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Risk perception and hesitancy towards malaria vaccines among hospital pharmacists in southeast Nigeria: a cross-sectional study

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ABSTRACT

This study evaluated the willingness and perceived concerns of hospital pharmacists in allowing and recommending malaria vaccines. This was a cross-sectional-based study. Participants were recruited from two teaching hospitals in southeast Nigeria – the University of Nigeria Nsukka (UNTH) and the Enugu State University Teaching Hospital (ESUTH). Outcomes were acceptability of the malaria vaccine and concerns about the use of malaria vaccine measured using a validated 21-item questionnaire adapted from a similar study. Descriptive statistics were used to characterise and compare data, with chi-test to test the association between variables. A sub-group analysis within the acceptability was done to determine the predictors of 'probably' by also dichotomizing the responses. Data were analysed using STATA v17. Out of 250 participants recruited for this study, 187 completed and returned the questionnaire, with UNTH having the highest response rate ($n = 137$, 73.3%). Ninety-two (54.1%) out of 170 participants agreed that they would allow their children to take the malaria vaccine. Sixty-six (50.4%) out of 131 and 30 (62.5%) out of 48 participants from UNTH and ESUTH, respectively, will likely recommend the vaccine to family members, while 64 (49.6%) out of 129 and 31 (64.6%) out of 48 participants from UNTH and ESUTH, respectively, were likely to recommend the vaccine to their patients. Eighty-three (61.9%) out of 134 and 33 (67.3%) out of 49 participants from UNTH and ESUTH, respectively, had concerns about the adverse effects of taking this vaccine. Education level ($p = 0.017$) and age ($p = 0.014$) were significantly associated with the likelihood of recommending this vaccine to patients. Our findings showed that pharmacists are not likely to accept and recommend malaria vaccines to


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their children and patients. Hospital pharmacists' demographic characteristics did not predict their acceptability or probability of allowing the malaria vaccine to be administered to their children. Similar findings were also observed for hesitancy towards malaria vaccines. There were concerns about the failure of the vaccine and its adverse effects.

Introduction

Malaria is a parasitic infectious disease that threatens public health and the global economy. It is one of the primary causes of morbidity and mortality in sub-Saharan Africa (Mbacham et al. 2019; Takem, Roca, and Cunningham 2014), with an estimated 219 million cases worldwide (Cibulskis et al. 2016). According to the World Health Organization (WHO), Nigeria has the highest malaria burden in the world, with about 97% of the population (173 million people) at risk of infection (Mbacham et al. 2019; WHO 2022). With over 51 million new cases and 207,000 reported deaths per year, Nigeria has about 30% of the malaria burden in Africa (Chukwuocha et al. 2018). From 2000 to 2016, countries categorized as lower-middle-income within the World Bank income groups for 2018 accounted for the largest spending (\$19.3 billion) on malaria control and treatment (Haakenstad et al. 2019).

Malaria research is now evolving towards the use of vaccines in children to reduce the burden of malaria. Following successful clinical trials, the WHO has certified the malaria vaccine to be safe and effective for use in humans (Aremu et al. 2022). The R21/Matrix-M vaccine, having demonstrated a protective effect of 77% over 12 months in a phase 2b trial involving young West African children, became the second vaccine to be approved by WHO (Dattoo et al. 2022). Nigeria recently launched a malaria vaccination program and granted approval to Oxford's R21 malaria vaccine (Nitika, Nema, and Kumar Bharti 2023), following Ghana, Kenya and Malawi (Yeboah, Owusu-Marfo, and Nyarko Agyeman 2022). However, the hesitancy towards the vaccine poses a huge threat to the complete eradication of malaria in Sub-Saharan Africa and the world (Asmare 2022; Sulaiman et al. 2023; Sulemane et al. 2022).

The hesitancy for the malaria vaccine by the public and recommendation by some health professionals, including pharmacists, may be fueled by concerns regarding the safety, efficacy and adverse effects of the vaccine (Sulaiman et al. 2023). Studies have shown that healthcare professionals' willingness to recommend vaccines can improve their uptake by the public (Aborode et al. 2021; Febir et al. 2013). To improve the uptake of the malaria vaccine, there is a need to understand the willingness, likelihood of acceptance and concerns of healthcare professionals towards the vaccine.

While there is ample evidence of rising vaccine hesitancy among healthcare workers in Africa, particularly in the context of other vaccines (Ackah et al. 2022), there is a gap in knowledge regarding hesitancy specifically towards malaria vaccines. A recent study reported a high prevalence of malaria vaccine hesitancy among caregivers of under-five children in Nigeria (Sulaiman et al. 2023); however, our study seeks to provide unique insights into the risk perception and hesitancy among hospital pharmacists in south-east Nigeria. Understanding the reasons behind vaccine hesitancy towards malaria vaccines is

crucial for designing targeted interventions and communication strategies to improve vaccine acceptance and coverage rates (Tuckerman, Kaufman, and Danchin 2022).

In Sub-Saharan Africa, pharmacists play a crucial role in reducing the malaria burden through vaccination campaigns and increasing public awareness (Cassidy et al. 2021). The study aimed to determine the likelihood of acceptance and risk perception toward malaria vaccines among hospital pharmacists in southeastern Nigeria.

Methods

Study design

This was a cross-sectional questionnaire-based study.

Study settings and participants

The study was conducted in two teaching hospitals in southeast Nigeria – the University of Nigeria Teaching Hospital (UNTH) and Enugu State University Teaching Hospital (ESUTH). The two hospitals were purposively selected as the only teaching hospitals in Enugu State, the former administrative capital of the old Eastern Nigerian region. Eligible participants were registered pharmacists who were 18 years and above, had been working as hospital pharmacists for over a year and had given written or verbal consent to participate. Sample size was not calculated for this study. Rather, all the registered pharmacists working at the two hospitals, irrespective of their ranks and specialties, were requested to participate in the study. The decision to use all the prospective respondents was made to saturate the study's sample/power, as an already low study population could lead to a lower total response: UNTH and ESUTH had 191 and 75 pharmacists, respectively, at the time of the study.

Participant recruitment and data collection

Heads of departments of each hospital were approached for clearance before contacting the eligible respondents. Interested potential participants were then approached by a member of the research team during the lunch breaks of their weekly clinical meeting days since all the pharmacists are expected to attend the meetings. If interested and willing to participate, they provided written or witness-informed verbal consent. They were then provided with a paper-based questionnaire plus a pre-paid postal envelope to complete and return to the research team at a specified address. All data collection was undertaken between September 2022 and January 2023.

Instrument for data collection and outcomes

A 21-item paper-based questionnaire was developed and validated for the study. The questions were adapted from a similar study (Isah and Michael Ubaka 2021). The questionnaire was administered in the English language. The questionnaire included four sections (A to D). Section A (six items) comprised of questions on socio-demographic characteristics and section B (four items) comprised of questions

relating to participants' family profile, including if the respondents have a biological child/children/ward, if their under-age child/children/ward have been diagnosed with malaria in the last 1 month, how concerned they are about their under-age child/children contracting malaria. Section C (five items) contained questions on the likelihood (viz.: certainly, definitely not and probably) of accepting and recommending malaria vaccines, and section D (six items) contained questions on perceived concerns regarding the vaccine, and the study participants were to answer 'yes', 'no' or 'not sure' to all the variables.

Data analysis

The questionnaires were coded into Microsoft Excel and cleaned for errors before exporting them to STATA v17 (Kohler and Kreuter 2005) for data analysis. The demographic and clinical characteristics of participants from both hospitals were described and compared using descriptive statistics. Chi-square was used to determine the relationship between variables, with the level of significance set at p -value < 0.05 . A logistic regression of the acceptability of the vaccine was determined for the main primary outcomes of the study: acceptability and hesitancy. For acceptability, the question 'Likelihood of allowing your child/children to be vaccinated with malaria vaccine' was used, while 'Failure of the vaccine to protect against malaria' was assumed to be the main measure of hesitancy. In the first measure of acceptability, the three-point Likert-scale response (definitely not, probably and certainly) was converted into two: definitely as 'refusal', then probably and certainly as 'acceptability'. Thereafter, a sub-group analysis within the acceptability was done to determine the predictors of 'probably' by also dichotomizing the responses.

Ethical considerations

Ethical clearance for this study was obtained from the Health Research and Ethics Committee of the University of Nigeria Teaching Hospital (Reference Number: NHREC/05/01/2008B-FWA00002458-1RB00002323).

Results

Demographic characteristics of the hospital pharmacists

Out of 250 potential participants who had given written or verbal consent to participate, 187 completed and returned the questionnaire, with UNTH having the highest response rate ($n = 137$, 73.3%) and 50 responses coming from ESUTH. Most of the respondents from UNTH, 92 (79.3%), were between 20 and 30 years, while the majority from ESUTH, 16 (45.7%), were between 30 and 40 years; however, age did not vary significantly across the two study settings ($P = 0.245$). More than half of the participants were female, 91 (48.9%) working in UNTH and 32 (17.2%) in ESUTH. Participants' socio-demographic characteristics are in [Table 1](#).

Table 1. Demographic characteristics of the hospital pharmacists.

Characteristics	ESUTH (n = 50)	UNTH (n = 137)	Total (n = 187)	P-value
n (%)				
Age (n = 187)				.245
20–30	23 (19.8)	92 (79.3)	115 (100)	
30–40	16 (45.7)	19 (54.3)	35 (100)	
40–50	9 (32.1)	19 (67.9)	28 (100)	
50–60	2 (40)	3 (60)	5 (100)	
Above 60	0 (0.0)	4 (100)	4 (100)	
Gender (n = 186)				.732
Female	32 (26.1)	91 (73.9)	123 (99.2)	
Male	17 (27)	46 (73)	63 (100)	
Monthly Income (n = 182)				.116
100,000–200,000	18 (17.5)	85 (82.5)	103 (100)	
Above 200,000	21 (36.8)	36 (63.2)	57 (100)	
Less than 100,000	10 (45.5)	12 (54.5)	22 (100)	
Educational Level (n = 170)				.306
BPharm/PharmD	28 (21.5)	102 (78.5)	130 (100)	
Postgraduate degree	20 (39.2)	31 (60.8)	51 (100)	
Marital Status (n = 186)				<.001
Engaged	1 (25)	3 (75)	4 (100)	
Married	26 (34.2)	50 (65.8)	76 (100)	
Single	23 (21.7)	83 (78.3)	106 (100)	
Religion (n = 185)				<.001
Christianity	50 (27.2)	134 (72.8)	184 (100)	
Islam	0 (0.0)	1 (100)	1 (100)	

P-values < 0.05 is significant.

Participants' family profile

A total of 102 (55.4%) participants had no biological children. Among those who had children, 28 (15.2%) were from ESUTH and were extremely concerned about their children contracting malaria 21 (13.5%). The majority of those from UNTH had no children, 81 (44.0%), but were extremely concerned about children who are less than 18 years contracting malaria 48 (30.8%). Details of the family profile of study participants are shown in Table 2.

Participants' likelihood to accept the malaria vaccine

Out of the 187 respondents, only 92 (54.1%) out of 170 were certainly likely to allow their children to be vaccinated with the malaria vaccine. Pharmacists in UNTH, 66 (50.4%) out of 131, and ESUTH, 30 (62.5%) out of 48, were certainly likely to recommend the vaccine to their family member's children, while 64 (49.6%) out of 129 in UNTH and 31 (64.6%) out of 48 ESUTH pharmacists would certainly recommend the same to children of friends. Among those who would probably recommend the vaccine to children of patients, 60 (46.2%) out of 130 were from UNTH and 10 (21.3%) out of 47 were ESUTH pharmacists. The likelihood variables were not significantly different in the two hospital settings. Table 3 shows the likelihood of acceptability of the malaria vaccine by hospital pharmacists.

Table 2. Participants' family profile.

Clinical Characteristics	ESUTH (<i>n</i> = 50)	UNTH (<i>n</i> = 137)	Total (<i>n</i> = 187)	P-value
<i>n</i> (%)				
Do you have (a) biological child/children? (<i>n</i> = 184)				.468
No	21 (20.6)	81 (79.4)	102 (100)	
Yes	28 (34.1)	54 (65.9)	82 (100)	
Have your child/children/ward less than 18 years been diagnosed with malaria in the last month? (<i>n</i> = 170)				.057
No	13 (21.3)	48 (78.7)	61 (100)	
Not applicable	8 (16)	42 (84)	50 (100)	
Yes	26 (44.1)	33 (55.9)	59 (100)	
How concerned are you about your child/children less than 18 years contracting malaria? (<i>n</i> = 156)				.902
Extremely Concerned	21 (30.4)	48 (69.6)	69 (100)	
Little concerned	4 (28.6)	10 (71.4)	14 (100)	
Not concerned	3 (27.3)	8 (72.7)	11 (100)	
Quite Concerned	17 (30.4)	39 (69.6)	56 (100)	
The reason you consider your child/children less than 18 years at higher risk of contracting malaria? (<i>n</i> = 119)				.715
Not sleeping under insecticide-treated bed nets	17 (25)	51 (75)	68 (100)	
Not taking prophylaxis	9 (36)	16 (64)	25 (100)	
Not using insect repellent	0 (0.0)	12 (100)	12 (100)	
Staying in swampy areas	5 (35.7)	9 (64.3)	14 (100)	

P-values < 0.05 are significant.

Concerns about the use of malaria vaccines

While 144 (79.6%) out of 181 respondents believe in vaccination, 97 (53.6%) out of 181 pharmacists from the two settings had concerns about the failure of the vaccine to protect against malaria, 83 (61.9%) out of 134 pharmacists in UNTH and 33 (67.3%) out of 49 pharmacists in ESUTH had concerns about adverse effects following immunization. A total of 105 (80.2%) out of 131 pharmacists in UNTH and 35 (71.4%) out of 49 pharmacists in ESUTH had concerns about the handling condition of the vaccine in Nigeria. There were no significant differences between the pharmacists' concerns about vaccine and their hospital settings. Concerns about the use of the malaria vaccine are shown in Table 4.

Association between demographics and the likelihood of allowing/recommending malaria vaccine to children or patients

Most of the female respondents, 60 (65.2%), were certainly likely to allow their children to be vaccinated with the malaria vaccine, while 62 (63.3%) would certainly recommend the same to their patients. Of the respondents, 60 (69.0%) had B. Pharm/PharmD and were certainly likely to allow their children to take the malaria vaccine, and more than half (31.0%) of 30.3% of postgraduate degree holders in the study were certainly likely to allow their children to take the malaria vaccine. Similarly, 65 (69.1%) B. Pharm/PharmD holders were certainly likely to recommend malaria vaccination to children of patients who seek

Table 3. Participants' likelihood to accept the malaria vaccine.

Acceptability of the Vaccine	ESUTH (n = 50)	UNTH (n = 137)	Total (n = 187)	P-value
n (%)				
Likelihood of allowing your child/children to be vaccinated with a malaria vaccine. (n = 170)				.252
Certainly	32 (34.8)	60 (65.2)	92 (100)	
Definitely Not	5 (38.5)	8 (61.5)	13 (100)	
Probably	10 (15.4)	55 (84.6)	65 (100)	
Likelihood of recommending malaria vaccination to child/children of family members. (n = 179)				.65
Certainly	30 (31.3)	66 (68.8)	96 (100)	
Definitely Not	5 (41.7)	7 (58.3)	12 (100)	
Probably	13 (18.3)	58 (81.7)	71 (100)	
Likelihood of recommending malaria vaccination to child/children of friends. (n = 177)				.702
Certainly	31 (32.6)	64 (67.4)	95 (100)	
Definitely Not	4 (33.3)	8 (66.7)	12 (100)	
Probably	13 (18.6)	57 (81.4)	70 (100)	
Likelihood of recommending malaria vaccination to child/children of fellow healthcare professionals. (n = 178)				.544
Certainly	32 (33.7)	63 (66.3)	95 (100)	
Definitely Not	4 (30.8)	9 (69.2)	13 (100)	
Probably	13 (18.6)	57 (81.4)	70 (100)	
Likelihood of recommending malaria vaccination to child/children of patients who seek professional advice. (n = 177)				.214
Certainly	33 (33.7)	65 (66.3)	98 (100)	
Definitely Not	4 (44.4)	5 (55.6)	9 (100)	
Probably	10 (14.3)	60 (85.7)	70 (100)	

P-values < 0.05 are significant.

professional advice, while 29 (30.9%) respondents who had postgraduate education were certainly likely to do so. Respondents who identified as being single, 51 (55.4%), were certainly likely to allow their children to be vaccinated, whereas more than half of the married respondents, 30 (46.2%), were probably likely to do so. Education level ($p = 0.017$) and age of respondents ($p = 0.014$) were the two sociodemographic variables that played a significant role in pharmacists' likelihood of recommending vaccines to patients. None of the respondents who were between 40 and 50 and above 60 years of age would recommend the malaria vaccine to patients (see Table 5).

Predictors of the respondents' choices about the malaria vaccine

Supplementary Tables S1–S3 show that none of the demographic characteristics was a predictor of the acceptability and probability of allowing the malaria vaccine to be administered to their children. The same findings were also observed for hesitancy towards the malaria vaccines.

Table 4. Concerns about the use of malaria vaccines.

Concerns about the Malaria Vaccines	ESUTH (<i>n</i> = 50)	UNTH (<i>n</i> = 137)	Total (<i>n</i> = 187)	P-value
<i>n</i> (%)				
Failure of the vaccine to protect against malaria. (<i>n</i> = 181)				.978
No	6 (20)	24 (80)	30 (100)	
Not sure	17 (31.5)	37 (68.5)	54 (100)	
Yes	25 (25.8)	72 (74.2)	97 (100)	
Malaria infection from the vaccine. (<i>n</i> = 181)				.998
No	25 (28.1)	64 (71.9)	89 (100)	
Not sure	12 (27.3)	32 (72.7)	44 (100)	
Yes	11 (22.9)	37 (77.1)	48 (100)	
Adverse effects following immunization. (<i>n</i> = 183)				.557
No	4 (11.8)	30 (88.2)	34 (100)	
Not sure	12 (36.4)	21 (63.6)	33 (100)	
Yes	33 (28.4)	83 (71.6)	116 (100)	
The handling condition of the vaccine in Nigeria. (<i>n</i> = 180)				.729
No	6 (26.1)	17 (73.9)	23 (100)	
Not sure	8 (47.1)	9 (52.9)	17 (100)	
Yes	35 (25)	105 (75)	140 (100)	
Is Malaria vaccination necessary? (<i>n</i> = 179)				.998
No	31 (26.1)	88 (73.9)	119 (100)	
Not sure	12 (27.9)	31 (72.1)	43 (100)	
Yes	4 (23.5)	13 (76.5)	17 (100)	
Do you believe in vaccination? (<i>n</i> = 181)				.998
Yes	38 (26.4)	106 (73.6)	144 (100)	
Not sure	4 (22.2)	14 (77.8)	18 (100)	
No	6 (31.6)	13 (68.4)	19 (100)	

P-values < 0.05 are significant.

Discussion

This study evaluated the likelihood of Nigerian pharmacists allowing malaria vaccination for their children and recommending it to other children of family members and patients, as well as their perceived concerns regarding the malaria vaccine. Only a few of the respondents were certain to allow their children to take the vaccine and to recommend the malaria vaccine to children of family members and patients who seek professional advice. However, age, gender, educational status, monthly income and marital status did not predict the acceptability and probability of allowing the malaria vaccine to be administered to their children.

With most of the participants reporting that they believe in vaccination and the necessity of the malaria vaccine, more than half of them were concerned about the failure of the vaccine to protect against malaria. Some of the participants were afraid of adverse effects following immunization and the handling condition of the vaccine in Nigeria. These concerns did not vary between the two hospital settings and imply that they have equal levels of fear, which informed their decision to allow and recommend malaria vaccines. Findings from this study are consistent with another study that evaluated the reasons for malaria vaccine hesitancy (Sulaiman et al. 2023) which showed fear of vaccine adverse effects and failure of the vaccine to protect against malaria as the main reasons for vaccine hesitancy. Given that the vaccine is still relatively new in Nigeria (Dattoo et al. 2022; Maduka 2018), and information on the adverse effects and ways to manage them are still sparse, these concerns are expected. Addressing these concerns will improve the likelihood of acceptability and recommendation of the vaccine (Amiebenomo et al. 2023; Asmare 2022; Mumtaz et al. 2023; Sulaiman et al. 2023).

Table 5. Association between demographics and the likelihood of allowing/recommending malaria vaccine to children or patients.

Variables	Likelihood of allowing vaccination for child/children				P-value	Likelihood of recommending vaccination to patients				P-value
	Definitely Not	Probably	Certainly	χ^2 (df)		Definitely Not	Probably	Certainly	χ^2 (df)	
Gender				1,995(2)	0.369				2,438(2)	0.296
Male	2(15.4)	20(31.3)	32(34.8)			1(11.1)	23(33.3)	36(36.7)		
Female	11(84.6)	44(68.8)	60(65.2)			8(88.9)	46(66.7)	62(63.3)		
Marital status				4,227(4)	0.376				2,825(4)	0.588
Single	6(46.2)	35(53.8)	51(55.4)			3(33.3)	38(54.3)	57(58.8)		
Engaged	0(0)	0(0)	4(4.3)			0(0)	2(2.9)	2(2.1)		
Married	7(53.8)	30(46.2)	37(40.2)			6(66.7)	30(42.9)	38(39.2)		
Educational level				2,098(2)	0.350				8,113(2)	0.017
BPharm/PharmD	7(53.8)	48(73.8)	60(69.0)			3(33.3)	54(78.3)	65(69.1)		
Postgraduate degree	6(46.2)	17(26.2)	27(31.0)			6(66.7)	15(21.7)	29(30.9)		
Age (Years)				9,205(8)	0.325				19,112(8)	0.014
20–30	5(38.5)	40(61.5)	55(59.8)			2(22.2)	43(61.4)	62(63.3)		
30–40	6(46.2)	9(13.8)	19(20.7)			6(66.7)	13(18.6)	14(14.3)		
40–50	1(7.7)	12(18.5)	14(15.2)			0(0)	10(14.3)	18(18.4)		
50–60	1(7.7)	2(3.1)	2(2.2)			1(11.1)	2(2.9)	2(2.0)		
Above 60	0(0)	2(3.1)	2(2.2)			0(0)	2(2.9)	2(2.0)		

P-values < 0.05 are significant.

Our findings show that pharmacists believe that the malaria vaccine is necessary for the elimination of malaria in Nigeria. Similar studies that evaluated the acceptability of the malaria vaccine showed that healthcare professionals believe that the malaria vaccine will help control the spread of malaria in Nigeria (Effiong et al. 2022; Nnaji and Artac Ozdal 2023). Healthcare professionals, including pharmacists, are knowledgeable about the deleterious effects of malaria and the need for a vaccine to curb its spread (Anosike et al. 2020; Ganfon et al. 2017; Gebresillassie, Howells, and Ashiru-Oredope 2023). While studies have shown the high acceptability of the malaria vaccine among family caregivers (Chukwuocha et al. 2018; Sulaiman et al. 2023), most parents still report concerns about the adverse effects of the vaccine and the inability of the vaccine to protect against malaria (Sulaiman et al. 2022). Systematic reviews that evaluated the acceptability of the malaria vaccine, safety concerns, an efficacy profile, and a poor level of awareness were identified as reasons for low acceptance (Mumtaz et al. 2023; Sulaiman et al. 2022). To address these concerns, there is a need for awareness and education campaigns on the importance of vaccines.

Pharmacists and other health workers are better positioned to disseminate vaccine information and encourage its use among the public. This is only obtainable when there is adequate trust in the vaccine's effectiveness and safety. In most African countries, pharmacists are frequently consulted for healthcare services by the public and have the potential to deliver reliable information regarding vaccines while refuting widely held misconceptions (Haymarket 2021; Tak et al. 2020). It is believed that when health professionals' trust in vaccines increases, they would recommend it to more people who would get vaccinated, leading to a reduced burden of disease and eradication of malaria in sub-Saharan Africa (Lancet 2022; Long 2019; Rosenthal 2022).

While a systematic review of similar studies has shown that age, sex, place of residence and religion could determine vaccine acceptance (Sulaiman et al. 2022), our findings showed that the pharmacists' sociodemographic characteristics did not predict their acceptability or probability of allowing the malaria vaccine to be administered to their children. This means that any public health efforts to improve the acceptability of the vaccine and reduce its hesitancy should be directed at the entire pharmacist population, irrespective of sociodemographic characteristics.

Strengths and limitations of the study

This is one of the first studies evaluating the likelihood of acceptance of the malaria vaccine among health workers in southeast Nigeria. However, some of the limitations need discussion. First, the sample size was small as the study was conducted in two teaching hospitals, which may not be representative of pharmacists in Nigeria, hence generalizations of the study findings should be treated with caution. Second, this was a cross-sectional study and responses were collected at a one-time point. Future studies should be designed to collect data at different time points to observe how risk perception and vaccine hesitancy change over time and provide a robust foundation for making informed decisions related to malaria vaccine promotion, communication strategies and resource allocation. Third, the questionnaires were self-administered. This could have led to incomplete responses as it did not provide an opportunity for the participants to seek clarification or ask for further explanation if they misunderstood the questions. Interviewer-administered questionnaire is highly recommended in future studies to clarify difficult questions and observe non-verbal cues and body

language. During the time of the study, the malaria vaccine was not yet available in southeast Nigeria. If the situation were reversed, the opinions of the participants might be different.

Implications for policy & practice

This study gives insight into the need for training and retraining of healthcare professionals about malaria vaccines and the need to sensitise the public on the benefits of complete childhood vaccination. Government and policymakers should implement educational interventions to enlighten individuals on the low health risk of WHO-certified vaccines to reduce the burden of malaria in low- and middle-income countries.

Conclusion

Our study provides insight into the acceptability and risk perception of the malaria vaccine among hospital pharmacists. Despite having a few concerns about the malaria vaccine, pharmacists were willing to recommend it to families and patients. Some of the concerns raised were the failure of the vaccine, possible adverse effects on health and poor storage facilities and handling conditions when these vaccines are delivered in Nigeria. Pharmacists' demographic characteristics were unable to predict whether they would accept the malaria vaccine or allow their children to be vaccinated with it.

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Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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