitable distribution, and consistent availability of malaria vaccines in all healthcare facilities.
3. Integrate malaria vaccines fully into the National Programme on Immunization (NPI) and Expanded Programme on Immunization (EPI).
4. Develop national policies that support free or subsidized malaria vaccination for under-five children.
5. Strengthen national surveillance and monitoring systems to evaluate malaria vaccine uptake and effectiveness.

RECOMMENDATIONS FOR THE STATE GOVERNMENT

1. Organize state-wide community awareness programmes focusing on malaria vaccine education.
2. Strengthen primary healthcare centers to ensure effective delivery and storage of malaria vaccines.
3. Collaborate with community and religious leaders to improve vaccine awareness and acceptance.

4. Provide continuous training programmes for healthcare workers on malaria vaccine communication and administration.

RECOMMENDATIONS FOR HEALTH AGENCIES

1. Conduct regular community outreach programmes aimed at educating caregivers on the benefits and safety of malaria vaccines.
2. Develop culturally appropriate educational materials regarding malaria vaccination.
3. Strengthen routine immunization services to improve accessibility of malaria vaccines in rural and urban communities.
4. Establish effective monitoring and evaluation systems for malaria vaccination programmes.

RECOMMENDATIONS FOR HEALTHCARE WORKERS

1. Provide accurate and consistent information regarding malaria vaccines during antenatal, postnatal, and child welfare clinics.
2. Address misconceptions and fears relating to malaria vaccine safety and effectiveness among caregivers.
3. Encourage caregivers to ensure complete vaccination of eligible children.
4. Maintain effective communication and good interpersonal relationships with caregivers to improve public trust in vaccination programmes.

RECOMMENDATIONS FOR CAREGIVERS

1. Seek accurate information regarding malaria vaccines from qualified healthcare professionals.
2. Ensure eligible children receive all recommended doses of malaria vaccines.
3. Participate actively in community health education programmes and immunization campaigns.
4. Avoid reliance on misinformation and unverified sources regarding malaria vaccines.

RECOMMENDATIONS FOR COMMUNITY LEADERS AND MEDIA ORGANIZATIONS

1. Support public sensitization campaigns promoting malaria vaccination within communities.
2. Disseminate accurate and evidence-based information regarding malaria vaccines through television, radio, and social media platforms.
3. Help combat misinformation and misconceptions surrounding malaria vaccines.
4. Encourage community participation in immunization programmes and other malaria control interventions.

REFERENCES

1. Bria YP, Yeh CH, Bedingfield S. Significant Symptoms and Non-Symptom-Related Factors for Malaria Diagnosis in Endemic Regions of Indonesia. Int J Infect Dis. 2020 Nov;103:194–200.
2. Bur R, JuwitaNelwan E, Danasasmita I, Hakim GL, Bahri S, Dewi S, et al. Challenges of diagnosing severe malaria with complications in adult patients: a case report. Trop Dis Travel Med Vaccines. 2024 Apr 1;10(1).
3. Ashley EA, Phyo AP. Treatment and prevention of malaria in children. Lancet Child Adolesc Health. 2020;4:775–89.
4. Nnaji A, Ozdal MA. Perception and awareness towards malaria vaccine policy implementation in Nigeria by health policy actors. Malar J. 2023 Mar 29;22(1).
5. Cohee LM, Laufer MK. Malaria in Children. Pediatr Clin North Am. 2017 Aug;64(4):851–66.
6. Milner DA. Malaria Pathogenesis. Cold Spring Harb Perspect Med. 2017 May 22;8(1):a025569.
7. Chukwuocha UM, Okorie PC, Iwuoha GN, Ibe SN, Dozie IN, Nwoke BE. Awareness, perceptions and intent to comply with the prospective malaria vaccine in parts of South Eastern Nigeria. Malar J. 2018 May 2;17(1).
8. Mohammad Ashraful Amin, Sadia Afrin, Atia Sharmin Bonna, Faisal M, Mohammad Hayatun Nabi, Delwer M. Knowledge and acceptance of malaria vaccine among parents of under-five children of malaria endemic areas in Bangladesh: A cross-sectional study. Health Expect. 2023 Sep 3;26(6):2630–43.
9. Musa S, Abdulhakeem Abayomi Olorukooba, Nuru Suleiman Muhammad, Muhammad B, Hauwa Umar Makarfi. Awareness, Perception and Acceptance of Malaria Vaccine among Women of the Reproductive Age Group in a rural community

ssssin Soba, Kaduna State, North-west Nigeria. Kanem J Med Sci. 2022 Jun 20;16(1):32–42.

10. Ajayi MB, Daniel Chukwuyere Emeto. Awareness and acceptability of malaria vaccine among caregivers of under-5 children in Northern Nigeria. Malar J. 2023 Oct 31;22(1).
11. Musa-Booth T, Enobun B, Agbomola A, Shiff C. Knowledge, attitude and willingness to accept the RTS,S malaria vaccine among mothers in Abuja, Nigeria. Ann Afr Med Res. 2021 Sep 13;4(1).
12. Iloabuchi FC, Chima UE, Umeh AU, Okafor PN, Amauche Pearl Ngige, Chigozie Gloria Anene-Okeke. Knowledge, Attitude, and Willingness to accept the RTS, S malaria vaccine among Mothers/Caregivers of under-five children: A Qualitative study in Enugu state, Nigeria. Res Square. 2024 Sep 5;
13. Hoyt J, Okello G, Bange T, Kariuki S, Jalloh MF, Webster J, et al. RTS,S/AS01 malaria vaccine pilot implementation in western Kenya: a qualitative longitudinal study to understand immunisation barriers and optimise uptake. BMC Public Health. 2023 Nov 18;23(1).
14. Laurenson AJ, Laurens MB. A new landscape for malaria vaccine development. PLoS Pathog. 2024 Jun 27;20(6):e1012309.
15. Muhammad Chutiyami, Priya Saravanakumar, Umar Muhammad Bello, Dauda Salihu, Adeleye K, Mustapha Adam Kolo, et al. Malaria vaccine efficacy, safety, and community perception in Africa: a scoping review of recent empirical studies. Infection. 2024 Mar 5.
16. Abdulkadir BI, Ajayi IO. Willingness to accept malaria vaccine among caregivers of under-5 children in Ibadan North Local Government Area, Nigeria. 2015 Jan 1;6:2–2. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11107874/

17. Bam V, Abdulaziz M, Kusi-Amponsah A, Armah JO, Alberta Yemotsoo Lomotey, Hayford Isaac Budu, et al. Caregivers' perception and acceptance of malaria vaccine for Children. PLoS One. 2023 Jul 26;18(7):e0288686.
18. Tabiri D, Ouédraogo JCRP, Nortey PA. Factors associated with malaria vaccine uptake in Sunyani Municipality, Ghana. Malar J. 2021 Jul 27;20(1).
19. Chinawa AT, Ossai EN, Onukwuli VO, Nduagubam OC, Uwaezuoke NA, Okafor CN, et al. Willingness to accept malaria vaccines amongst women presenting at outpatient and immunization clinics in Enugu state, Southeast Nigeria. Malar J. 2024 Apr 25;23(1):117.
20. Duffy PE, Gorres JP, Healy SA, Fried M. Malaria vaccines: a New Era of Prevention and Control. Nat Rev Microbiol. 2024 Jul 18;22:1–17.
21. Arora N, C Anbalagan L, Pannu AK. Towards Eradication of Malaria: Is the WHO's RTS,S/AS01 Vaccination Effective Enough? Risk Manag Healthc Policy. 2021;14:1033–9.
22. Fletcher TE, Beeching NJ. Malaria. J R Army Med Corps. 2013 Jul 11;159(3):158–66.
23. Phillips MA, Burrows JN, Manyando C, van Huijsduijnen RH, Van Voorhis WC, Wells TNC. Malaria. Nat Rev Dis Primers. 2017 Aug 3;3(17050):17050.
24. Fikadu M, Ashenafi E. Malaria: An Overview. 2023 May 1;16(16):3339–47.
25. Blessing Nkechi Emmanuel, Abubakar Nuhu Ishaq, Olisaemeka Zikora Akunne, Umar Faruk Saidu. Evaluating the knowledge, attitude, perception, and readiness of caregivers of under 5-year-old children to accept malaria vaccine in Nigeria. Clin Exp Vaccine Res. 2024 Jan 1;13(2):121.
26. World Health Organization. Severe Malaria. Trop Med Int Health. 2014 Sep;19:7–131.

27. Kafai NM, Odom John AR. Malaria in Children. Infect Dis Clin North Am. 2018 Mar;32(1):189–200.
28. Shimizu S, Chotirat S, Dokkulab N, Hongchad I, Khowsroy K, Kiattibutr K, et al. Malaria cross-sectional surveys identified asymptomatic infections of Plasmodium falciparum, Plasmodium vivax and Plasmodium knowlesi in Surat Thani, a southern province of Thailand. Int J Infect Dis. 2020 Jul;96:445–51.
29. Daily JP, Minuti A, Khan N. Diagnosis, Treatment, and Prevention of Malaria in the US. JAMA. 2022 Aug 2;328(5):460.
30. Jiskoot W, Kersten GFA, Mastrobattista E. Vaccines. In: Pharmaceutical Biotechnology. 2013. p. 439–57.
31. Enomoto M, Kawazu S, Kawai S, Furuyama W, Ikegami T, Watanabe J, et al. Blockage of Spontaneous Ca2+ Oscillation Causes Cell Death in Intraerythrocytic Plasmodium falciparum. PLoS One. 2012 Jul 6;7(7):e39499.
32. Pollard AJ, Bijker EM. A Guide to vaccinology: from Basic Principles to New Developments. Nat Rev Immunol. 2020;21(21):1–18.
33. Choutos D, Poulaki A, Piperaki ET. Malaria in Children: Updates on Management and Prevention. Pediatr Infect Dis J. 2023 Feb 8;42(4):e116–8.
34. Cowman AF, Healer J, Marapana D, Marsh K. Malaria: Biology and Disease. Cell. 2016 Oct 20;167(3):610–24.
35. Kayser V, Ramzan I. Vaccines and vaccination: History and emerging issues. Hum Vaccin Immunother. 2021 Sep 28;17(12):1–14.
36. Ogieuhi IJ, Ajekiigbe VO, Kolo-Manma K, Akingbola A, Odeniyi TA, Soyemi TS, et al. A narrative review of the RTS S AS01 malaria vaccine and its implementation in Africa to reduce the global malaria burden. Discov Public Health. 2024 Oct 25;21(1).

37. Chen J, Wang Q, He X, Yang B. Malaria Vaccines: Current Achievements and Path Forward. Vaccines. 2025 May 19;13(5):542.
38. Genton B. R21/Matrix-M malaria vaccine: a new tool to achieve WHO`s goal to eliminate malaria in 30 countries by 2030 ? J Travel Med. 2023 Nov 11;30(8):taad140.
39. Datoo MS, Dicko A, Tinto H, Ouédraogo JB, Hamaluba M, Olotu A, et al. Safety and efficacy of malaria vaccine candidate R21/Matrix-M in African children: a multicentre, double-blind, randomised, phase 3 trial. Lancet. 2024 Feb 1;403(10426).
40. Tsoumani ME, Voyiatzaki C, Efstathiou A. Malaria Vaccines: From the Past towards the mRNA Vaccine Era. Vaccines. 2023 Sep 1;11(9):1452.
41. Swartz K, Collins LG. Caregiver Care. Am Fam Physician. 2019 Jun 1;99(11):699–706.
42. Aman Z, Liew S, Ramdzan S, Philp I, Khoo E. The impact of caregiving on caregivers of older persons and its associated factors: a cross-sectional study. Singapore Med J. 2020 May;61(5):238–45.
43. Semere W, Makaroun LK, Beach S, Schillinger D, Rosland AM. Family caregivers navigating the health care system: Evolving roles during the COVID-19 pandemic. Fam Syst Health. 2022 Jun;40(2):268–73.
44. Hoover CG, Coller RJ, Houtrow A, Harris D, Agrawal R, Turchi R. Understanding Caregiving and Caregivers: Supporting CYSHCN at Home. Acad Pediatr. 2022 Jan;22(2).
45. Sherman DW. A review of the complex role of family caregivers as health team members and second-order patients. Healthcare. 2019 Apr 24;7(2):63.
46. Hall S, Rohatinsky N, Holtslander L, Peacock S. Caregivers to older adults require support: A scoping review of their priorities. Health Soc Care Community. 2022 Oct 17;30(6).

47. Galehdar N, Heydari H. Exploring caregivers' perceptions of community-based service requirements of patients with spinal cord injury: a qualitative study. BMC Prim Care. 2023 Apr 11;24(1).
48. Röbl K, Fischer HT, Alexandre Delamou, Abdul Karim Mbawah, Geurts B, Feddern L, et al. Caregiver acceptance of malaria vaccination for children under 5 years of age and associated factors: cross-sectional household survey, Guinea and Sierra Leone, 2022. Malar J. 2023 Nov 20;22(1).
49. Floriano Amimo. Malaria vaccination: hurdles to reach high-risk children. BMC Med. 2024 Mar 13;22(1).
50. O'Leary ST, Opel DJ, Cataldi JR, Hackell JM, O'Leary ST, Campbell JD, et al. Strategies for Improving Vaccine Communication and Uptake. Pediatrics. 2024 Feb 26;153(3).
51. Kabir Sulaiman S, Isma'il Tsiga-Ahmed F, Sale Musa M, Kabir Sulaiman A, Muhammad Dayyab F, AB Khan M, et al. Prevalence, determinants, and reasons for malaria vaccine hesitancy among caregivers of under-five children in Nigeria: Results from a nationwide cross-sectional survey. Vaccine. 2023 Feb 17;41(8):1503–12.
52. Larson HJ. The state of vaccine confidence. Lancet. 2018 Nov;392(10161):2244–6.
53. Singhal C, Aremu TO, Garg P, Shah K, Okoro ON. Awareness of the Malaria Vaccine in India. Cureus. 2022 Sep 15;
54. Niger Delta Budget Monitoring Group. Overview of Edo [Internet]. 2025 [cited 2025 Dec 17]. Available from: https://www.nigerdeltabudget.org/overview-of-edo/
55. Imarhiagbe EE, Onwudiwe CC, Akahomhen M. Water, Sanitation, Hygiene and Health Status of Ekosodin Community Residents, Benin City, Edo State, Nigeria. J Appl Sci Environ Manag. 2023 Nov 28;27(11):2611–8.

56. Mcfarlane I, Daldin J, Jayaram T, Ratcliffe L, Trautwein C, Baker D, et al. Infinite possibilities the case for rights and choices State of World Population report 2023. 2023.
57. International Labour Organization. International Standard Classification of Occupation. ISCO-08. 1st ed. Geneva: International Labour Office; 2012.

APPENDIX

APPENDIX I

QUESTIONNAIRE

KNOWLEDGE, PERCEPTION, AND ACCEPTANCE OF MALARIA VACCINE AMONG CAREGIVERS OF CHILDREN IN BENIN CITY

Dear Respondent,

We are 600-level Medical students carrying out a one-year project designed to assess the knowledge, perception, and acceptance of the malaria vaccine among caregivers of children in Benin City. It would be highly appreciated if you could kindly participate in this research by answering the following questions.Your involvement in this research is critical to the success of this study.

ALL INFORMATION VOLUNTEERED BY YOU WILL BE KEPT CONFIDENTIAL.

SECTION A: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS (Please indicate your response or tick your choice)

1. Age in years (as at last birthday): ___________
2. Gender:Male ( ), Female( )
3. Ethnic group: Benin ( ),Esan( ), Igbo ( ), Yoruba ( ), Other (specify):_______________
4. Religion: Christianity ( ),Islam ( ), African Traditional Religion ( ), Other (specify): ______________
5. Marital Status: Single ( ), Married( ), Separated ( ), Divorced ( ), Widowed ( ), Co-habiting ( )
6. Family type: Monogamous ( ), Polygamous ( )
7. Size of household: 2-6 ( ), 6 and above ( )
8. Age of child (in months) :

9. Sex of child: Male ( ), Female ( )

10. Relationship to child: Mother ( ), Father ( ), Guardian( ), Grandparents ( )

11. Highest Level of Education: No formal education ( ),Primary ( ),Secondary ( ),Tertiary ( )

12. Occupation: Farming ( ), Business ( ), Civil Servant ( ), Student ( ), Private firm worker ( ), Unemployed ( )

13. Monthly income in naira: Less than 70,000 ( ), 70,000-139,999 ( ), 140,000-209,999 ( ), 210,000-279,999 ( ), 280,000 and above ( )

SECTION B: ASSESSMENT OF THE KNOWLEDGE OF MALARIA AND MALARIA VACCINE AMONG RESPONDENTS

14. Have you heard of Malaria? Yes ( ), No ( )

15. What is your source of information? **Multiple responses allowed**

    Television ( ), Radio ( ), Social Media( ), Newspapers ( ), Health professional ( ), Government agency ( ), Friends ( ), Others________________

16. Major cause of malaria?

    Mosquito ( ) Dirty environment ( ) Evil spirit ( ) Curse from God ( ),Others (specify):

    ____

17. Symptoms of Malaria include? **Multiple responses allowed**

    Fever ( ), Headache ( ), weakness ( ), Stomach pain ( ) Nausea and Vomiting ( ) Watery stool ( ) Loss of consciousness ( ) Others (specify): ________________

18. How is Malaria transmission prevented? **Multiple responses allowed**

    Sleeping under mosquito net ( ), Use of insecticide spray ( ), Clearing of bushes ( ) Avoidance of social interaction ( ), Protected sexual intercourse ( ), Washing of hands ( )

19.Have you heard of the malaria vaccine? Yes ( ), No ( )

If NO move to question move to section B

20. What is your source of information? **Multiple responses allowed**

Television ( ), Radio ( ), Social Media( ), Newspapers ( ), Health professional ( ), Government agency ( ), Friends ( ), Others_______________

21. What is Malaria vaccine? **Multiple responses allowed**

A drug that can stop Malaria virus ( ) A drug that can prevent Malaria virus ( ) A vaccine that can confer protection againstMalaria ( )   A drug that cures Malaria virus ( )   I don't know ( )

22. What are the classes of Malaria vaccine you are aware of? **Multiple responses allowed**

Pre-erythrocytic vaccine ( )   Live-attenuated vaccine ( )   Erythrocyticvaccine ( )   Protein subunit vaccine ( )   Nucleic acid vaccine ( )   Transmission blocking vaccine ( ) I don't know ( )

23. Is the Malaria vaccine available in Nigeria? Yes ( )   No ( )   I don't know ( )

24. What types of Malaria vaccine is available in Nigeria? **Multiple responses allowed**

R21/Matrix-M ( )RTS, S/AS01 ( ) PAMAVAC ( ) Full Length SCP ( )I don't know ( )

25. What is the site of administration? _______________

SECTION C: ASSESSMENT OF THE PERCEPTION TOWARDS THE MALARIA VACCINE

For Questions 26-35, please select how much you agree or disagree with the statement by ticking the preferred box.

SECTION D: LEVEL OF ACCEPTANCE AND FACTORS AFFECTING LEVEL OF

S/N	QUESTION	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
26	It is safe to take the Malaria vaccine					
27	The Malaria vaccine can prevent the Malaria infection					
28	The Malaria vaccine increases the occurrence of the Malaria infection					
29	There is need for children to vaccinate with the Malaria Vaccine					
30	Malaria vaccine protects children fully					
31	Vaccination saves me the stress of wasting money to buy drugs or wasting working hours in visiting the hospital with my child					
32	The Malaria vaccine is effective and is likely to work for everyone					
33	Suspicion around the Malaria vaccine can negatively affect my willingness to vaccinate my child					
34	It is against my religion to take any vaccine					
35	It is against my culture to receive any vaccine					

ACCEPTANCE OF THE MALARIA VACCINE

36. Have any of your child received the vaccine? Yes ( ), No ( ) IF No move to question 39

37. IF Yes did you experience any side effect? Yes ( ), No ( )

38. If YES, Side effects noticed after receiving the vaccine? Headache ( ), Fever( ), Rash( ), Joint pain( ), Vomiting ( ), Others (specify): ____________

39. Are you Willing to allow your child take the malaria vaccine Yes ( ), No ( )

40. If No, why? Multiple responses allowed

Fear of adverse reaction( ) My religion is against it ( ) My culture is against it ( ) Personal bias against it ( ) Spousal refuse ( ) Others (specify): ____________

41. Will you recommend others to allow their child to take the vaccine ? Yes ( ), No ( ) Not sure ( )

42. IF Yes, why? ______________

THANK YOU FOR YOUR RESPONSE!!!!!

APPENDIX II

INFORMED CONSENT FORM

TITLE OF STUDY:KNOWLEDGE, PERCEPTION AND ACCEPTANCE OF MALARIA VACCINE AMONG CAREGIVERS OF CHILDREN IN BENIN CITY, EDO STATE.

INSTITUTION: Department of Public Health and Community Medicine, College of Medicine, University of Benin, Benin city, Edo state, Nigeria.

PRINCIPAL INVESTIGATORS: Okotete Emmanuel and Omorogbe Wisdom Osahenrumwen

PARTICIPATION: Participation in this study is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue your participation at any time without penalty or loss of benefits. The principal investigator may decide to withdraw you from the study if we are unable to obtain the necessary information.

INTRODUCTION: I am interested in assessing knowledge, Perception and Acceptance of Malaria Vaccine among Caregivers of Children in Benin City, Edo State.

PROCEDURES TO BE FOLLOWED

If respondents agree to participate, a questionnaire will be sent to such respondents manually and this questionnaire will only assess the knowledge, Perception and Acceptance of Malaria Vaccine among Caregivers of Children in Benin City, Edo State.

BENEFITS: Participants would contribute to important research that may help improve public health promotion strategies. The results obtained from this research work would help us assess knowledge, Perception and Acceptance of Malaria Vaccine among Caregivers of Children in Benin City, Edo State with the view to improving knowledge and creating healthy mindset towards the need for malaria vaccines in improving Child Health.

COMPENSATION: Participants will not receive any compensation for their participation.

.

DURATION OF PARTICIPATION: This study only requires the questionnaire. There is no follow-up or further information needed.

WHO CAN PARTICIPATE IN THIS STUDY: The study focuses caregivers of children in Benin City, Edo state. The participants will be selected from Ekosodin, Ovia North-East within Benin City to ensure good representation.

ASSURANCE OF CONFIDENTIALITY OF VOLUNTEER'S IDENTITY: Records relating to your participation in the study will remain confidential. Your name will not be used in any report resulting this study. All questionnaires, computerized records, and analysis of data will contain only a unique study number, not your name.

PERSONS AND PLACES FOR ANSWERS REGARDING YOUR RIGHTS AS A RESEARCH SUBJECT:

If during the course of this study you have questions concerning the nature of the research or you believe you have sustained a research-related injury or assault, you should contact;

Okotete Emmanuel

Department of Public Health and Community Medicine, College of Medicine, University of Benin.

Benin city,

Edo State,

Nigeria.

Phone number: 08073213173

Email: okoteteejiro52@gmail.com

Omorogbe Wisdom Osahenrumwen

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Benin city,

Edo State,

Nigeria.

Phone number: 08078995194

Email: omorogbew@gmail.com

Ethics and Research Committee,

Phone number:

Email: ubthresearchethics@gmail.com

CERTIFICATION OF CONSENT

I,________________________________ having full capacity to consent for myself do thereby consent to my participation in the research study.

The methods and means by which the study will be conducted have been explained to me by Ethical Committee. I have been given the opportunity to ask questions concerning this investigational study, and any such questions have been answered to my full and complete satisfaction.

I understand that I may at any time during the course of this study revoke this consent and withdraw myself from the study without prejudice.

Participant's Signature:__________________

Date:____________

APPENDIX III

ETHICAL APPROVAL

HEALTH RESEARCH ETHICS COMMITTEE (HREC)

UNIVERSITY OF BENIN TEACHING HOSPITAL

P.M.B. 1111 BENIN CITY NIGERIA Telephone: 052-600418 Website: ubth.org

CHIEF MEDICAL DIRECTOR Prof. (Mrs) I.N Ize-Iyamu
DIRECTOR OF ADMINISTRATION Jim Uwadie, Esq
CHAIRMAN Prof. (Mrs.) Antoinette N. Ofili

HREC OFFICE:
Committee email: ubthresearchethics@gmail.com
Registration Number:
NHREC-UBTH-HREC/24/12/2022B

PROTOCOL NUMBER: ADM/E 22/A/VOL. VII/1486549127273

PROPOSAL TITLE: "KNOWLEDGE, PERCEPTION AND ACCEPTANCE OF MALARIA VACCINE AMONG CAREGIVERS OF CHILDREN IN BENIN CITY, EDO STATE"

PRINCIPAL INVESTIGATOR(S): OKOTETE EMMANUEL, OMOROGBE WISDOM O.

DEPARTMENT/INSTITUTION: DEPARTMENT OF PUBLIC HEALTH AND COMMUNITY MEDICINE, SCHOOL OF MEDICINE, UNIVERSITY OF BENIN, BENIN CITY, EDO STATE, NIGERIA

DATE CONSIDERED: FEBRUARY 23RD, 2026

DECISION OF THE COMMITTEE: APPROVED

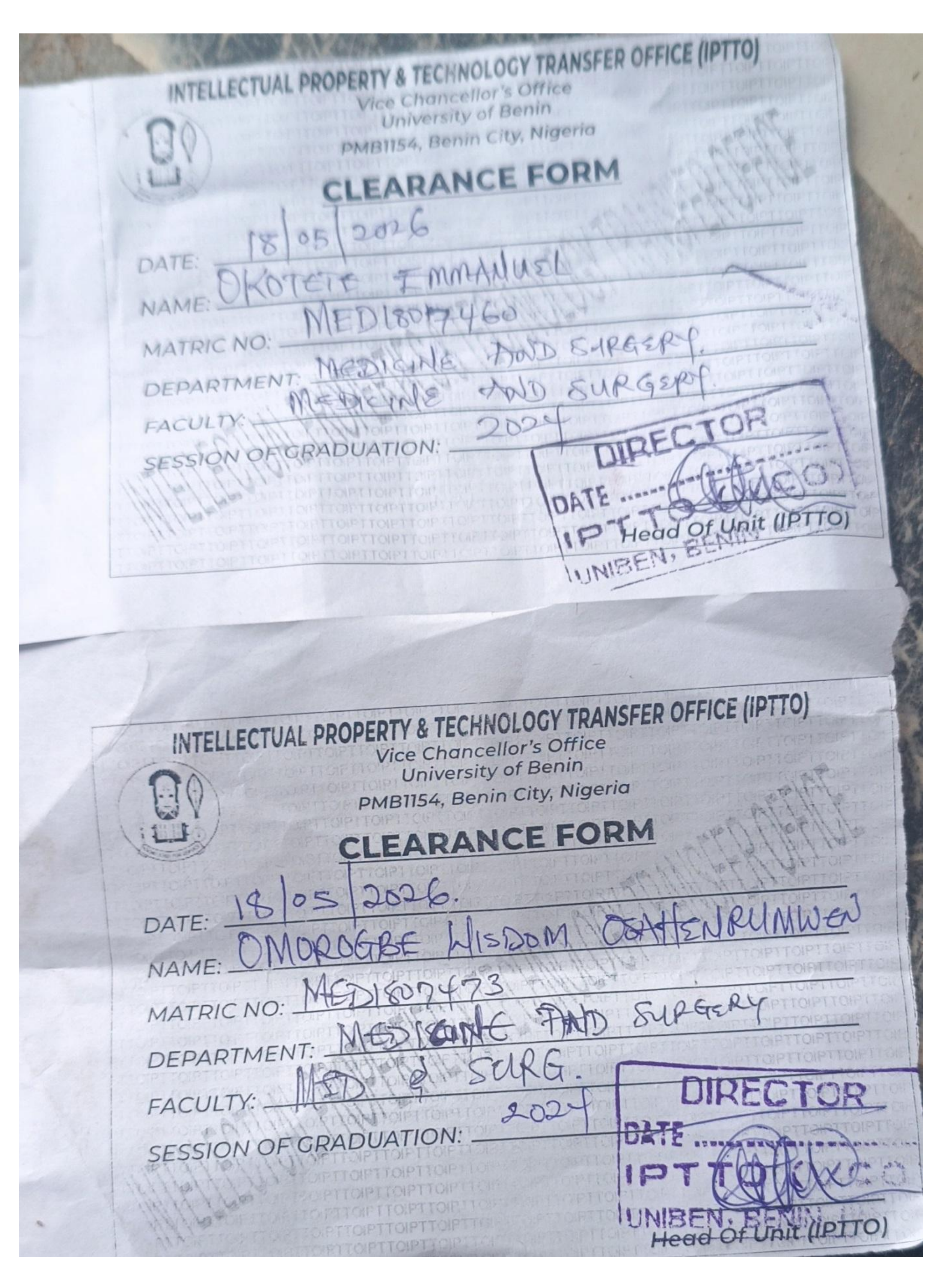
THIS APPROVAL DATES 23/02/2026 TO 22/01/2027. IF THERE IS DELAY IN STARTING THE RESEARCH, PLEASE INFORM THE HREC SO THAT THE DATES OF APPROVAL CAN BE ADJUSTED ACCORDINGLY
REMARK:

CHAIRMAN: PROF. (MRS) A.N. OFILI SIGNATURE & DATE: 23/2/2026

SUPERVISOR (S): DR. (MRS) O. E OBARISIAGBON, DR. G. OKO-OBOH

DECLARATION BY INVESTIGATOR(S):
PROTOCOL NUMBER (please quote in all enquiries)
Note that no participant accrual or activity related to this research may be conducted outside of these dates and you **are to furnish the committee with the research activities at the completion of the study.** All informed consent forms used in this study must carry the HREC assigned number and duration of HREC approval of the study. In multiyear research, endeavor to submit your annual report to the HREC early in order to obtain renewal of your approval and avoid disruption of your research. No changes are permitted in the research without prior approval by the HREC except in circumstances outlined in the Code. The HREC reserves the right to conduct compliance visit your research site without previous notification.

Signature & Date: 25/3/2026


INTELLECTUAL PROPERTY & TECHNOLOGY TRANSFER OFFICE (IPTTO)
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CLEARANCE FORM

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MATRIC NO: MED1807460
DEPARTMENT: MEDICINE AND SURGERY.
FACULTY: MEDICINE AND SURGERY.
SESSION OF GRADUATION: 2024

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DATE ....
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UNIBEN, BENIN
Head Of Unit (IPTTO)

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