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Knowledge and Compliance to the Uptake of Malaria Vaccines by Caregivers to under-5 Years at the Mambanda Community Douala Cameroon

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Abstract:

- ***Background:***

Malaria remains a leading cause of morbidity and mortality among children under five years in sub-Saharan Africa, with Cameroon ranking among the most affected countries. Despite advancements in malaria control strategies, the introduction and uptake of the RTS,S/AS01 malaria vaccine face significant challenges, particularly in underserved urban communities. This study assessed the knowledge and compliance of caregivers to the RTS,S malaria vaccine in Mambanda, a densely populated and peri-urban community in Douala, Cameroon.

- ***Materials and method:***

A community-based cross-sectional study was conducted from June to July 2024 among 150 mothers of children under five years residing in Mambanda. Participants were selected using a convenient random sampling technique. Data were collected through a semi-structured, pilot-tested questionnaire assessing sociodemographic characteristics, knowledge of malaria and its vaccines, and compliance with the RTS,S vaccine schedule. Statistical analysis was performed using SPSS version 23, descriptive statistics was used to evaluate proportions and significance was set at $p<0.05$.

- ***Results:***

The study revealed high general awareness of malaria (98%) and the importance of vaccination (79.3%) among participants. However, knowledge of specific malaria vaccines was low, with only 22% and 9.3% of participants aware of the RTS,S and R21 vaccines, respectively. Despite this, 92.7% of participants understood that vaccines help prevent malaria, and 86.7% knew vaccines were accessible in hospitals. The actual uptake of the RTS,S vaccine among children was 44.7%, with most mothers (68.7%) expressing willingness to vaccinate their children. However, compliance with the full four-dose RTS,S schedule was not evaluated due to early stages of rollout. Common barriers included limited knowledge, vaccine myths for example fear of pain (89.3%), and infrastructural constraints.

- ***Conclusions:***

The findings highlight a significant gap between general malaria knowledge and specific awareness and uptake of the RTS,S vaccine. This study underscores the need for robust, community-centered communication strategies that go beyond

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traditional media. Recommendations include leveraging community health workers and religious leaders for sensitization, implementing digital reminder systems, enhancing transport infrastructure for better healthcare access, and providing continuous training for healthcare workers on vaccine communication.

Keywords: *Knowledge, Compliance, Uptake, Malaria, Vaccine, Mambanda, community, Douala.*

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I. INTRODUCTION

A. Background

Malaria is a mosquito-borne parasitic disease that continues to cause deleterious high levels of illness and deaths in sub-Saharan Africa and the world at large (Shin *et al.*, 2024). The disease is transmitted by female *Anopheles* mosquitoes with severe and fatal malaria incidence being caused by *Plasmodium falciparum*. *P. falciparum* accounts for more than 90% of the world's malaria mortality (WHO, 2024) and it disproportionately affects mainly children under 5 years. In 2022 alone, Cameroon recorded more than 6.4 million malaria cases and over 12,500 malaria related deaths making it the most affected zone in sub-Saharan Africa (MalariaWorld, 2024). According to the 2022 Cameroon Malaria Indicator Survey (CMIS), the southern regions experience the highest transmission due to year-round malaria exposure, while other regions show varying levels based on seasonality (INS Cameroon, 2022). The available preventive tools for malaria include vector control measures, chemoprophylaxis, and preventive chemotherapies (Poespoprodjo *et al.*, 2023).

Artemisinin-based Combination Therapies (ACTs) are the standard treatment for uncomplicated *P. falciparum* malaria in Cameroon. Commonly used ACTs include artemether-lumefantrine and artesunate-amodiaquine, provided free of charge in many public health facilities (Journal du Cameroun, 2024). For severe malaria, the recommended treatment is intravenous artesunate, followed by a complete course of ACTs once the patient can take oral medications (SevereMalaria.org, 2024). To improve access, the Ministry of Public Health, with support from partners like the Global Fund and WHO, ensures a steady supply of antimalarial drugs across the country. In addition, rapid diagnostic tests (RDTs) and light microscopy are widely used to confirm malaria before treatment, reducing unnecessary use of antimalarial drugs and improving overall case management (INS Cameroon, 2022).

The treatment of malaria in Cameroon has experienced several challenges in which between 2021 and 2023, Cameroon raised only 132 billion CFA francs of the 232 billion CFA francs required for treatment prevention campaigns. This left a significant gap of about 100 billion which was need to ensure supply of medications to rural areas of the country (Journal du Cameroun, 2024). This funding gap also affected health worker training, and community health outreach programs. Additionally, regional disparities in malaria transmission mean that a one-size-fits-all approach does not work. As such, the government began implementing targeted regional interventions based on transmission intensity (ALMA, 2024).

Vaccination has been one of the major ways of prevention of pediatric pathologies in the world (WHO, 2024). The WHO acknowledges different malaria vaccines which include; RTS,S/AS01, and R21/Matrix-M, (WHO, 2023). Recently, Cameroon implemented the Vaccine Rollout program which saw that in January 2024, Cameroon became the first country to implement a nationwide rollout of the RTS,S (Mosquirix) malaria vaccine for children under five. The goal was to vaccinate 250,000 children by the end of 2024, in partnership with Gavi and WHO (AP News, 2024; The Guardian, 2024). The government has also recently adopted the National Strategic Plan for Malaria Control (2024–2028), which includes introducing perennial malaria chemoprevention (PMC) for infants in regions with non-seasonal transmission patterns (SevereMalaria.org, 2024).

Initial knowledge about RTS,S has been driven by media campaigns, health facility sensitization programs, and the involvement of community health workers (AP News, 2024; The Guardian, 2024). However, a gap persists in rural and underserved areas, where vaccine literacy is often low. A preliminary report by Cameroon's Ministry of Public Health suggests that; more than 60% of parents in urban areas are aware of the vaccine. In rural communities, awareness dropped below 40%, often due to poor communication infrastructure and lack of local sensitization (Journal du Cameroun, 2024). Health education campaigns are ongoing, but barriers like misconceptions about vaccine safety and cultural beliefs still affect full community acceptance. This vaccine has also been implemented in some African countries but the knowledge on the vaccine still seem to be low. For example, a 2023 survey revealed that awareness of the RTS,S vaccine was generally low across the Nigeria, with only 28% of respondents in the North West region being aware of it . In Southeastern Nigeria, a study found that 48.2% of caregivers were aware of the vaccine, and 88.2% had a positive perception of it (Ajayi and Emeto, 2023). Also, In Ghana, Kenya, and Malawi, pilot programs have administered over 1.7 million doses of RTS,S, reaching more than 650,000 children. These programs demonstrated strong community demand and the feasibility of integrating the vaccine into existing immunization schedules (Asante *et al.*, 2024). Furthermore, a systematic review reported an overall acceptance rate of 87.5% for the RTS,S vaccine across various studies, with

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rates ranging from 32.3% to 99.3%. Factors influencing acceptance included marital status, knowledge levels, previous vaccination experiences, and trust in healthcare systems (Ansar *et al.*, 2024)

The RTS,S vaccine requires four doses administered over 18 months. Compliance is a challenge, especially in communities with poor access to health services. Early data from pilot districts in Yaoundé and Douala show high initial uptake (first dose) among eligible children (over 75%), but a drop-off to about 50–60% by the third and fourth doses (Ndoula *et al.*, 2024). Key compliance challenges include; long intervals between doses, transport difficulties, lack of consistent follow-up by healthcare providers, and parents' lack of understanding about the need for multiple doses (SevereMalaria.org, 2024). There is still limited data on the uptake rate and compliance to the malaria vaccine regimen in endemic regions and Cameroon in particular. This study therefore seek to asses knowledge and compliance to RTS,S vaccine in the Mambanda community in Douala in the Littoral Region of Cameroon. This is to evaluate whether mothers comply to these vaccine for the prevention of malaria in children under 5 years. The finding from this study will also evaluate some general mythological ideas about vaccines in relationship to the RTS,S vaccine.

II. MATERIALS AND METHODS

A. Study area

Mambanda is a rapidly growing and densely populated community located in the Bonabéri area of Douala IV subdivision, in the Littoral Region of Cameroon. It lies on the western bank of the Wouri River, forming part of the industrial and peri-urban expansion of Douala. Mambanda covers an estimated area of 500 hectares, composed of 39 residential blocks (Douala Today). As of 2013, the population was estimated at around 132,000 inhabitants, making it one of the most densely populated communities in Douala IV. It accounted for about 30% of the total population of Douala IV at the time (Cameroon Tribune). The community is largely youthful, with a high proportion of women. Many residents are involved in informal trade, industrial labor, and small-scale agriculture (Douala Today). Mambanda faces several urban challenges including poor drainage, inadequate access to clean water, poor waste disposal, and limited healthcare services. The road network is underdeveloped, which affects mobility and access to essential services (Cameroon Tribune). Notable educational institutions include; Lycée Bilingue de Mambanda, CETIC Bonabéri, École Publique de Mambanda. Mambanda community has many Health Centres and sub clinics that take part in vaccination routine every month end, this vaccination includes children from 0-9months and above. Hospitals in this area also offer vaccination campaigns both fixed and mobile campaigns for diseases such as cholera, chicken pox and yellow fever.

B. Study design

A community-based cross-sectional study design was used collect data from mothers who consented to take part in the study. This involved a convenient random sampling technique to collect data between 4th of June to the 10th July, 2024.

C. Population size determination

The Fisher's formula was used to determine the number of participants need to take part in this study.Using the Fischer's formula the sample size is calculated as shown below;

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where Z=1.96 at 95% confidence interval

P= 87.5% = 0.875 (Overall acceptance rate of RTS, S vaccine across many studies in Africa) (Ansar *et al.*, 2024)

1-P = 1-0.875 = 0.125

d= 5%=0.05 (error margin),

$$n = \frac{1.96^2 \times 0.875\ (0.125)}{0.05^2}$$

n= 168.07 ≈ 169 participants

- *Inclusion criteria*

Women who stayed within the Mambanda community and signed an informed consent form.

- *Exclusion Criteria*

Women who came from different communities and who did not sign the informed consent form.

D. Data collection tool

A pilot-tested semi-structured questionnaires was used to data from the different participants. This questionnaire were translated to any participant who could not understand English language. The first section of the questionnaire sought to determine socio-demographic information about the participants while the other sections assessed knowledge and compliance of the women to the RTS, S vaccine for children under 5 years.

E. Data analysis

The data collected was analyzed using SPSS (Statistical Package for the Social Science) version 23. The Pearson's Chi-square test was used to compare the differences between groups and descriptive analysis was used to determine proportions within the study population. Results were presented on tables and figures while statistical significance were set at $p < 0.05$.

III. RESULTS

A. Socio-demographic characteristics of the study population

A total of 150 participants out of 170 questionnaires served completely responded to the questions on the questionnaires which gave a response rate of 88.2%. Out of the 150 participants, the majority were between the age group of 20-25 years (49.3%) with just 1 participant (0.7%) between the

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age group of 26-30 years. Most of the participants were married (54.7%). Also, 60% of the study population had tertiary education with the community mainly occupied by Christians (92.7%). Additionally, majority of these women did business (41.3%) while 13.3% were healthcare professionals (Table 1).

Table 1 Socio-demographic characteristics of the study population

Factor	Variable	Frequency (n)	Percentage (%)
Age group (years)	Below 20	36	24.0
	20-25	74	49.3
	26-31	1	0.7
	Above 31	39	26.0
Marital status	Married	82	54.7
	Single	68	45.3
Educational level	Primary	16	10.7
	Secondary	44	29.3
	Tertiary	90	60.0
Religion	Christian	139	92.7
	Muslim	11	7.3
Occupation	Business	62	41.3
	Teacher	18	12.0
	Healthcare professionals	20	13.3
	Accountants	17	11.3
	Student	23	15.3
	Secretary	10	6.7

B. Knowledge on RTS, S vaccine by mothers in the Mambanda community

The study was meant to determine the women's knowledge on the RTS,S vaccine as well as malaria in children under 5 years. Statistical analysis revealed that majority of the mothers (98.0%) in the Mambanda community had knowledge on malaria in children and its consequences. Unfortunately, majority (68.7%; 103/150) of the women did not know about the RTS,S and R21 vaccines. Thirty-three (22.0%) knew about the RTS,S vaccine while 14 (9.3%) knew about the R21 malaria vaccine (Figure 2). Nonetheless, most of the study participants knew the malaria vaccine was used for the prevention of malaria (92.7%), and these vaccines are very important (79.3%). Most of the participants revealed that, the malaria vaccine can be obtained in the hospital (86.7%) (Table 2).

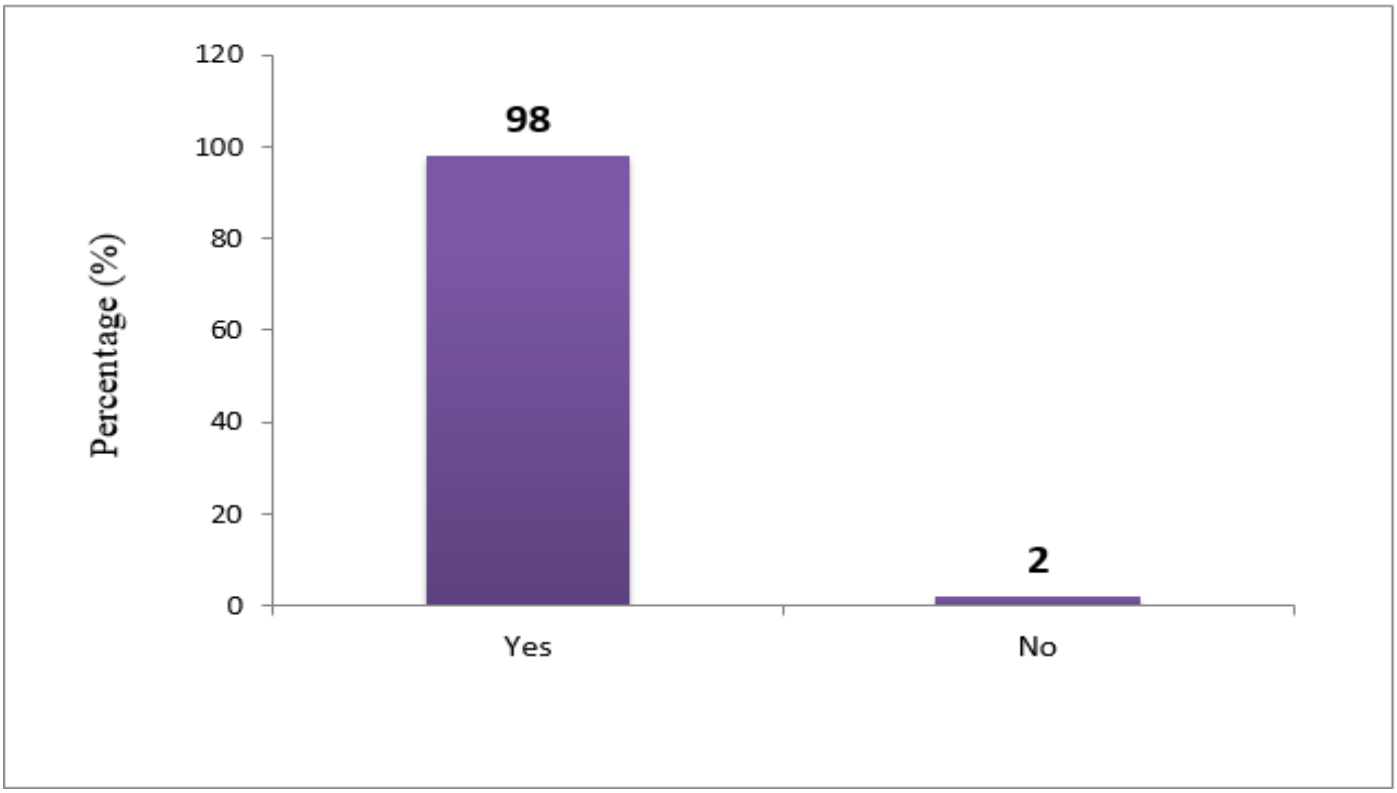

Fig 1 Knowledge of Malaria in Children and its Consequences

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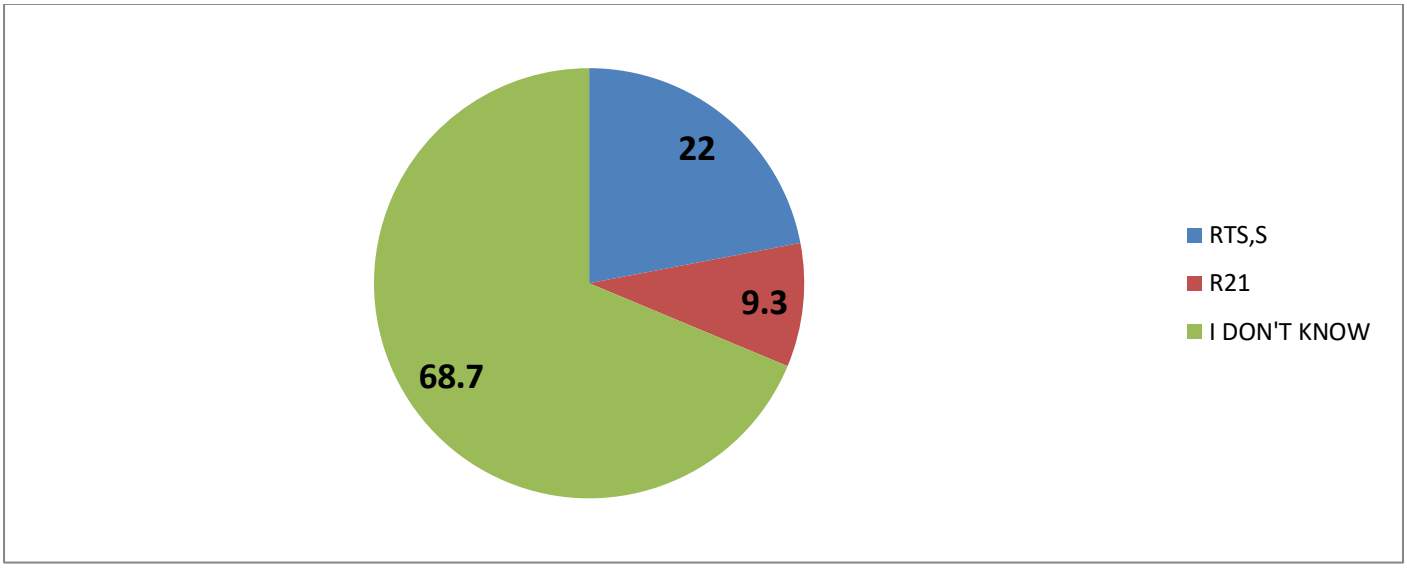

Fig 2 Knowledge on the types of Malaria vaccine

Table 2 Knowledge on Vaccine, its Importance and Where it can be Received

Factor	Variable	Frequency (n)	Percentage (%)
Malaria prevention	Yes	139	92.7
	No	11	7.3
Vaccines are important	Yes	119	79.3
	No	31	20.7
Where can you receive the malaria vaccine	Hospital	130	86.7
	Pharmacy	14	9.3
	Others	6	4.0

C. Uptake, compliance and the myths of the RTS ,S vaccine

Figure 3 depicts the uptake of malaria vaccine by children between 0-5 years in the Mambanda community. It was revealed 44.7% (67/150) had received the malaria vaccine while 55.3% (83/150) had not yet received the vaccine. Most of the mothers had no problems in allowing their children to be administered the RTS,S (68.7%; 103/150) (figure 4).The women were also quizzed on a few myths or challenges about the receipt of or compliance to RTS,S vaccine. Most of the women attested that vaccines cause pain (89.3%; 134/150) during the uptake process but vaccines are much better (92.0%, 134/150) than the malaria treatment itself (figure 5).

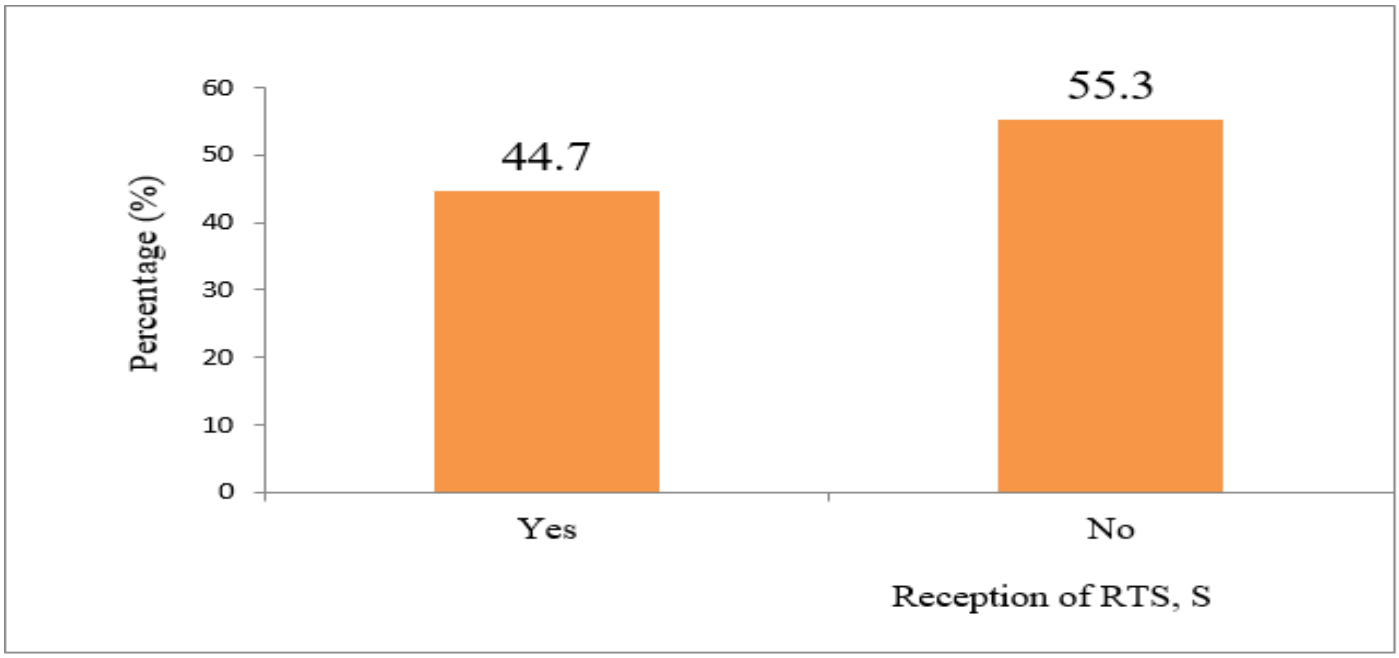

Fig 3 Uptake of Malaria Vaccine by Children

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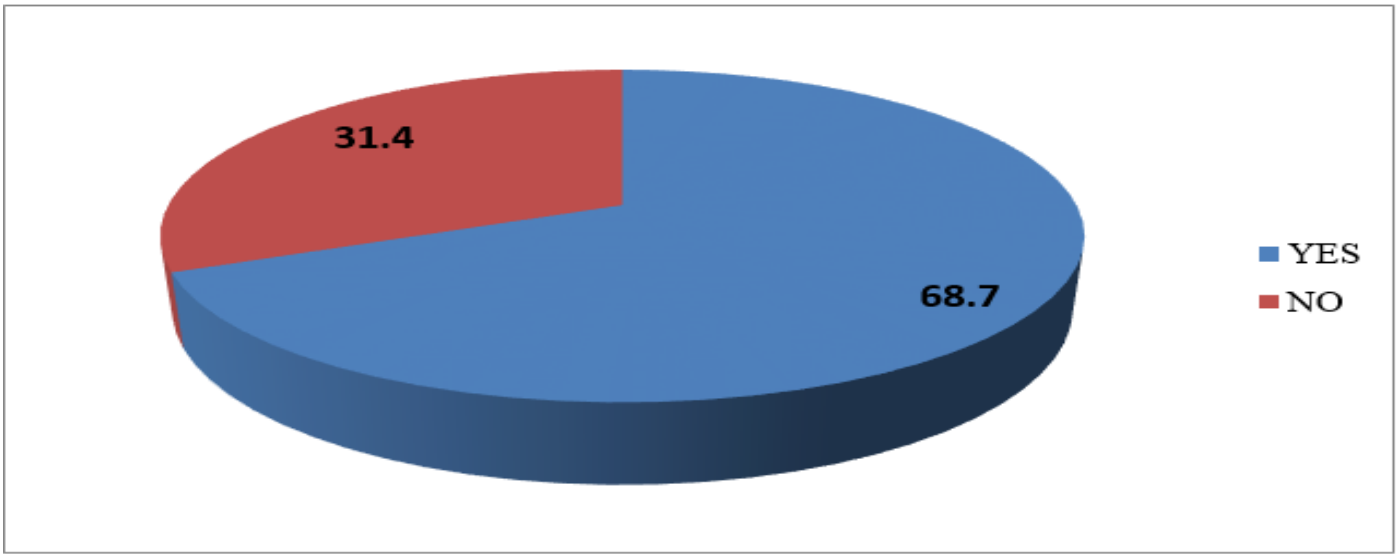

Fig 4 Will you Allow a nurse to Administer the Malaria Vaccine to your child?

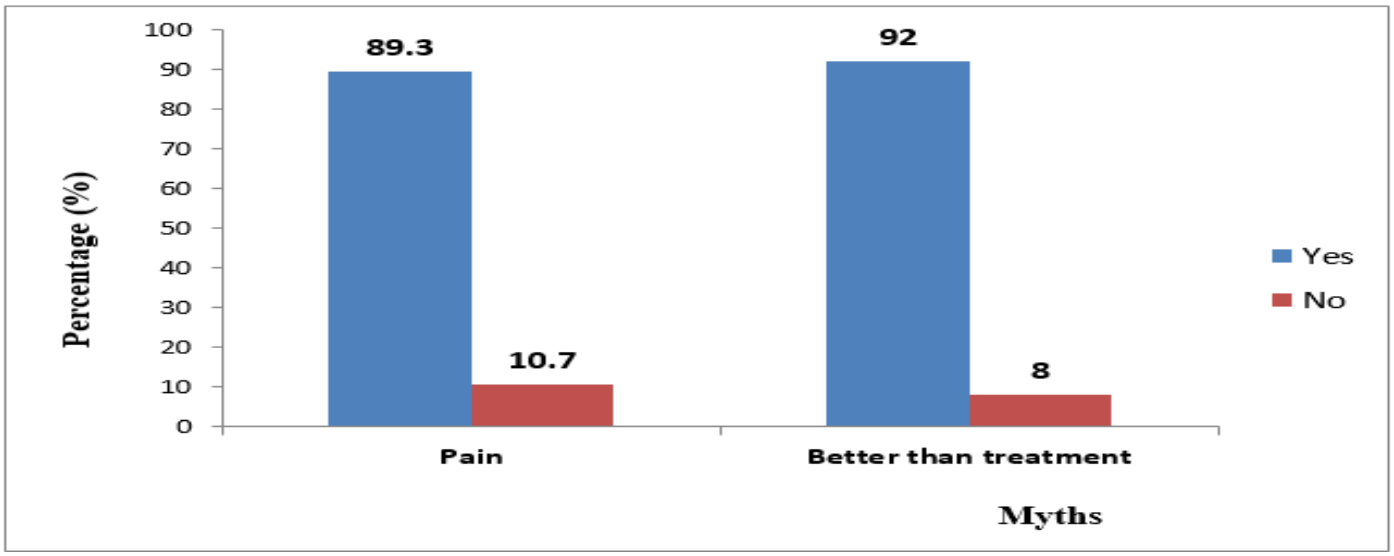

Fig 5 The Myths About the Uptake of Malaria Vaccine

IV. DISCUSSION

The findings of this study shed light on a critical public health issue in the ongoing fight against malaria in sub-Saharan Africa, particularly in urban poor communities such as Mambanda in Douala, Cameroon. Despite widespread knowledge about malaria and its burden among mothers (98%), the study revealed low awareness and compliance regarding the RTS,S/AS01 (Mosquirix) malaria vaccine. Only 22% of participants were aware of the RTS,S vaccine, and less than half (44.7%) of the children had received it. This suggests that there was no correlation between general health literacy and specific knowledge and behavior related to new medical interventions.

These results are consistent with previous studies conducted in similar settings. A study in Ghana found that while 90% of caregivers were aware of malaria, only 37% were aware of the RTS,S vaccine when it was first introduced (Owusu-Agyei *et al.*, 2023). Similarly, in Northern Nigeria, awareness rates varied significantly by region and education level, with rural populations lagging significantly behind urban counterparts (Ajayi & Emeto, 2023). These disparities point to a major challenge in implementing equitable health communication strategies, especially in underserved and marginalized areas. The low level of awareness in Mambanda despite a relatively educated population (60% had tertiary education) points to possible weaknesses in communication channels used during vaccine introduction. Research by Nyarko et al. (2023) underscores that traditional media campaigns may not sufficiently reach peri-urban or semi-literate populations. Instead, interpersonal communication via community health workers and local influencers has proven more effective in driving vaccine acceptance in such contexts. Moreover, the misconception that vaccines are excessively painful or potentially harmful, as expressed by nearly 89.3% of participants in this study, mirrors findings from studies in Kenya and Tanzania, where pain and fever after vaccination were common deterrents to compliance (Otieno *et al.*, 2022). These myths can be compounded by rumors and misinformation, which often spread faster than evidence-based health information.

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One of the greatest hurdles to RTS,S vaccine uptake is not initial acceptance but sustained compliance through all four doses administered over 18 months. Our study reflects a common pattern also reported in early implementation research: a drop-off in vaccine coverage after the first dose, with compliance declining to 50–60% by the third or fourth dose (Ndoula *et al.*, 2024). This is not unique to Cameroon. A WHO monitoring report across Ghana, Kenya, and Malawi found similar drop-off rates due to the long dosing schedule and challenges related to follow-up (WHO, 2023).

Systemic barriers such as inconsistent healthcare access, poor road networks, and a shortage of trained personnel are also likely contributors to low compliance. In fact, several global evaluations (Gavi, 2023; PATH, 2023) have emphasized that logistical factors—like transportation issues, irregular vaccine supply, and lack of digital recordkeeping—can severely hamper sustained vaccine uptake.

Although most mothers (68.7%) in Mambanda expressed no objection to allowing their children to be vaccinated, cultural beliefs and mistrust in formal healthcare still linger beneath the surface. Trust in the healthcare system has been found to be a significant determinant of vaccine uptake. For instance, a multi-country survey by Larson et al. (2016) revealed that countries with higher trust in the healthcare system had significantly higher childhood vaccination rates.

It is encouraging that most participants in this study agreed that malaria vaccines are more effective than malaria treatment (92%), suggesting that there is a conceptual appreciation of preventive medicine. However, translating this into practice requires consistent reinforcement through trusted channels. The findings have direct implications for malaria policy in Cameroon. While the government's commitment through the 2024–2028 National Strategic Plan for Malaria Control is commendable, this study shows that awareness alone is not enough. Policies must bridge the gap between knowledge and action. There must be targeted investments in: strengthening community health worker's programs, improving vaccine logistics and data tracking, developing region-specific communication strategies. Programs such as Ethiopia's Health Extension Program and Rwanda's community health worker strategy have shown how integrating routine vaccines with community-based outreach can dramatically increase compliance rates (UNICEF, 2022).

V. CONCLUSION

This study revealed that while general awareness of malaria and the importance of vaccination is high among mothers in Mambanda, awareness and compliance with the RTS,S vaccine schedule remain low. The disparity between knowledge of malaria and uptake of preventive vaccines underscores the urgent need for improved communication, sustained community engagement, and infrastructural support. The introduction of the RTS,S vaccine is a landmark in malaria prevention; however, its success depends not just on availability but on access, acceptability, and adherence. The observed gaps reflect broader systemic challenges faced in many African communities, such as resource constraints, transport difficulties, and cultural barriers.

RECOMMENDATIONS

- Health education should go beyond urban centers and include door-to-door campaigns in underserved neighborhoods. Community health workers and religious leaders should be mobilized to dispel myths and promote trust in vaccines.
- Implement digital reminder systems (e.g., SMS) for scheduled doses and create community-based monitoring to ensure full compliance with the four-dose RTS,S schedule.
- Invest in improving transport and road access to health facilities in communities like Mambanda. Mobile vaccination units could be used to reach hard-to-access populations.
- Continuous training for healthcare providers on vaccine counseling and communication can help reassure hesitant mothers and combat misinformation.
- Regular evaluations should be built into malaria vaccine rollouts to identify uptake bottlenecks and adjust strategies accordingly. Involvement of caregivers in feedback mechanisms can also foster ownership and trust.

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DECLARATIONS

- *Administrative Authorization*

Administrative authorizations were obtained from Cornerstone University and Theological Seminary, Cameroon and from the Regional Delegation of Public Health, Littoral Douala (Ref.No. RII/MINSANTE/LR /RDPH/PS/629/661).

Further administrative authorization was obtained from the Chief of Mambanda community. Every woman who took part in this study, signed an informed concern form and participation was at the convenience of the women. The participant had the right to opt out of the study at any time when she felt uncomfortable. All data collected was kept confidential and it was used only for the purpose of this research.

- *Competing interests*

The authors declare that they have no competing interests.

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➢ *Author contributions*

HFM conceived, designed, supervised the study and major contributions and performed statistical analysis and drafted manuscript, NF participated in designing the projected and carried out data collection in the field. WCA, PHL, WDS and ALB contributed in the revision of the manuscript. All authors read and approved the final manuscript.

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No special funding was received for this research.

➢ *Availability of data and materials*

All datasets generated and analyzed during the study are presented in the paper

➢ *Abbreviations*

- WHO: World Health Organization
- UNICEF: United Nations International Children's Emergency Fund
- PATH: Program for Appropriate Technology in Health
- ALMA Cameroon: African Leaders Malaria Alliance (Cameroon chapter)
- INS Cameroon: Institut National de la Statistique (National Institute of Statistics,Cameroon)
- RTS,S vaccine: RTS,S/AS01 Malaria Vaccine (Mosquirix; targets Plasmodium falciparum)
- SPSS: Statistical Package for the Social Sciences
- AP News Cameroon: Associated Press News (Cameroon coverage or bureau)
- CETIC Bonaberi: Collège d'Enseignement Technique Industriel et Commercial Bonaberi

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