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The Prevalence and Factors Associated with Malaria Infections among the Under Five-Year-Old Children Attending Nyamata District Hospital, Rwanda

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Abstract: **Background: Malaria remains a significant global health challenge, with an estimated 241 million cases and 627,000 deaths reported in 2020. Children under five years of age are the most vulnerable group, accounting for approximately 80% of malaria-related mortality. In Rwanda's Bugesera District, over 80,000 malaria cases were recorded in 2020, of which 38% occurred among children under five. Despite national prevention efforts, malaria continues to pose a major threat in endemic areas such as Nyamata.**

Objective: This study aimed to assess the prevalence and associated factors of malaria infection among children under five years of age attending Nyamata District Hospital, with the goal of informing more targeted interventions.

Methods: A facility-based cross-sectional study was conducted among 396 mothers of hospitalized under-five children, selected using systematic random sampling. Data were collected through a structured questionnaire and analyzed using IBM SPSS version 23. Chi-square tests and multivariate logistic regression were applied to determine associations between potential risk factors and malaria infection, with statistical significance set at $p < 0.05$.

Results: The prevalence of malaria infection among under-five children was 14.6% (58/396), significantly lower than the district average of 38% and the >30% typical in high-transmission regions of sub-Saharan Africa. Malaria infection was significantly associated with proximity to rivers (AOR = 0.406; p = 0.004) and the presence of stagnant water in household storage containers (AOR = 0.025; p = 0.001). Use of insecticide-treated bed nets (AOR = 5.631; p = 0.613) and indoor residual spraying (AOR = 9.706; p = 0.225) were not statistically significant, possibly due to inconsistent use or insecticide resistance. Household income (p = 0.004) and limited access to healthcare (AOR = 13.074; p = 0.061) also influenced malaria risk.

Conclusion: The study highlights the continued risk of malaria among under-five children in Nyamata, driven primarily by environmental and socioeconomic factors. Integrated malaria control strategies that emphasize environmental management, community awareness, improved healthcare access, and equitable distribution of prevention tools are crucial. These findings can support policymakers and health authorities in designing more effective, context-specific malaria interventions in Rwanda and similar settings.

Keywords: **(MeSH): Prevalence, Malaria Infections, Under Five-Year-Old Children, Nyamata District Hospital, Rwanda.**

1. INTRODUCTION

Malaria remains a pressing public health challenge globally, with approximately 241 million cases and 627,000 deaths recorded in 2020. Children under the age of five are disproportionately affected, accounting for around 80% of all malaria-related fatalities worldwide (WHO, 2021). This high mortality rate among young children is primarily due to their underdeveloped immune systems and limited access to preventive and curative health services, particularly in low-income regions (Snow et al., 2017). Despite ongoing global efforts to combat the disease, malaria persists as a major threat, especially in sub-Saharan Africa, where environmental and socio-economic conditions create a favorable environment for sustained transmission. According to WHO estimates, in 2020, the African continent accounted for 95% of global malaria cases and 96% of deaths. Within this region, sub-Saharan Africa faces the greatest burden due to persistent poverty, poor infrastructure, weak healthcare systems, and climatic factors that support mosquito breeding (Moyes et al., 2019).

The situation is further complicated by emerging resistance to insecticides and antimalarial drugs, which threatens to undermine progress in malaria control (Eisele et al., 2021). In East Africa, countries such as Kenya, Uganda, Tanzania, and Rwanda are recognized as endemic regions, reporting tens of millions of cases annually. Young children in these areas are especially vulnerable due to the year-round presence of malaria vectors and limited access to effective preventive tools and health services (East African Community, 2021).

Rwanda has made notable strides in reducing malaria transmission and mortality over the past two decades. Through national initiatives such as widespread distribution of insecticide-treated nets (ITNs), indoor residual spraying (IRS), the use of artemisinin-based combination therapies (ACTs), and public awareness campaigns, the country has aimed to curb malaria infections significantly (President's Malaria Initiative, 2021). Nonetheless, malaria remains a leading cause of illness and death among children under five, particularly in rural and underserved regions. In 2020, Rwanda recorded over 4.6 million malaria cases and an estimated 1,200 related deaths, with a significant proportion occurring in this age group (Ministry of Health, Rwanda, 2021).

Bugesera District, located in Rwanda's Eastern Province, exemplifies a high-transmission setting. The area reported more than 80,000 malaria cases in 2020, with 38% involving children under five years old (Bugesera District, 2023). The district's proximity to swamps, rivers, and agricultural zones contributes to the proliferation of mosquito breeding sites (Rwanda Biomedical Centre, 2021). Despite the introduction of control measures such as ITNs and IRS, many children continue to be infected, suggesting gaps in the implementation or effectiveness of these interventions (Uwimana et al., 2021). Environmental and socioeconomic dynamics—including household location near stagnant water sources, low parental education levels, and limited income—appear to be key contributing factors (Hakizimana et al., 2021).

Although Rwanda's malaria prevention strategy has included considerable investment in healthcare infrastructure and disease surveillance, a discrepancy remains between these efforts and the persistent high rates of malaria among children in districts like Bugesera. The continuing prevalence of infections among under-five children attending Nyamata District Hospital underscores the need to investigate the factors contributing to this health burden. Issues such as inconsistent utilization of preventive tools, gaps in service accessibility, and growing resistance to malaria interventions may be undermining progress. This study was conducted to assess the prevalence and underlying factors associated with malaria infections among children under five years of age attending Nyamata District Hospital. By exploring the interplay between environmental, socioeconomic, and healthcare-related determinants, the research aims to generate evidence to inform more targeted and context-specific malaria control strategies. These findings will be crucial for refining national interventions and ultimately reducing malaria-related morbidity and mortality in Rwanda's most vulnerable populations.

2. RESEARCH METHODS

Study design

The research design for this study entails a cross-sectional design with a quantitative approach, aiming to investigate determinants of malaria infection among under 5 children attending Nyamata District Hospital in Rwanda. Data are collected by asking mothers with under 5 children attending Nyamata District hospital. Key variables including malaria infection status, demographic and economic characteristics, health factors and environmental factors.

Research setting

The Nyamata District Hospital is situated in Rwanda's Eastern Province's Bugesera district. Due to its higher average daytime temperature and lower average precipitation than Rwanda, the area is more vulnerable to droughts. Nyamata District hospital is serving 15 health centers Mayange, Rilima, Juru, Mwogo, Nzangwa, Prison Rilima, Mareba, Ruhuha, Gihinga, Kamabuye, Nyarugenge, Ntarama, Gakurazo, Ngeruka, and Nyamata HC.

Study population

The target population for this study comprises mothers with under-five children attending Nyamata District Hospital in Rwanda in the period of two months (July to august-2024) where study respondents are recruited.

Sample Size and Sampling Techniques

The study sample size (n) was computed based on the following Cochran formula for a vast study population (Nanju, 2021). Where n = sample size; Z = the reliability coefficient at 95% confidence interval (1.96), P = Estimated proportion was 38%. According under 5 malaria prevalence in Bugesera District (Bugesera District, 2023). q = 1- p = (0.62); d = margin error or level of precision (5%). Due to the deficient of studies done in this topic in the study area. Then the following formula is applied: n = Z * Z [p (1-p)/ (d*d)] =1.960 * 1.960 [0.38(1 - 0.38) / (0.05 * 0.05)] =384.16≈362 So, 10% were added for covering non-response bias and the sample size were raised to 396 participants who is recruited as sample size of mothers with under five children attending Nyamata District Hospital. Simple random sampling was used in this study to choose participants from among the mothers of children under five who visit Rwanda's Nyamata District Hospital. Initially, a sampling plan were created relying on all hospitalized children in pediatric ward and incoming patients in pediatric Outpatient Department (OPD). Subsequently, an equal chance basket containing the numbers of incoming patients in OPD were used and non-hospitalized children.

Data Collection Instruments

In this study, data collection was primarily relied on adapted “Determinants of Malaria Infection Questionnaire” (DMIQ) which are used during data collection. The questionnaire was research-administered and divided into five sections: Section A was containing socio-demographic characteristics information about mothers and children under 5. Section B was included questions designed to malaria information. Section C was contained questions about the environmental factors, and Section D was asked questions related to knowledge regarding malaria. Section E was asked questions related to socio-economic factors.

Data Analysis Procedures

Data analysis, as expressed by Braun & Clarke (2016), comprises a range of specified techniques and methods used to derive pertinent findings and conclusions. The findings obtained from the study instruments were undergo immediate data processing, which includes coding, cleaning, and tabulation. IBM SPSS software version 21 was utilized to facilitate efficient data management. Descriptive analysis was conducted on quantitative findings to present associated frequencies, means, and standard deviations, aiming to determine the prevalence of malaria infection at Nyamata District Hospital in Rwanda.

Descriptive statistics including mean, standard deviation, percentages, and frequency counts were used to assess the data obtained from the instruments. Furthermore, to explore relationships between independent variables and the dependent variable (malaria infection), descriptive statistics, regression analyses, and chi-square tests were employed, following the guidelines of Tabachnick and Fidell (2019). Variables that show significance in the bivariate analysis was considered for inclusion in a multivariable logistic regression model to account for potential influencing factors in the relationship. Both the p-value and Adjusted Odds Ratio (AOR) was utilized for significance testing. A variable was considered statistically significant if its p-value is less than 0.05 at a 95% confidence interval.

Ethical Considerations

Ethical approval for this study was granted by the Mount Kenya University-Rwanda Institutional Review Board, and authorization was sought from Nyamata District Hospital. Participation was voluntary, with participants consenting after a thorough explanation of the study's objectives and procedures. Assurance was provided regarding honesty, privacy, dignity, and respect for all participants.

All data collected were anonymized, and each participant was received a unique ID code. Data was securely stored in a locked drawer and entered into a secure Excel database on a protected computer. Participant names were not appeared on questionnaires or in any publications. Identifiers were used during data collection to distinguish participants. A separate document linking consent forms to questionnaires were securely stored and destroyed after data cleaning and analysis, while the main database was remained de-identified. Participants were informed that there are no direct benefits or risks to participating in the study, but the findings were informed future policies aimed at benefiting the wider population.

3. RESULTS

Demographic characteristics of respondents

The data provided offers a detailed look at the socio-demographic characteristics of children under five years of age attending Nyamata District Hospital for malaria treatment. The distribution of children across different age groups shows that the majority of cases are concentrated in the 12–60-month range, with the 12-24 months, 24-36 months, and 48-60 months' categories each representing around 25% of the total cases. Infants (1 day to 12 months) account for 5.1% of cases, while children aged 36-48 months represent 20.2% of the total. The gender distribution reveals a higher proportion of female children (64.9%) compared to male children (35.1%) seeking treatment for malaria.

Regarding the location of treatment, the pediatric ward accommodates the majority of patients (74.7%), indicating that a significant number of children require hospitalization for their malaria treatment. The remaining 25.3% of cases are seen in the outpatient department (OPD). Maternal occupation data shows that most mothers of these children work in teaching (30.3%) or farming (29.3%), with smaller proportions engaged in health professions, business, or casual work. Most mothers (40.2%) fall in the 25-35 age range, and the father's occupation largely mirrors the mother's, with a similar distribution of farming, teaching, health professions, business, and casual work. Fathers in the 35-45 age group constitute the largest proportion (30.3%) of the sample.

The wealth index reveals a fairly even distribution across categories, with the second and third categories each comprising 30.1% of families, indicating that a large portion of the population falls into middle-income levels. In terms of family size, a majority of children (59.8%) come from families with 1-4 children, while 25.3% come from families with 5-8 children, and 14.9% from families with more than 8 children. Most children (75%) reside in rural settings, and a substantial number (60.1%) are covered by the Community-Based Health Insurance (CBHI), reflecting a strong reliance on local health insurance schemes. Finally, religious affiliation is predominantly Catholic (39.9%), with smaller percentages of Protestant, Adventist, Pentecostal, Muslim, and other religious groups represented. This data highlights the significant social and demographic factors influencing malaria infection rates and health-seeking behaviors in this population.

Table 1. Social-demographic characteristics of malaria infections among under five aged children attending NYAMATA District Hospital (n=396)

Variables(n=396)	Frequency (n)	Percent (%)
Ages		
one day -12 month	20	5.1
12-24 month	98	24.7
24-36 month	99	25.0
36-48 month	80	20.2
48-60 month	99	25.0
Gender of the child		
Male	139	35.1
Female	257	64.9
Total	396	100.0
Location (in Hospital)		
Pediatric Ward	296	74.7
OPD	100	25.3
Mother Occupation		
Farmar	116	29.3
Teacher	120	30.3
Health professional	100	25.3
Business	20	5.1
Casual work	40	10.1
Age of the mother		
15-25 ages	79	19.9
25-35 ages	159	40.2
35-45 ages	119	30.1
Above 45 ages	39	9.8
Father occupation		
Farmar	40	10.1
Teacher	98	24.7
Health professional	120	30.3
Business	119	30.1

Casual work	19	4.8
Age of the father		
15-25 ages	39	9.8
25-35 ages	100	25.3
35-45 ages	120	30.3
Above 45 ages	137	34.6
Wealth index levels		
First category	60	15.2
Second category	119	30.1
Third category	119	30.1
Fourth category	98	24.7
Number of family members		
1-4 children	237	59.8
5-8 children	100	25.3
Above 8 children	59	14.9
Religion		
Catholic	158	39.9
Protestant	79	19.9
Adventist	59	14.9
Pentecost	40	10.1
Muslim	40	10.1
Other	20	5.1
Residence setting place		
Rural	297	75.0
Urban	99	25.0
Health insurance		
CBHI(Mutuelle)	238	60.1
RSSB	98	24.7
MMI	40	10.1
Other	20	5.1

Source: Primary data, 2025

The data provided offers insight into the various patient-related factors influencing malaria infections among children under five years of age attending Nyamata District Hospital. Prevention methods play a significant role in the control of malaria. A majority of the children (55.1%) had some form of internal prevention for malaria, while 70.2% of children were protected through external prevention measures. However, 44.9% of children did not use internal prevention, and 29.8% lacked external malaria protection. The knowledge of malaria transmission is high, with 79.8% of parents or guardians being aware of how the disease spreads. Despite this knowledge, misconceptions persist: 15.2% believed that malaria could be transmitted by eating sugar cane, and 5.1% thought it could be caused by bad air or witchcraft.

When considering the household conditions, most of the children (60.1%) lived in modern houses, and a substantial portion (60.1%) had access to water tanks with stagnant water, which could potentially serve as breeding grounds for mosquitoes. However, there was a lack of proper sanitation in many households, with 84.8% of families not using pit latrines and 89.9% not having a toilet. In terms of malaria prevention measures, a significant percentage of families (84.8%) engaged in regular indoor residual spraying, but only 25.3% of children used insecticide-treated bed nets. Interestingly, 79.8% of families owned insecticide-treated bed nets, but this number does not fully translate to regular use, which is a crucial factor in malaria prevention.

The socio-economic factors show that a significant portion of the population (44.9%) earns above 20,000 Rwf, while 35.4% earn between 10,001-20,000 Rwf, and 19.7% earn below 5,000 Rwf. Despite the varying income levels, access to malaria drugs was limited, with 71.2% of families reporting a lack of access. This can contribute to delays in treatment, which may worsen the condition. In terms of malaria outcomes, the majority of the children (85.4%) tested negative for malaria, suggesting either effective preventive measures or misdiagnosis in some cases. However, 14.6% of children had a positive malaria test result, reflecting the ongoing challenges in malaria control in this area despite various preventive strategies being in place. In summary, while there is a reasonable level of awareness about malaria transmission and preventive methods, challenges such as misconceptions, poor sanitation, limited access to malaria drugs, and low usage of insecticide-treated bed nets persist. These factors highlight areas where additional interventions and education could be beneficial in reducing malaria infections among under-five children in the region.

Table 2. Description of patients related factors of malaria infections among under five aged children attending NYAMATA District Hospital(n=396)

Variables	Frequency(n)	Percent (%)
Preven maleria internally		
Yes	218	55.1
Not	178	44.9
Preven maleria externally		
Yes	278	70.2
Not	118	29.8
Presumed malaria		
Yes	239	60.4
Not	157	39.6
Modern house		
Yes	238	60.1
Not	158	39.9
House with covered window		
Yes	178	44.9
Not	218	55.1
Living near of river		
Yes	60	15.2
Not	336	84.8
Using pit latrine		
Yes	60	15.2
Not	336	84.8
No toilet		
Yes	40	10.1
Not	356	89.9
Water tank near home Stagnant water		
Yes	238	60.1
Not	158	39.9
Open water sources		
Yes	177	44.7
Not	219	55.3
Knowledge about malaria transmission		
Yes	316	79.8
Not	80	20.2
Malaria transmission caused by eating more sugar cane		
Yes	60	15.2
Not	336	84.8
Malaria transmission caused by bad air or witchcraft		
Yes	20	5.1
Not	376	94.9
Source of information		
Malaria awareness campaign	99	25.0

Radio	60	15.2
TV Health facility 5. CHWs	40	10.1
Health facility	79	19.9
CHWs	118	29.8
Socio-economic factors		
5,000 Rwf and below	78	19.7
10,001-20,000 Rwf	140	35.4
20,001 and above	178	44.9
Having insecticide treated bed nets		
Yes	100	25.3
Not	296	74.7
Number of insecticides treated bed nets		
Yes	316	79.8
Not	80	20.2
Number of insecticides treated bed nets		
Yes	316	79.8
Not	80	20.2
Total	396	100.0
Regular indoor residual praying		
Yes	336	84.8
Not	60	15.2
Practicing of other preventive measures		
Yes	276	69.7
Not	120	30.3
Poor hygiene		
Yes	60	15.2
Not	336	84.8
Access to malaria drugs		
Yes	114	28.8
Not	282	71.2
Malaria results		
Positive	58	14.6
Negative	338	85.4

Source: Primary data, 2025

Bivariate analysis of factors associated with prevalence malaria infections among under five aged children

The bivariate analysis reveals significant associations between various factors and malaria infection rates among under-five children at Nyamata District Hospital. The age of the child is strongly associated with malaria infection, particularly for those aged 1 day - 12 months, where 24.1% tested positive for malaria (p-value = 0.001). This group is significantly more vulnerable to malaria, likely due to weaker immune systems. The infection rates decrease progressively with age, showing a clear trend of younger children being at higher risk. Maternal and paternal occupations also have a significant influence on the prevalence of malaria. For instance, children of mothers who are farmers show a significantly higher malaria prevalence (56.9% positive, p-value = 0.001) compared to those of teachers or health professionals. Similarly, the occupation of the father, with farmers (24.1% positive, p-value = 0.001) showing higher rates, is significantly linked to malaria infections.

Several environmental factors, such as the living conditions of the children, also exhibit significant associations with malaria outcomes. Children living in rural areas have a higher malaria infection rate (44.8% positive, p-value = 0.001) compared to those in urban areas (55.2% positive). This suggests that rural environments, which may have more exposure to mosquito breeding grounds, are more conducive to malaria transmission. Additionally, living near rivers and open water sources increases the risk of malaria infection. Children living near these water sources show a high infection rate (91.4% positive, p-value = 0.001), underlining the role of environmental factors in malaria transmission. The use of preventive measures, such as insecticide-treated bed nets and modern housing, significantly reduces the likelihood of infection. Children in modern houses (12.1% positive, p-value = 0.001) and those using insecticide-treated nets (98.3% positive, p-value = 0.001) show lower infection rates compared to those without these preventive measures.

Hygiene and sanitation also play a significant role in malaria transmission. Children from households with poor hygiene practices (32.8% positive, p-value = 0.001) have a significantly higher malaria infection rate compared to those with better hygiene practices. The presence of stagnant water near homes and the use of pit latrines (both p-values = 0.001) are strongly associated with increased malaria infections. Access to healthcare and malaria drugs is also a key factor: children with access to these resources show significantly fewer positive malaria results (62.1% positive, p-value = 0.001). This emphasizes the importance of improving healthcare access and the timely treatment of malaria in reducing infection rates.

Finally, awareness and knowledge about malaria transmission significantly impact infection rates. Children whose caregivers are knowledgeable about malaria transmission (98.3% positive, p-value = 0.001) have lower rates of infection, suggesting that educating families on how malaria is spread can help reduce its prevalence. Similarly, participating in malaria awareness campaigns (25.9% positive, p-value = 0.001) significantly lowers infection rates, reinforcing the importance of community-level education and awareness campaigns as part of malaria prevention efforts. In bivariate we describe the odds ratio, P-value and 95% of confidence interval. When the odds ratio is more or equal to one, that factors are enhance the malaria infections. In bivariate associations were tested using Pearson's chi-square tests.

Table 3. Bivariate analysis of factors associated with prevalence malaria infections among under five aged children

Ages	**Category**	**Malaria results**			
		Positive (%)	**Negative (%)**	**X^2**	**P-Value**
	one day -12 month	14(24.1)	6(1.8)	79.03	0.061
	12-24 month	3(5.2)	95(28.1)		
	24-36 month	22(37.9)	77(22.8)		
	36-48 month	2(3.4)	78(23.1)		
	48-60 month	17(29.3)	82(24.3)		
Gender					
	Male	22(37.9)	117(34.6)	0.24	0.625
	Female	36(62.1)	221(65.4)		
Location in hospitalization					
	Pediatric Ward	39(67.2)	257(76.0)	2.03	0.154
	OPD	19(32.8)	81(24.0)		
Mother occupation					
	Farmar	33(56.9)	83(24.6)	35.33	**0.001**
	Teacher	4(6.9)	116(34.3)		
	Health professional	18(31.0)	82(24.3)		
	Business	1(1.7)	19(5.6)		
	Casual work	2(3.4)	38(11.2)		
Ages of the mother					
	15-25 ages	4(6.9)	75(22.2)	46.14	0.011
	25-35 ages	32(55.2)	127(37.6)		
	35-45 ages	5(8.6)	114(33.7)		
	Above 45 ages	17(29.3)	22(6.5)		
Father occupation					
	Farmar	14(24.1)	26(7.7)	25.95	0.101
	Teacher	3(5.2)	95(28.1)		
	Health professional	20(34.5)	100(29.6)		
	Business	20(34.5)	99(29.3)		
	Casual work	1(1.7)	18(5.3)		

Ages of father					
	15-25 ages	1(1.7)	38(11.2)	5.48	0.140
	25-35 ages	16(27.6)	84(24.9)		
	35-45 ages	21(36.2)	99(29.3)		
	Above 45 ages	20(34.5)	117(34.6)		
Wealt index level					
	First category	14(24.1)	46(13.6)	13.26	**0.004**
	Second category	20(34.5)	99(29.3)		
	Third category	20(34.5)	99(29.3)		
	Fourth category	4(6.9)	94(27.8)		
Number of family members					
	1-4 children	8(13.8)	229(67.8)	60.05	**0.001**
	5-8 children	32(55.2)	68(20.1)		
	Above 8 children	18(31.0)	41(12.1)		
Religion					
	Catholic	32(55.2)	126(37.3)	43.03	0.011
	Protestant	3(5.2)	76(22.5)		
	Adventist	20(34.5	39(11.5)		
	Pentecost	1(1.7)	39(11.5)		
	Muslim	2(3.4)	38(11.12)		
	Other	0	20(5.9)		
Residence setting place					
	Rural	26(44.8)	271(80.2)	32.99	**0.001**
	Urban	32(55.2)	67(19.8)		
Health insurance					
	CBHI(Mutuelle)	20(34.5)	218(64.5)	104.74	**0.001**
	RSSB	19(32.8)	79(23.4)		
	MMI	1(1.7)	39(11.5)		
	Other	18(31.0)	2(6.0		
Prevent malaria internally					
	Yes	25(43.1)	193(57.1)	3.92	0.048
	Not	33(56.9)	145(42.9)		
Preven malaria externally					
	Yes	25(43.1)	253(74.9)	23.85	**0.001**
	Not	33(56.9)	85(25.1)		
Presumed malaria					
	Yes	24(41.4)	215(63.6)	10.22	**0.001**
	Not	34	123(36.4		
Modern house					
	Yes	7(12.1)	231(68.3)	65.38	**0.001**
	Not	51(87.9)	107(31.7)		
House with covered window					
	Yes	35(60.3)	143(42.3)	6.51	0.011
	Not	23(39.7)	195(57.7)		
Living near of river					
	Yes	32(55.2)	28(8.3)	84.66	**0.001**
	Not	26(44.8)	310(91.7)		
Using pit latrine					
	Yes	32(55.2)	28(8.3)	84.66	**0.001**
	Not	26(44.8)	310(91.7)		

No toilet					
	Yes	0	40(11.8)	7.64	0.006
	Not	58(100)	298(88.2)		
Water tank near home stagnant water					
	Yes	7(12.1)	231(68.3)	65.38	**0.001**
	Not	51(87.9)	107(31.7)		
Open water sources					
	Yes	53(91.4)	124(36.7)	59.91	**0.001**
	Not	5(8.6)	214(63.3)		
Knowledge about malaria transmission					
	Yes	57(98.3)	259(76.6)	14.39	**0.001**
	Not	1(1.7)	79(23.4)		
Malaria transmission caused by eating more sugar cane					
	Yes	32(55.2)	28(8.3)	84.66	**0.001**
	Not	26(44.8)	310(91.7)		
Malaria transmission caused by bad air or witchcraft					
	Yes	18(31.0)	2(0.6)	95.67	
	Not	40(69.0)	336(99.4)		
Source of information					
	Malaria awareness campaign	15(25.9)	84(24.9)	20.29	**0.001**
	Radio	1(1.7)	59(17.5)		
	TV Health facility 5. CHWs	2(3.4)	38(11.2)		
	Health facility	21(36.2)	58(17.2)		
	CHWs	19(32.8)	99(29.3)		
Socio economic factors					
	5,000 Rwf and below	19(32.8)	59(17.5)	22.45	**0.001**
	10,001-20,000 Rwf	5(8.6)	135(39.9)		
	20,001 and above	34(58.6)	144(42.6)		
Having insecticide treated bed nets					
	Yes	14(24.1)	86(25.4)	0.05	0.833
	Not	44(75.9)	252(74.6)		
Number of insecticides treated bed nets					
	Yes	57(98.3)	259(76.6)	14.39	0.011
	Not	1(1.7)	79(23.4)		
Regular indoor residual praying					
	Yes	57(98.3)	279(82.5)	9.53	0.122
	Not	1(1.7)	59(17.5)		
Practicing of other preventive measures					
	Yes	37(63.8)	239(70.7)	1.12	0.290
	Not	21(36.2)	99(29.3)		
Poor hygiene					
	Yes	19(32.8)	41(12.1)	16.39	**0.001**
	Not	39(67.2)	297(87.9)		
Access to health facility					
	Yes	38(65.5)	75(22.2)	45.57	**0.001**
	Not	20(34.5)	263(77.8)		
Access to malaria drugs					
	Yes	36(62.1)	78(23.1)	36.72	**0.001**
	Not	22(37.9)	260(76.9)		

Source: Primary data, 2025

Multivariate of health determinant of factors with malaria infections among under five aged children

The multivariate analysis was performed to determine factors that were associated with malaria infections among under five aged children in the bivariate analysis at the less than 0.5 significance level to develop the final multi-variable model using a backward elimination method. In the table, factors with a star had significance. In the tables, adding stars increases the significance. The multivariate analysis of patient-related factors with malaria infections in children under five years old at Nyamata District Hospital reveals several key associations between various factors and the risk of malaria. The presence of a house with covered windows had an AOR of [13.686], with a confidence interval of [2.080 to 90.070], and a p-value of [0.126]. Although the AOR is quite high, the p-value suggests this relationship is not statistically significant, indicating that having covered windows may not have influence on malaria risk in this particular population.

In contrast, living near a river significantly reduced the odds of malaria infection, with an AOR of [0.406] and a p-value of [0.004], which is statistically significant. The confidence interval ranges from [0.031 to 5.353], supporting the hypothesis that proximity to a river are the risk factor of malaria, possibly due to environmental factors or better access to healthcare and preventive measures in such areas. Additionally, the presence of stagnant water in a water tank near the home was found to be a major risk factor for malaria, with an AOR of [0.025] (CI: [0.005 to 0.136]) and a p-value of [0.001]. This indicates that stagnant water is a significant environmental risk factor for malaria transmission. Similarly, the presence of open water sources near the home also showed a significant association with malaria infection (AOR = [0.117], CI: [0.018 to 0.763], p-value = [0.002]), suggesting that such water sources may serve as breeding grounds for mosquitoes.

Other factors, such as beliefs about malaria transmission, did not show significant associations. For instance, the belief that malaria is caused by Anopheles mosquitoes had an AOR of [0.266] (CI: [0.009 to 7.997]) with a p-value of [0.445], which indicates no statistically significant association. Likewise, the belief that malaria is caused by bad air or witchcraft had an AOR of [0.025] (CI: [0.000 to 2.244]) and a p-value of [0.108], which again shows significant impact. Income levels had significantly affect the odds of malaria infection either, with p-values of [0.004] for the 10,001-20,000 Rwf category and [0.169] for the 20,001 and above category, indicating no statistically significant relationship between income and malaria. When it comes to preventive measures, the use of insecticide-treated bed nets (AOR = [5.631], p-value = [0.613]), regular indoor residual spraying (AOR = [9.706], p-value = [0.225]), and practicing other preventive measures (AOR = [2.020], p-value = [0.758]) did not show statistically significant associations with malaria infection. Similarly, poor hygiene practices (AOR = [3.269], p-value = [0.574]) were not significantly related with malaria. However, access to health facilities had an AOR of [13.074] (CI: [2.986 to 57.243]) and a p-value of [0.061], suggesting that while the relationship is not significant, access to health facilities may play a crucial role in reducing malaria risk, and further studies might help solidify this finding.

Table 4: Multivariate association of patient-related factors with malaria infections among under five aged children attending Nyamata District Hospital

Variables	AOR	95% C.I.for EXP(B)		P-value
		Lower	Upper	
House with covered window				
Yes	13.686	2.080	90.070	0.126
Not	Reference			
Living near of river				
Yes	0.406	0.031	5.353	**0.004**
Not	Reference			
Water tank near home Stagnant water				
Yes	0.025	0.005	0.136	**0.001**
Not	Reference			
Open water sources				
Yes	0.117	0.018	0.763	**0.002**
Not	Reference			
Is malaria transmission caused by mosquito Anophele female	0.266	0.009	7.997	0.445
Yes	0.266	0.009	7.997	0.445
Not	Reference			

Is malaria transmission caused by bad air or witchcraft				
Yes	0.025	0.000	2.244	0.108
Not				
Average Monthly income				
5,000 Rwf and below	Reference			
10,001-20,000 Rwf	0.047	0.006	0.380	**0.004**
20,001 and above	0.230	0.028	1.872	0.169
Having insecticide treated bed nets				
Yes	5.631	1.831	17.320	0.613
Not	Reference			
Regular indoor residual praying				
Yes	9.706	0.247	381.862	0.225
Not	Reference			
Practicing of other preventive measures				
Yes	2.020	0.023	177.958	0.758
Not	Reference			
Poor hygiene				
Yes	3.269	0.052	203.698	0.574
Not	Reference			
Access to health facility				
Yes	13.074	2.986	57.243	0.061
Not	Reference			

Source: Primary data, 2025

4. DISCUSSION

The prevalence of malaria among children under five in Nyamata District Hospital was found to be 14.6% (58/396), which is lower than the reported of Bugesera District over 80,000 malaria cases, with 38% of those cases found among children under five (Bugesera District, 2023), and is lower than the reported prevalence in high-transmission areas of sub-Saharan Africa, where rates often exceed 30% (Bhatt et al., 2015). This indicates that malaria prevention efforts in Rwanda, such as insecticide-treated bed nets (ITNs) and indoor residual spraying (IRS), may have contributed to a lower prevalence. However, the burden remains substantial, particularly considering the vulnerability of young children to malaria-related morbidity and mortality (Weiss et al., 2022). The findings reinforce the need for continuous surveillance and enhanced vector control measures to further reduce malaria prevalence in this high-risk group.

The study identified several environmental factors associated with malaria risk. Living near a river was found to significantly increase malaria infection odds (AOR = 0.406, p-value = 0.004), those are same as Haque et al. (2020), who reported that proximity to mosquito breeding grounds, such as stagnant water, increases malaria risk. This finding suggests that proximity to a river is necessarily lead to higher mosquito densities in Nyamata District. However, the presence of stagnant water in water tanks near homes was a major risk factor (AOR = 0.025, p-value = 0.001), aligning with findings by Owusu-Agyei et al. (2017) that such environments are ideal breeding sites for Anopheles mosquitoes. This emphasizes the need for improved water storage practices and environmental management in malaria prevention strategies.

Surprisingly, factors such as insecticide-treated bed net usage (AOR = 5.631, p-value = 0.613) and regular indoor residual spraying (AOR = 9.706, p-value = 0.225) did not show statistically significant associations with malaria infection. Those are same with multiple studies, including Bhatt et al. (2015), which highlight ITNs and IRS as highly effective malaria prevention tools. Possible explanations include inconsistent usage, reduced effectiveness due to insecticide resistance (Hemingway et al., 2016).

Socioeconomic determinants, including income levels, did significantly influence malaria infection in this study (p-values of 0.004 and 0.169). This is same as with Ngonghala et al. (2017), who found that lower-income households had higher odds of malaria infection due to barriers in accessing preventive measures. The lack of significant association in Nyamata District may reflect Rwanda's relatively strong malaria control programs that provide free or subsidized ITNs and treatment, thereby reducing the income-related disparities in malaria risk. Nevertheless, further research on indirect economic burdens, such as out-of-pocket treatment costs and work productivity losses, is essential for a comprehensive understanding of malaria's socioeconomic impact.

Access to health facilities was an important factor, with an AOR of 13.074 and a p-value of 0.061, suggesting that better healthcare access may play a role in reducing malaria risk. This supports findings from Deressa et al. (2017), who noted that delayed treatment due to healthcare inaccessibility increases the likelihood of severe malaria outcomes. Although the relationship was not statistically significant, the data suggests that improved healthcare infrastructure, rapid diagnostic tests (RDTs), and early treatment interventions could further mitigate malaria morbidity and mortality. Strengthening healthcare delivery systems and ensuring equitable access to malaria diagnosis and treatment should remain a priority in malaria-endemic areas like Nyamata District.

5. CONCLUSION

The study highlights the prevalence of malaria among children under five in Nyamata District Hospital at 14.6%, which is relatively lower than reported cases in Bugesera District and other high-transmission areas in sub-Saharan Africa. The findings suggest that malaria prevention efforts in Rwanda, including the use of insecticide-treated bed nets (ITNs) and indoor residual spraying (IRS), have contributed to the reduction in malaria prevalence. However, the burden remains significant, especially for young children who are particularly vulnerable to malaria-related morbidity and mortality.

Environmental factors such as proximity to rivers and the presence of stagnant water in water tanks were identified as significant risk factors for malaria transmission, pointing to the importance of improved water storage practices and environmental management in malaria prevention. While ITN usage and IRS did not show statistically significant associations with malaria infection in this study, their effectiveness may be reduced due to inconsistent usage and insecticide resistance. Socioeconomic factors, particularly income levels, were also noted as influencing malaria risk, with lower-income households facing higher odds of infection. Access to healthcare was identified as an important determinant, suggesting that improving healthcare infrastructure and access to malaria diagnosis and treatment could further reduce malaria-related morbidity and mortality.

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