Determinants of Malaria Vaccine Acceptance Among Caregivers of Under 5 Children in Kisumu East Sub-County, Kisumu, Kenya

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ABSTRACT

Malaria remains a major public health challenge in Kenya, particularly among children under five years, despite the introduction of the malaria vaccine as part of routine immunization. Caregiver acceptance is critical to achieving high vaccine uptake and maximizing the vaccine's public health impact. This study examined the determinants of malaria vaccine acceptance among caregivers of children under five years in Kisumu East Sub-County, Kenya, focusing on socio-demographic, health system, and knowledge and perception factors. An analytic cross-sectional mixed-methods study was conducted among 387 caregivers selected through systematic random sampling from public health facilities. Quantitative data were collected using structured questionnaires and analyzed using descriptive statistics, chi-square tests, and multivariable logistic regression, while qualitative data from Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) were analyzed thematically. Malaria vaccine acceptance was high, with 86.6% of caregivers reporting that their children had received the vaccine. In multivariable analysis, male caregivers were significantly less likely to accept the vaccine than female caregivers (AOR = 0.066, $p < 0.001$). Health system barriers reduced vaccine acceptance (AOR = 0.107, $p = 0.003$), whereas receiving vaccine information from community leaders (AOR = 55.989, $p = 0.030$) and awareness of vaccine side effects (AOR = 12.97, $p = 0.011$) significantly increased acceptance. Age and education were not significant predictors in the adjusted model. Qualitative findings highlighted trust in healthcare providers, community engagement, and service accessibility as key facilitators, while long waiting times and occasional vaccine stock-outs hindered uptake. Strengthening male involvement, improving service delivery, and leveraging community leadership structures could further enhance malaria vaccine acceptance and uptake.

Keywords: malaria vaccine, vaccine acceptance, caregivers, RTS, S/AS01

INTRODUCTION

Malaria remains one of the leading causes of illness and death among children under five years in sub-Saharan Africa. The World Health Organization (WHO) estimated 263 million malaria cases and 597,000 deaths globally in 2023, with the African Region accounting for 94% of cases and 95% of deaths. Children under five represented approximately 76% of malaria-related deaths. Kenya continues to experience substantial malaria transmission, particularly in the lake endemic region that includes Kisumu County. Kisumu East Sub-County is therefore an important setting for evaluating malaria vaccine acceptance among caregivers of young children. (WHO, 2024; KMIS, 2022)

Conventional malaria prevention strategies, including insecticide-treated nets, indoor residual spraying, larval source management, and prompt diagnosis and treatment, have substantially reduced malaria transmission over the years. However, the effectiveness of these interventions has been threatened by challenges such as insecticide resistance, parasite resistance to antimalarial drugs, and operational constraints, necessitating complementary interventions (WHO, 2024). Consequently, malaria vaccination has emerged as an important addition to existing

malaria control measures. The RTS, S/AS01 malaria vaccine, evaluated in large-scale Phase III clinical trials conducted between 2009 and 2014, demonstrated significant efficacy by reducing clinical malaria episodes by more than 50% during the first year after vaccination and lowering severe malaria cases and malaria-related mortality among children living in moderate- to high-transmission settings (WHO, 2024; PATH, 2023). Based on evidence from pilot implementation programmes in Kenya, Ghana, and Malawi, the World Health Organization recommended the inclusion of RTS, S/AS01 in routine childhood immunization programmes in areas with moderate to high malaria transmission (WHO, 2023).

Kenya introduced the RTS, S/AS01 malaria vaccine into its routine immunization programme in 2019 through the National Vaccines and Immunization Programme (NVIP) in collaboration with the Division of National Malaria Programme (DNMP), targeting selected sub-counties within the lake endemic region. The programme has since expanded to additional sub-counties, with the Ministry of Health reporting substantial reductions in severe malaria, child hospitalizations, and malaria-related deaths following vaccine introduction (MoH, 2023). Currently, the vaccine is administered free of charge in four doses at 6, 7, 9, and 24 months of age as part of Kenya's routine immunization schedule (MoH, 2023).

Despite the demonstrated effectiveness and availability of the malaria vaccine, its public health impact depends largely on caregiver acceptance. Vaccine acceptance refers to caregivers' willingness to have their children vaccinated and to comply with recommended vaccination schedules (Betsch et al., 2018). Acceptance is a complex behavioural construct influenced by multiple factors, including socio-demographic characteristics, health system performance, knowledge, perceptions, cultural beliefs, and trust in healthcare services (Chukwuocha et al., 2018). Previous studies have reported considerable geographical variation in malaria vaccine acceptance, with socio-demographic characteristics, healthcare accessibility, vaccine availability, quality of health services, caregiver knowledge, and perceptions consistently identified as important determinants (Ojakaa et al., 2014; Jing et al., 2022; Robl et al., 2023). For instance, a study conducted in Guinea and Sierra Leone found that caregivers residing in remote areas and those with limited knowledge of malaria were less likely to accept malaria vaccination than their counterparts in urban settings (Robl et al., 2023).

Although studies conducted in Kenya have reported generally high malaria vaccine acceptance, most have focused on overall acceptance levels or vaccine efficacy and have paid limited attention to the contextual factors influencing caregivers' decisions in specific malaria-endemic settings. Furthermore, existing evidence has largely emphasized vaccine availability and cost while providing limited insight into the role of healthcare provider engagement, caregiver trust in the health system, community information sources, and socio-cultural influences on vaccine acceptance. Such localized evidence is particularly important in Kisumu County, where malaria transmission remains high and unique contextual factors may influence caregivers' decisions regarding childhood vaccination.

This study was therefore undertaken to determine the socio-demographic, health system, and knowledge and perception determinants of malaria vaccine acceptance among caregivers of children under five years in Kisumu East Sub-County. Understanding these determinants is essential for informing context-specific interventions aimed at improving caregiver acceptance, strengthening routine immunization programmes, and ultimately reducing malaria-related morbidity and mortality among children in malaria-endemic regions of Kenya.

METHODOLOGY

Study Design

The study adopted an analytic cross-sectional mixed-methods to assess the determinants of malaria vaccine acceptance among caregivers of children under five years in Kisumu East Sub-County, Kisumu County, Kenya. The quantitative component examined associations between socio-demographic, health system, and caregiver knowledge and perception factors and malaria vaccine acceptance, while the qualitative component explored contextual factors influencing caregivers' vaccination decisions through focus group discussions (FGDs) and key

informant interviews (KIIs). The mixed-methods approach enabled triangulation of findings, thereby enhancing the validity and comprehensiveness of the study

Study duration and Period

The study spanned from March 2025 to January 2026 with data collection occurring between September 2025 and December 2025 while data cleaning, analysis, and report writing were completed between January 2026 and March 2026.

Study Area

The study was conducted in Kisumu East Sub-County, one of the seven sub-counties in Kisumu County, western Kenya. Kisumu County lies within the Lake Victoria malaria-endemic zone, where malaria transmission is perennial with seasonal peaks. Kisumu East comprises both urban and peri-urban populations and is served by several public health facilities that provide routine childhood immunization services, including the RTS, S/AS01 malaria vaccine under Kenya's National Immunization Programme. The sub-county was selected because of its high malaria burden and ongoing implementation of routine malaria vaccination, making it an appropriate setting for investigating determinants of vaccine acceptance.

Study Population

The study population comprised caregivers of children aged 0–59 months residing in Kisumu East Sub-County. Caregivers included biological parents or legal guardians responsible for making healthcare decisions for eligible children. According to the Kisumu County Department of Health, approximately 34,198 caregivers of children under five resided in the sub-county during the study period. Secondary participants consisted of healthcare providers involved in malaria vaccination services, including nurses and Community Health Promoters (CHPs), who participated in qualitative interviews to provide perspectives on health system and community-level determinants of vaccine acceptance. Caregivers temporarily visiting the sub-county or those unable to participate because of illness at the time of data collection were excluded from the study.

Sample Size and Sampling Techniques

Sample Size Determination

The sample size for the quantitative survey was calculated using Fisher's formula for populations greater than 10,000, assuming a 95% confidence level ($Z = 1.96$), an expected proportion of 50%, and a margin of error of 5%. The minimum sample size obtained was 385 participants. To account for possible non-response and incomplete questionnaires, an additional 10% (39 participants) was added, giving a target sample size of 424 caregivers, however, during fieldwork, 412 eligible caregivers were successfully recruited. For the qualitative component, purposive sampling was used to recruit five Community Health Promoters and two nurses for key informant interviews, while three focus group discussions comprising six caregivers each were conducted across urban, peri-urban, and rural settings to capture diverse community perspectives.

Sampling Technique

A multistage sampling strategy was employed. First, Probability Proportional to Size (PPS) sampling was used to allocate the minimum required sample of 385 caregivers across the five administrative wards of Kisumu East Sub-County based on the population of children under five years. Subsequently, systematic random sampling was used to recruit caregivers from clinic registers maintained by public health facilities providing malaria vaccination services. To reduce selection bias associated with facility-based recruitment, Community Health Promoters assisted in identifying eligible caregivers within communities, and household surveys were conducted in randomly selected community clusters. Healthcare providers participating in the qualitative study were selected purposively based on their direct involvement in malaria immunization service.

Table 1: Distribution of the minimum quantitative sample across the five wards using probability proportional to size (PPS)

No	Ward	Population	Sample Size
1	Kolwa East	4,851	55
2	Manyatta	6,374	72
3	Nyalenda A	6,441	72
4	Kajulu	9,317	105
5	Kolwa Central	7,232	81
	Total	34,215	385

Data Collection Tools and Procedures

Data Collection Tools

Quantitative data were collected using a structured interviewer-administered questionnaire developed from published literature and aligned with the study objectives. The questionnaire captured information on caregivers' socio-demographic characteristics, malaria vaccine acceptance, health system experiences, and knowledge and perceptions regarding malaria vaccination. Qualitative data were collected using semi-structured interview guides during key informant interviews and focus group discussions. Key informants included nurses and Community Health Promoters involved in immunization services, while FGDs explored caregivers' beliefs, experiences, barriers, facilitators, and suggestions for improving malaria vaccine uptake. All discussions were conducted by trained research personnel in a private setting and audio-recorded with participants' consent.

Validity and Reliability

The questionnaire was pretested among caregivers outside the study area to assess clarity, reliability, and completeness. Internal consistency was evaluated using Cronbach's alpha, with a coefficient of at least 0.70 considered acceptable. Face and content validity were established through expert review by faculty members from the School of Public Health and Community Development, Maseno University. Data collectors received standardized training before fieldwork, and completed questionnaires were checked daily for completeness and consistency by the research team.

Data analysis

Quantitative data were entered, cleaned, and analyzed using Stata version 18. Descriptive statistics were computed and summarized as frequencies and percentages. Associations between independent variables and malaria vaccine acceptance were assessed using Pearson's chi-square tests. Variables associated with malaria vaccine acceptance at the bivariate level were entered into multivariable logistic regression models to identify independent predictors of vaccine acceptance. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported, and statistical significance was set at $p < 0.05$. Qualitative data from interviews and focus group discussions were transcribed verbatim and analyzed using thematic analysis. Codes were developed inductively and grouped into broader themes that complemented the quantitative findings through methodological triangulation

Ethical Considerations

Ethical approval for the study was obtained from the Maseno University Ethics Review Committee, and research authorization was granted by the National Commission for Science, Technology and Innovation (NACOSTI). Written informed consent was obtained from all participants before data collection. Participation was voluntary, and respondents were informed of their right to decline participation or withdraw at any stage without

consequences. Confidentiality was maintained by assigning unique identification codes instead of personal identifiers, and all electronic and paper records were securely stored with access restricted to the research team

RESULTS

Participant Characteristics

A total of 412 caregivers were approached to participate in the study, of whom 387 completed the survey, yielding a response rate of 93.9%. Additionally, qualitative data were collected through seven key informant interviews comprising five Community Health Promoters and two nurses, and three focus group discussions involving caregivers from urban, peri-urban, and rural settings.

Malaria vaccine acceptance

Among the 387 caregivers interviewed, 335 (86.6%) reported that their eligible child had received the malaria vaccine, whereas 52 (13.4%) reported that their child had not been vaccinated (Table 2). These findings demonstrate a high level of malaria vaccine acceptance among caregivers in Kisumu East Sub-County.

Table 2 :Tabulation of Vaccine Acceptance

Has your child received the malaria vaccine?	Freq.	Percent
No	52	13.44
Yes	335	86.56
Total	387	100.00

Socio-Demographic Characteristics

Most caregivers were aged 20–29 years (53.8%), followed by those aged 30–39 years (28.4%). Females constituted 88.6% of respondents, reflecting the predominant role of mothers in child healthcare and immunization. Nearly half (46.0%) had attained secondary education, while 20.9% had tertiary education. Most caregivers (77.3%) reported being unemployed.

Table 3a; Socio-demographic characteristics of caregivers (n=387)

Variable		**Freq**	**Percent (N=387)**
Age	20-29 years	208	53.75
	30-39 years	110	28.42
	40-49 years	32	8.27
	50 years and above	13	3.36
	Under 20 years	24	6.2
Gender	Female	343	88.63
	Male	44	11.37
Highest education attainment	Tertiary education (college/university)	81	20.93
Occupation	Employed	88	22.74
	Unemployed	299	77.26

Association between socio-demographic characteristics and malaria vaccine acceptance

Bivariate analysis showed statistically significant associations between caregiver age, sex, occupation, and malaria vaccine acceptance (Table 3). Caregivers aged 20–29 years recorded the highest vaccination rates, whereas those aged 50 years and above demonstrated comparatively lower acceptance ($\chi^2 = 11.50$, $p = 0.022$). Gender was strongly associated with vaccine acceptance ($\chi^2 = 57.06$, $p < 0.001$). Female caregivers were substantially more likely to have vaccinated their children than male caregivers. Occupation was also significantly associated with vaccine acceptance ($\chi^2 = 10.65$, $p = 0.001$), with unemployed caregivers reporting higher vaccination rates than employed caregivers. In contrast, caregiver education level was not significantly associated with malaria vaccine acceptance ($\chi^2 = 0.87$, $p = 0.833$).

Table 3b. Bivariate association between socio-demographic characteristics and malaria vaccine acceptance

Variable		COR	p-value	[95% C.I)
Age	20-29 years	ref	.	.
	30-39 years	0.591	0.146	0.29-1.201
	40-49 years	0.359	0.037	0.137-0.939
	50 years and above	0.226	0.022	0.064-0.804
	Under 20 years	0.302	0.024	0.107-0.851
Gender	Female	ref	.	.
	Male	0.096	<0.001	0.048-0.193
Education	No formal education	ref		
	Primary education	1.633	0.485	0.412-6.472
	Secondary education	1.773	0.403	0.463-6.781
	Tertiary education	1.438	0.613	0.352-5.864
Occupation status	Employed	ref	.	.
	Unemployed	2.71	0.001	1.465-5.013

Health system factors associated with malaria vaccine acceptance

Most caregivers perceived malaria vaccination services to be accessible, with 42.4% reporting that health facilities were accessible and 21.7% reporting them to be very accessible. More than half (51.4%) indicated that the malaria vaccine was consistently available at health facilities, while 93.0% reported that vaccination was provided free of charge. Among caregivers who incurred costs, the majority considered these costs affordable. Trust in healthcare providers was generally high, with 63.8% reporting high or very high levels of confidence in healthcare workers delivering malaria vaccination services. Qualitative findings reinforced these observations, with participants consistently identifying healthcare workers as their most trusted source of vaccine information and emphasizing that respectful interactions and consistent vaccine availability encouraged continued utilization of immunization services.

Table 4; Association Between Health System Factors and vaccine acceptance among caregivers

Variable		COR	p-value	[95% CI)
Health facilities accessibility	Accessible	Ref	.	.
	Inaccessible	1.884	0.145	0.804-4.417
	Neutral	0.549	0.123	0.256-1.176
Availability of malaria	Available	Ref	.	.

vaccines	Sometimes available	0.562	0.067	0.303-1.041
	Unavailable	0.346	0.058	0.116-1.037
Costs associated with receiving the vaccine	No	Ref	.	.
	Yes	0.225	0.001	0.096-0.523
Affordability of costs associated with vaccine	Affordable	Ref	.	.
	Neutral	0.057	0	0.027-0.119

Knowledge and Perception factors associated with malaria vaccine acceptance

The study assessed caregivers' knowledge and perceptions regarding the malaria vaccine and their association with malaria vaccine acceptance. Overall, caregivers demonstrated a high level of awareness of the malaria vaccine, with most respondents reporting that they had previously received information about the vaccine, its benefits, vaccination schedule, and possible side effects. Healthcare workers emerged as the primary source of vaccine information, although community leaders, Community Health Promoters, the media, and social networks also contributed to information dissemination. Caregivers who had heard about the malaria vaccine, understood its benefits, were aware of the recommended vaccination schedule, and had knowledge of possible vaccine side effects were significantly more likely to accept malaria vaccination than those with limited knowledge. Similarly, caregivers who perceived the vaccine as safe and effective, trusted information provided by healthcare workers, and believed that malaria vaccination protects children against severe malaria demonstrated significantly higher levels of vaccine acceptance.Caregivers who got information from community leaders were 64 times more likely to accept vaccination (p = 0.003),Information from healthcare providers also increased acceptance (~6.3 times), though without statistical significance (p = 0.069) and Awareness of side effects strongly increased acceptance (OR = 15.6, p < 0.001).

Table 5; Association between knowledge and perception factors and malaria vaccine acceptance

Variable		**COR**	**p-value**	**95% CI**
Source of information	Friends/Family	ref	.	.
	Community leaders	64	0.003	3.96-1034.32
	Healthcare providers	6.343	0.069	0.865-46.5
	Religious leaders	0.2	0.278	0.011-3.661
	Social media	3.556	0.235	0.438-28.886
Vaccination misinformation	No	ref	.	.
	Yes	6.589	0.01	1.564-27.754
vaccination side effects	No	ref	.	.
	Yes	15.63	<0.001	3.732-65.432

Independent Predictors of Malaria Vaccine Acceptance among caregivers of children under 5 years

A multivariable logistic regression analysis was performed to identify the independent predictors of malaria vaccine acceptance after controlling for potential confounders. Male caregivers were significantly less likely to accept malaria vaccination than female caregivers (AOR = 0.066; 95% CI: 0.02–0.28; $p < 0.001$). Caregivers who incurred indirect costs while accessing vaccination were also less likely to accept malaria vaccination (AOR

= 0.107; 95% CI: 0.03–0.46; p = 0.003), while those who perceived vaccination costs as only moderately affordable ("neutral") had significantly lower odds of vaccine acceptance than those who considered the costs affordable (AOR = 0.070; 95% CI: 0.02–0.21; $p < 0.001$).Knowledge and perception factors were also significant predictors. Caregivers who received malaria vaccine information from community leaders had substantially higher odds of accepting vaccination than those who relied on friends or family members (AOR = 55.99; 95% CI: 1.48–2118.91; $p = 0.030$). Likewise, awareness of malaria vaccine side effects was associated with increased odds of vaccine acceptance (AOR = 12.97; 95% CI: 1.81–92.94; $p = 0.011$). Conversely, although exposure to vaccination misinformation appeared to increase the odds of vaccine acceptance (AOR = 4.733), the association was not statistically significant (95% CI: 0.63–35.65; p = 0.131). Therefore, misinformation was not an independent predictor of malaria vaccine acceptance after controlling for other variables. Overall, the multivariable analysis demonstrated that caregiver gender, indirect costs associated with accessing vaccination, perceived affordability, receiving vaccine information from community leaders, and awareness of malaria vaccine side effects were the key independent predictors of malaria vaccine acceptance among caregivers of children under five years in Kisumu East Sub-County, while caregiver age, employment status, other sources of vaccine information, and exposure to misinformation were not independently associated with vaccine acceptance.

Table 6; Independent Predictors of Malaria Vaccine Acceptance among caregivers of children under 5 years

Variable		AOR	p-value	95% CI
Age	20-29 years	ref	.	.
	30-39 years	0.728	0.631	0.2-2.65
	40-49 years	0.272	0.149	0.05-1.6
	50 years & above	2.01	0.582	0.17-24.11
	Under 20 years	0.467	0.414	0.08-2.9
Gender	Female	ref	.	.
	Male	0.066	0	0.02-0.28
Employment status	Employed	ref	.	.
	Unemployed	1.609	0.454	0.46-5.86
Costs associated with receiving the vaccine	No	ref	.	.
	Yes	0.107	0.003	0.03-0.46
Affordability of costs associated with vaccine	Affordable	ref	.	.
	Neutral	0.07	0	0.02-0.21
Source of information	Friends/Family	ref	.	.
	Community leaders	55.989	0.03	1.48-2118.91
	Healthcare providers	4.848	0.269	0.3-79.77
	Religious leaders	0.082	0.405	0-29.47
	Social media	2.445	0.583	0.1-59.67
Vaccination misinformation	No	ref	.	.
	Yes	4.733	0.131	0.63-35.65
vaccination side effects	No	ref	.	.
	Yes	12.97	0.011	1.81-92.94

Qualitative Findings on the Determinants of malaria vaccine acceptance

The qualitative findings complemented the quantitative results by providing contextual explanations for the factors influencing malaria vaccine acceptance among caregivers in Kisumu East Sub-County. Four major themes emerged: gender roles in child healthcare decision-making, health system barriers, community influence and trusted information sources, and knowledge, counselling, and trust in healthcare providers. These themes

illustrate that malaria vaccine acceptance is shaped by a complex interaction of individual, community, and health system factors.

Table 6; Major Themes Emerging from KIIs and FGDs

Major Theme	Description	Illustrative Quote
Gender roles in child healthcare decision-making	Mothers were primarily responsible for taking children for immunization and making decisions regarding vaccination. Limited male involvement sometimes delayed vaccine uptake, particularly where fathers were the principal household decision-makers.	*"Immunization is mostly done by mothers because they attend clinics more than fathers."* (Nurse, KII)
Health system barriers	Long waiting times, occasional vaccine stock-outs, transport costs, and inadequate staffing discouraged some caregivers from completing malaria vaccination schedules despite positive attitudes towards the vaccine.	*"Sometimes the vaccine is not available when you go to the facility."* (Caregiver, FGD) *"If you are working, it is difficult to spend the whole day at the clinic."* (Caregiver, FGD)
Community influence and trus	Community leaders and Community Health Promoters played an important role in mobilizing caregivers, addressing misconceptions, and promoting confidence in malaria vaccination through community engagement activities.	*"People believe the information more when it comes through the village elders or community health promoters because they know us."* (Community Health Promoter, KII)

DISCUSSION

This study examined the determinants of malaria vaccine acceptance among caregivers of children under five years in Kisumu East Sub-County. Overall, malaria vaccine acceptance was high (86.6%), suggesting that the introduction of the RTS, S/AS01 malaria vaccine has been largely embraced by caregivers in this malaria-endemic setting. The high level of acceptance observed in this study may reflect sustained community sensitization, increased awareness of the burden of malaria, and growing confidence in routine childhood immunization services. Given that Kisumu County experiences perennial malaria transmission and recurrent malaria-related morbidity among children, caregivers are likely to perceive malaria vaccination as an important preventive intervention. This finding suggests that communities experiencing a high burden of malaria may be more receptive to preventive innovations that are perceived to reduce childhood illness and death.

Determinants Of Malaria Vaccine Acceptance

Socio-demographic factors: The study found that male caregivers were significantly less likely than female caregivers to accept malaria vaccination for their children. This finding suggests that mothers remain the primary decision-makers regarding childhood immunization within the study setting. It is likely that women possess greater knowledge and confidence regarding routine childhood vaccines because they are more frequently exposed to maternal and child health services during antenatal care, postnatal care, and child welfare clinics. In contrast, men may have fewer opportunities to receive accurate vaccine information, potentially limiting their participation in vaccination decisions. This finding is consistent with studies conducted in Kenya, Ghana, and

Malawi, which have similarly reported greater maternal involvement in childhood immunization and higher vaccine acceptance among female caregivers. However, the present study extends this evidence by demonstrating that the gender disparity persists even after controlling for health system and knowledge-related factors, suggesting that male involvement should be considered an important component of future malaria vaccination strategies. This finding is consistent with studies conducted in Kenya, Ghana, and Malawi, which have similarly reported greater maternal involvement in childhood immunization and higher vaccine acceptance among female caregivers. However, the present study extends this evidence by demonstrating that the gender disparity persists even after controlling for health system and knowledge-related factors, suggesting that male involvement should be considered an important component of future malaria vaccination strategies. Contrary to expectations, education level was not independently associated with malaria vaccine acceptance. This finding is encouraging because it suggests that malaria vaccine information has reached caregivers across different educational levels through routine health education and community sensitization activities. It also implies that the decision to vaccinate may be driven more by trust in health services than by formal educational attainment. Similar findings have been reported in several implementation studies where community-based health education successfully minimized educational inequalities in vaccine uptake.

Health system determinants: Health system factors emerged as important determinants of malaria vaccine acceptance. Caregivers who experienced barriers such as vaccine stock-outs, long waiting times, transport difficulties, and staff shortages were significantly less likely to vaccinate their children. These findings demonstrate that caregiver willingness alone is insufficient to achieve optimal vaccine coverage if health services are unable to provide timely and reliable immunization services. These findings underscore the importance of viewing vaccine acceptance as a continuum that extends beyond individual attitudes. A caregiver who is motivated to vaccinate a child may still fail to complete the vaccination schedule if repeated visits are disrupted by stock-outs or prolonged waiting times. Such experiences may gradually erode confidence in the health system and discourage future utilization of immunization services. The qualitative findings reinforce this interpretation, with caregivers describing missed vaccination opportunities due to vaccine unavailability and lengthy clinic waiting times. Healthcare providers similarly acknowledged that occasional stock-outs and inadequate staffing affected service delivery. These findings are consistent with previous studies in sub-Saharan Africa that have identified health system performance as a critical determinant of vaccine uptake

Knowledge and perception determinants: The study found that caregivers who were aware of possible malaria vaccine side effects were significantly more likely to accept vaccination. At first glance, this finding appears counterintuitive because knowledge of side effects is often associated with increased vaccine hesitancy. However, the qualitative findings provide an important explanation. This finding serves as evidence of effective counselling by healthcare providers. Rather than creating fear, discussions regarding expected mild side effects appeared to reassure caregivers by improving transparency and building trust in the vaccination process. Caregivers expressed confidence that healthcare workers had adequately prepared them for possible post-vaccination reactions, enabling them to distinguish expected side effects from serious adverse events. This interpretation aligns with behavioural theories such as the Health Belief Model, which suggests that individuals are more likely to adopt preventive health behaviors when they perceive the benefits to outweigh the perceived barriers and when they receive sufficient cues to action. The study also found that caregivers who received vaccine information from community leaders were substantially more likely to accept malaria vaccination. This finding demonstrates the continued influence of trusted community structures in shaping health behaviours. In many communities within Kisumu East Sub-County, community leaders, village elders, and Community Health Promoters serve as credible intermediaries between health facilities and households. Their endorsement of malaria vaccination may therefore reinforce confidence in the vaccine and address community concerns more effectively than facility-based communication alone. Interestingly, Exposure to misinformation did not remain statistically significant after adjustment. This finding suggests that misinformation itself was not an independent determinant of malaria vaccine acceptance. Rather, caregivers who encountered misinformation may have sought clarification from healthcare providers and Community Health Promoters, thereby reducing its negative influence. The qualitative findings support this explanation, as participants consistently identified healthcare workers as trusted sources of accurate vaccine information.

Study Limitations

This study has several limitations that should be considered when interpreting the findings. The use of an analytic cross-sectional study design limited the ability to establish causal relationships between the identified determinants and malaria vaccine acceptance. The study captured caregivers' views and experiences at a single point in time; therefore, temporal changes in attitudes and acceptance could not be assessed. Data on vaccine acceptance, knowledge, perceptions, and health system experiences were self-reported by caregivers. As such, the findings may have been influenced by social desirability bias, with some respondents providing responses they perceived to be acceptable to the interviewer, particularly because vaccination is a recommended public health intervention. Additionally, recall bias may have occurred when caregivers were asked to remember previous vaccination experiences or sources of vaccine information. While the mixed-methods design enhanced understanding of the findings through triangulation, the qualitative component involved a relatively small number of key informants and focus group participants. Although thematic saturation was achieved, the qualitative findings may not capture the full diversity of views among all caregivers and healthcare providers. Despite these limitations, the study has several strengths. The use of a mixed-methods approach enabled triangulation of quantitative and qualitative findings, providing a comprehensive understanding of the determinants of malaria vaccine acceptance. The high response rate enhanced the reliability of the findings, while the application of multivariable logistic regression allowed for the identification of independent predictors after controlling for potential confounders. These strengths increase confidence in the validity and applicability of the study findings for informing malaria vaccination programmes in similar malaria-endemic settings.

CONCLUSION

Malaria vaccine acceptance among caregivers of children under five years in Kisumu East Sub-County was high, reflecting substantial community confidence in the RTS, S/AS01 malaria vaccine. However, acceptance was significantly influenced by caregiver gender, health system barriers, perceived affordability of vaccination, trusted community information sources, and awareness of vaccine side effects. The findings indicate that improving malaria vaccine uptake requires more than ensuring vaccine availability. Strengthening health system performance, promoting male involvement in child health, enhancing caregiver counselling, and leveraging trusted community leadership structures are critical strategies for sustaining high vaccine acceptance and achieving optimal vaccination coverage in malaria-endemic settings.

RECOMMENDATIONS

The Ministry of Health and the Kisumu County Department of Health should strengthen male involvement in routine childhood immunization by developing targeted health education programmes that encourage fathers to participate in antenatal, postnatal, and child welfare clinics. Community Health Promoters (CHPs) and local administrators should also promote couple-based health education and community dialogue forums to foster shared decision-making on childhood immunization. The Ministry of Health and Kisumu County Department of Health should strengthen routine immunization services by ensuring uninterrupted vaccine availability, adequate staffing, reduced waiting times, and regular supportive supervision of health facilities. In addition, the County Health Department should expand outreach immunization services and strengthen community-based vaccination programmes to reduce transport costs and improve access for caregivers residing in underserved areas. The Sub-County Health Management Team should collaborate with Community Health Promoters, village elders, religious leaders, and other community opinion leaders to deliver consistent, evidence-based information on malaria vaccination. Healthcare providers should continue providing comprehensive counselling on the benefits, vaccination schedule, expected side effects, and safety of the malaria vaccine during every immunization visit to build caregiver confidence and address misconceptions before they influence vaccination decisions. Future studies should adopt longitudinal or cohort study designs to assess factors influencing completion of the four-dose RTS, S/AS01 malaria vaccination schedule and long-term caregiver acceptance. Further research should also explore determinants of malaria vaccine acceptance among fathers and other household decision-makers, as well as evaluate the effectiveness of community-based interventions aimed at increasing male involvement and improving uptake and completion of malaria vaccination in endemic settings.

Declarations

This manuscript is original and has not been published or submitted elsewhere. All sources have been appropriately cited.

There were no conflicts of interest in this work.

Consent For Publication

Not Applicable

Availability of Data And Materials

The data generated and analyzed from this study are available from the corresponding author upon request.

Competing Interests

No competing interests among the authors

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REFERENCES

1. Abdulkadir, B. I., & Ajayi, I. O. (2015). Willingness to accept malaria vaccine among caregivers of under-5 children in Ibadan North Local Government Area, Nigeria. Malaria World J, 6(2).
2. Alkhawaja, S. O. and Albaity, M. (2020). Retirement saving behaviour: evidence from uae. Journal of Islamic Marketing, 13(2), 265-286. https://doi.org/10.1108/jima-03-2020-0072
3. Al-Mohaithef, M. and Padhi, B. K. (2020). <p>determinants of covid-19 vaccine acceptance in saudi arabia: a web-based national survey</p>. Journal of Multidisciplinary Healthcare, Volume 13, 1657-1663. https://doi.org/10.2147/jmdh.s276771
4. Alqudeimat, Y., Alenezi, D., AlHajri, B., Alfouzan, H., Almokhaizeem, Z., Altamimi, S., … & Ziyab, A. H. (2021). Acceptance of a covid-19 vaccine and its related determinants among the general adult population in Kuwait. Medical Principles and Practice, 30(3), 262-271. https://doi.org/10.1159/000514636

5. Arce, J., Warren, S., Meriggi, N., Scacco, A., McMurry, N., Voors, M., … & Omer, S. (2021). Covid-19 vaccine acceptance and hesitancy in low- and middle-income countries. Nature Medicine, 27(8), 1385-1394. https://doi.org/10.1038/s41591-021-01454-y
6. Asmare, G. Willingness to accept malaria vaccine among caregivers of under-5 children in Southwest Ethiopia: a community based cross-sectional study. Malar J 21, 146 (2022). https://doi.org/10.1186/s12936-022-04164-z
7. Azeem, M. W. (2022). A modified version of diagonal systematic sampling in the presence of linear trend. Plos One, 17(3), e0265179. https://doi.org/10.1371/journal.pone.0265179
8. Bam, V., Mohammed, A., Kusi-Amponsah, A., Armah, J., Lomotey, A. Y., Budu, H. I., Atta Poku, C., Kyei-Dompim, J., & Dwumfour, C. (2023). Caregivers' perception and acceptance of malaria vaccine for Children. PloS one, 18(7), e0288686. https://doi.org/10.1371/journal.pone.0288686
9. Bekalu, M. A., Minsky, S., & Viswanath, K. (2016, 7 15). Beliefs about smoking-related lung cancer risk among low socioeconomic individuals: the role of smoking experience and interpersonal communication. Global Health Promotion, 1(6), 1-6. doi:10.1177/1757975917732758
10. Betsch, C., Schmid, P., Heinemeier, D., Korn, L., Holtmann, C., Böhm, R. (2018). Beyond Confidence: Development Of a Measure Assessing The 5c Psychological Antecedents Of Vaccination. PLoS ONE, 12(13), e0208601. https://doi.org/10.1371/journal.pone.0208601
11. Bisi-Onyemaechi, A., Chikani, U. N., & Nduagubam, O. C. (2018). Reducing incidence of cervical cancer: knowledge and attitudes of caregivers in nigerian city to human papilloma virus vaccination. Infectious Agents and Cancer, 13(1). https://doi.org/10.1186/s13027-018-0202-9
12. Boualam, M., Scola, B., Drancourt, M., Barbieri, R. (2021). Malaria In Europe: a Historical Perspective. Front. Med., (8). https://doi.org/10.3389/fmed.2021.691095
13. Bryman, A. (2012). Social Research Methods (4 ed.). Oxford: Oxford University Press. Retrieved 8 9, 2018
14. Budu, E., Darteh, E., Seidu, A., & Dickson, K. (2020). Trend and determinants of complete vaccination coverage among children aged 12-23 months in ghana: analysis of data from the 1998 to 2014 ghana demographic and health surveys. Plos One, 15(10), e0239754. https://doi.org/10.1371/journal.pone.0239754
15. Bukhari, S. A. R. (2021). Sample size determination using krejcie and morgan table.. https://doi.org/10.13140/rg.2.2.11445.19687
16. Chukwuocha, U., Okorie, P., Iwuoha, G., Ibe, S., Dozie, I., Nwoke, B. (2018). Awareness, Perceptions and Intent To Comply with The Prospective Malaria Vaccine In Parts Of South Eastern Nigeria. Malar J, 1(17). https://doi.org/10.1186/s12936-018-2335-0
17. Cooper, S., Rooyen, H., Wiysonge, C. (2021). Covid-19 Vaccine Hesitancy In South Africa: How Can We Maximize Uptake Of Covid-19 Vaccines?. Expert Review of Vaccines, 8(20), 921-933. https://doi.org/10.1080/14760584.2021.1949291
18. Dawadi, S., Shrestha, S., & Giri, R. A. (2021). Mixed-Methods Research: A Discussion on its Types, Challenges, and Criticisms. Journal of Practical Studies in Education, 2(2), 25–36. https://doi.org/10.46809/jpse.v2i2.20
19. Dimala, C. A., Kika, B. T., Kadia, B. M., & Blencowe, H. (2018). Current challenges and proposed solutions to the effective implementation of the RTS, S/AS01 Malaria Vaccine Program in sub-Saharan Africa: A systematic review. PloS one, 13(12), e0209744. https://doi.org/10.1371/journal.pone.0209744
20. Dzieciolowska, S., Hamel, D., Gadio, S., Dionne, M., Gagnon, D., Robitaille, L., … & Longtin, Y. (2021). Covid-19 vaccine acceptance, hesitancy, and refusal among canadian healthcare workers: a multicenter survey. American Journal of Infection Control, 49(9), 1152-1157. https://doi.org/10.1016/j.ajic.2021.04.079
21. Elmendorf, W.F., and A. E. Luloff. (2006)"Using key informant interviews to better understand open space conservation in a developing watershed." Journal of Arboriculture and Urban Forestry 32(2):54-61
22. European Medicines Agency (2015) Assessment report MosquirixTM International non-proprietary name: Plasmodium falciparum and hepatitis B vaccine (recombinant, adjuvant) Procedure No.

EMEA/H/W/002300/000.London: United Kingdom; https://www.ema.europa.eu/en/opinion-medicine-use-outside-EU/human/mosquirix

23. Fajar, J., Sallam, M., Soegiarto, G., Sugiri, Y., Anshory, M., Wulandari, L., … & Harapan, H. (2022). Global Prevalence and Potential Influencing Factors Of Covid-19 Vaccination Hesitancy: A Meta-analysis. Vaccines, 8(10), 1356. https://doi.org/10.3390/vaccines10081356
24. Ganczak, M., Owsianka, B., & Korzeń, M. (2018). Factors that Predict Parental Willingness to Have Their Children Vaccinated against HPV in a Country with Low HPV Vaccination Coverage. International Journal of Environmental Research and Public Health, 15(4), 645. https://doi.org/10.3390/ijerph15040645.
25. Glanz , K., Rimer , B., & Winey, V. (2008). Health Behaviour and Health Communication. San Franscisco, USA: Jossey-Bass publisher.
26. Gopaul, C., Ventour, D., Thomas, D. (2022). Covid-19 Vaccine Acceptance and Uptake Among Healthcare Workers In Trinidad &Amp; Tobago.. https://doi.org/10.1101/2022.05.09.22274854
27. Guerra, C., Gikandi, P., Tatem, A., Noor, A., Smith, D., Hay, S., … & Snow, R. (2008). The Limits and Intensity of Plasmodium Falciparum Transmission: Implications For Malaria Control and Elimination Worldwide. PLoS Med, 2(5), e38. https://doi.org/10.1371/journal.pmed.0050038
28. Immurana, M., Boachie, M., Klu, D., Dalaba, M., Manyeh, A., & Alhassan, R. (2022). Determinants of willingness to accept child vaccination against malaria in ghana. The International Journal of Health Planning and Management, 37(3), 1439-1453. https://doi.org/10.1002/hpm.3406
29. Jing, R., Fang, H., Wang, H., Wang, J. (2022). The Role Of General Attitudes and Perceptions Towards Vaccination On The Newly-developed Vaccine: Results From A Survey On Covid-19 Vaccine Acceptance In China. Frontiers in Psychology, (13). https://doi.org/10.3389/fpsyg.2022.841189
30. Jung, Sin-Ho. (2014). Stratified Fisher's Exact Test and its Sample Size Calculation. Biometrical journal. Biometrics Zeitschrift. 56. 129-40. 10.1002/bimj.201300048.
31. Kang, H.-Y., & Kim, J.-S. (2011). Knowledge, Attitudes of Human Papillomavirus Vaccine, and Intention to Obtain Vaccine Among Korean Female Undergraduate Students. Women & Health, 51(8), 759–776. https://doi.org/10.1080/03630242.2011.627091
32. Karafillakis, E., Simas, C., Jarrett, C., Verger, P., Peretti-Watel, P., Dib, F., … & Larson, H. J. (2019). Hpv Vaccination In a Context Of Public Mistrust And Uncertainty: A Systematic Literature Review Of Determinants Of Hpv Vaccine Hesitancy In Europe. Human Vaccines &Amp; Immunotherapeutics, 7-8(15), 1615-1627. https://doi.org/10.1080/21645515.2018.1564436
33. Kenya National Immunization Policy Guidelines 2023.
34. Kifle, M. M., Teklemariam, T. T., Teweldeberhan, A. M., Tesfamariam, E. H., Andegiorgish, A. K., & Kidane, E. A. (2019). Malaria risk stratification and modeling the effect of rainfall on malaria incidence in eritrea. Journal of Environmental and Public Health, 2019, 1-11. https://doi.org/10.1155/2019/7314129
35. Kisumu cidp III (2023-2027). (2023, July 27). County Government of Kisumu. https://www.kisumu.go.ke/download/kisumu-cidp-iii-2023-2027/
36. Larson, H. J., Figueiredo, A. M. d., Xiahong, Z., Schulz, W., Verger, P., Johnston, I. G., … & Jones, N. S. (2016). The state of vaccine confidence 2016: global insights through a 67-country survey. EBioMedicine, 12, 295-301. https://doi.org/10.1016/j.ebiom.2016.08.042
37. Lin, S.-Y., Zhang, S.-Y., Chantler, T., Sun, F. Y., Zou, J.-T., Cheng, J.-J., Chen, Y.-Q., Sun, M., & Howard, N. (2022). Vaccination coverage determinants in low uptake areas of China: A qualitative study of provider perspectives in Sichuan, Guangdong, and Henan Provinces. Human Vaccines & Immunotherapeutics, 18(1), 2030623. https://doi.org/10.1080/21645515.2022.2030623
38. Liu, J. X., Bousema, T., Zelman, B., Gesase, S., Hashim, R., Maxwell, C., … & Gosling, R. (2014). Is housing quality associated with malaria incidence among young children and mosquito vector numbers? evidence from korogwe, tanzania. PLoS ONE, 9(2), e87358. https://doi.org/10.1371/journal.pone.0087358
39. MacDonald, N. (2015). Vaccine hesitancy: definition, scope and determinants. Vaccine, 33(34),4161-4164. https://doi.org/10.1016/j.vaccine.2015.04.036

40. Malaria vaccines (RTS, S and R21). (2023, October 2). https://www.who.int/news-room/questions-and-answers/item/q-a-on-rts-s-malaria
41. Malik, A. A., McFadden, S. M., Elharake, J., & Omer, S. B. (2020). Determinants of COVID-19 vaccine acceptance in the US. EClinicalMedicine, 26, 100495. https://doi.org/10.1016/j.eclinm.2020.100495
42. Mudhune, V., Ondeng'e, K., Otieno, F., Otieno, D. B., Bulinda, C. M., Okpe, I., Nabia, S., Bar-Zeev, N., Otieno, O., & Wonodi, C. (2023). Determinants of COVID-19 Vaccine Acceptability among Healthcare Workers in Kenya—A Mixed Methods Analysis. Vaccines, 11(8), 1290. https://doi.org/10.3390/vaccines11081290
43. Mumtaz, H., Nadeem, A., Bilal, W., Ansar, F., Saleem, S., Khan, Q. A., Tango, T., Farkouh, C., Belay, N. F., Verma, R., Farkouh, M., & Saqib, M. (2023). Acceptance, availability, and feasibility of RTS, S/AS01 malaria vaccine: A review. Immunity, inflammation and disease, 11(6), e899. https://doi.org/10.1002/iid3.899
44. Nalinya, S., Musoke, D. & Deane, K. 31 (2022). Malaria prevention interventions beyond long-lasting insecticidal nets and indoor residual spraying in low- and middle-income countries: a scoping review. Malar J 21, https://doi.org/10.1186/s12936-022-04052-6
45. Nehal, K., Steendam, L., Ponce, M., Hoeven, M., & Smit, G. (2021). Worldwide vaccination willingness for covid-19: a systematic review and meta-analysis. Vaccines, 9(10), 1071. https://doi.org/10.3390/vaccines9101071
46. Ojakaa, D., Jarvis, J., Matilu, M., & Thiam, S. (2014). Acceptance of a malaria vaccine by caregivers
47. Okunlola, O. A. and Oyeyemi, O. T. (2019). Spatio-temporal analysis of association between incidence of malaria and environmental predictors of malaria transmission in nigeria. Scientific Reports, 9(1). https://doi.org/10.1038/s41598-019-53814-x
48. Omer, S., Salmon, D., Orenstein, W., deHart, M., Halsey, N. (2009). Vaccine Refusal, Mandatory Immunization, and The Risks Of Vaccine-preventable Diseases. New England Journal of Medicine, 19(360), 1981-1988. https://doi.org/10.1056/nejmsa0806477
49. Patwary, M. M., Bardhan, M., Disha, A. S., Hasan, M., Haque, Md. Z., Sultana, R., Hossain, Md. R., Browning, M. H. E. M., Alam, Md. A., & Sallam, M. (2021). Determinants of COVID-19 Vaccine Acceptance among the Adult Population of Bangladesh Using the Health Belief Model and the Theory of Planned Behavior Model. Vaccines, 9(12), 1393. https://doi.org/10.3390/vaccines9121393
50. Sallam, M. (2021). Covid-19 vaccine hesitancy worldwide: a concise systematic review of vaccine acceptance rates. Vaccines, 9(2), 160. https://doi.org/10.3390/vaccines9020160
51. Sekhon, M., Cartwright, M., & Francis, J. J. (2017). Acceptability of healthcare interventions: an overview of reviews and development of a theoretical framework. BMC Health Services Research, 17(1). https://doi.org/10.1186/s12913-017-2031-8
52. Skinner, C. J. (2016). Probability proportional to size (pps) sampling. Wiley StatsRef: Statistics Reference Online, 1-5. https://doi.org/10.1002/9781118445112.stat03346.pub2
53. Sulaiman, S. K., Musa, M. S., Tsiga-Ahmed, F. I., Dayyab, F. M., Sulaiman, A. K., & Bako, A. T. (2022). A systematic review and meta-analysis of the prevalence of caregiver acceptance of malaria vaccine for under-five children in low-income and middle-income countries (LMICs). PLOS ONE, 17(12), e0278224. https://doi.org/10.1371/journal.pone.0278224
54. Sultana, M., Sheikh, N., Mahumud, R. A., Jahir, T., Islam, Z., & Sarker, A. R. (2017). Prevalence and associated determinants of malaria parasites among Kenyan children. Tropical medicine and health, 45, 25. https://doi.org/10.1186/s41182-017-0066-5
55. Taber, K. S. (2017). The use of cronbach's alpha when developing and reporting research instruments in science education. Research in Science Education, 48(6), 1273-1296. https://doi.org/10.1007/s11165-016-9602-2
56. The Kenya Malaria Indicator Survey (MIS 2015) GHDx Entry last modified on: Dec 17, 2022 https://ghdx.healthdata.org/record/kenya-malaria-indicator-survey-2015
57. Vermandere, H., Naanyu, V., Mabeya, H., Vanden Broeck, D., Michielsen, K., & Degomme, O. (2014). Determinants of Acceptance and Subsequent Uptake of the HPV Vaccine in a Cohort in Eldoret, Kenya. PLoS ONE, 9(10), e109353. https://doi.org/10.1371/journal.pone.0109353

58. World Health Organization. (2022). World malaria report https://scholar.google.com/scholar_lookup?title=World%20malaria%20report%202020&publication_year=2020
59. Zumbo, B. D. and Chan, E. C. Y. (2014). Validity and validation in social, behavioural, and health sciences. Social Indicators Research Series. https://doi.org/10.1007/978-3-319-07794-9