Research Square

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Prevalence of malaria, factors associated with malaria, and malaria coinfections among pregnant women attending antenatal care in Bweyale Town Council, Kiryandongo District, Uganda: a facility-based cross-sectional study

Charles Drichi
Gulu University
Hillary Ngolobe
hillaryngolobe1@gmail.com

Gulu University
Peterson David Kamulegeya
Gulu University
Linda Mercy Akello
Gulu University
Daniel S. Ebbs
Yale University
Felix Bongomin
Gulu University

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Abstract

Background

Malaria during pregnancy remains a major cause of preventable maternal and neonatal morbidity and mortality in sub-Saharan Africa despite the availability of effective preventive interventions. Pregnant women with malaria may also have concurrent infections such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), and syphilis, which can further worsen pregnancy outcomes. However, little is known about burden of malaria, associated factors, and malaria coinfections among pregnant women in Bweyale Town Council, Uganda. This study determined the prevalence of malaria, factors associated with malaria, and malaria coinfections among pregnant women attending antenatal care (ANC) in Bweyale Town Council, Kiryandongo District, Uganda.

Methods

A facility-based cross-sectional study was conducted between April and May 2026 at three health centres in Bweyale Town Council. Participants were recruited using convenience sampling. Malaria was confirmed using a pan-species rapid diagnostic test, while HIV, hepatitis B and syphilis results were extracted from antenatal records using interviewer-administered questionnaires. Factors associated with malaria were assessed using modified Poisson regression with robust standard errors, and adjusted prevalence ratios (aPRs) with 95% confidence intervals were reported. Statistical significance was set at $p < 0.05$.

Results

A total of 422 pregnant women were enrolled. The median age was 24 years (IQR: 20–27), and 95.3% (402/422) were married. The prevalence of laboratory-confirmed malaria was 12.6% (53/422; 95% CI: 10.0%–16.0%). HIV, HBV, and syphilis prevalence were 4.0%, 2.8%, and 2.6%, respectively. Malaria-HIV and malaria-syphilis coinfections occurred in 0.5% and 1.0% of participants, respectively. Women who did not sleep under long-lasting insecticide-treated nets (LLINs) had more than twice the prevalence of malaria compared with net users (aPR 2.45, 95% CI 1.47–4.09; p = 0.001).

Conclusion

About one in eight pregnant women attending ANC in Bweyale Town Council had malaria, and malaria coinfections with HIV and syphilis were also identified. Failure to sleep under an insecticide-treated net was independently associated with malaria. Strengthening LLINs utilization and integrating malaria prevention with routine maternal infection screening could further reduce malaria and adverse pregnancy outcomes.

Introduction

Malaria remains a major global public health challenge despite sustained control efforts. In 2024, the World Health Organization (WHO) estimated 280 million malaria cases and more than 600,000 malaria-related deaths worldwide, with the greatest burden occurring in sub-Saharan Africa[1]. Pregnant women are particularly vulnerable, with an estimated 13 million pregnancies in the WHO African Region affected by malaria in 2024[1]. The burden was highest in West Africa (38%), followed by Central Africa (42%), while East and Southern Africa recorded a prevalence of 30%[1]. Malaria during pregnancy remains a major cause of maternal anemia, placental malaria, low birth weight, preterm birth, and neonatal mortality [1–3].

Pregnancy increases susceptibility to Plasmodium falciparum infection because physiological immune modulation and placental sequestration of parasitized erythrocytes reduce naturally acquired immunity, particularly among primigravidae [4, 5] .Consequently, malaria in pregnancy remains a major obstacle to improving maternal and newborn health in malaria-endemic countries and continues to contribute substantially to adverse pregnancy outcomes [1, 6].

Uganda remains among the countries with the highest malaria burden globally. National surveillance data indicate that laboratory-confirmed malaria among pregnant women attending antenatal care increased from 15% in 2015 to 21% in 2023, with more than 2.8 million malaria episodes reported during the period. The burden remains highest among adolescents and women residing in high-transmission regions [7].

To reduce malaria-related maternal and neonatal morbidity, the WHO recommends a comprehensive prevention package comprising early antenatal care attendance, intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP) from the second trimester, universal use of long-lasting insecticide-treated nets (LLINs), and prompt diagnosis and effective treatment of confirmed malaria infections [1–8]. In line with these recommendations, Uganda has transitioned from malaria control to malaria elimination through the Uganda Malaria Elimination Strategic Plan (2026–2030), which prioritizes universal access to malaria prevention and case management, aims to achieve ≥ 90% coverage of at least three IPTp-SP doses among pregnant women, and strengthen integrated vector management and surveillance[9]. Evidence shows that insecticide-treated nets reduce placental parasitaemia by approximately 23%, while receipt of at least three doses of IPTp-SP reduces peripheral parasitaemia and decreases sub microscopic infections [10–11]. Nevertheless, malaria transmission has resurged in Uganda despite repeated indoor residual spraying and mass distribution of insecticide-treated nets, potentially compromising gains in malaria prevention[12].

Besides malaria, pregnant women in sub-Saharan Africa are frequently affected by other infections, including human immunodeficiency virus (HIV), hepatitis B virus (HBV), and syphilis, each of which independently contributes to adverse maternal and neonatal outcomes [13–21]. Coinfection with malaria may further increase the risks of maternal anaemia, placental insufficiency, fetal growth restriction, preterm birth, congenital infection and perinatal mortality. The World Health Organization therefore

recommends routine antenatal screening for HIV, hepatitis B and syphilis alongside comprehensive malaria prevention and management to improve maternal and new-born outcomes [1–22].

Previous studies have identified several factors associated with malaria during pregnancy, including maternal age, gravidity, HIV infection, rural residence, poor housing, lower educational attainment, inadequate LLIN use, poor uptake of IPTp-SP, and limited vector control interventions as important determinants of malaria during pregnancy[23–25]. Although national surveillance has described trends in malaria in pregnancy across Uganda, there remains limited evidence on the prevalence of laboratory-confirmed malaria, malaria coinfections with HIV, hepatitis B and syphilis, and factors associated with malaria among pregnant women attending antenatal care in Bweyale Town Council, Kiryandongo District. This study assessed the prevalence of laboratory-confirmed malaria, malaria coinfections, and factors associated with malaria among pregnant women attending antenatal care in Bweyale Town Council, Kiryandongo District, Uganda.

Methods

Study design and setting

A health facility-based cross-sectional study was conducted between 15 April and 15 May 2026 among pregnant women attending antenatal care (ANC) services in Bweyale Town Council, Kiryandongo District, western Uganda.

The study was conducted at three public health facilities: Panyadoli Health Centre IV, Nyakadot Health Centre III, and Kichwabugingo Health Centre II, which provide routine ANC, malaria prevention, diagnosis, and treatment services to both the host population and refugees residing in the area[26](Fig. 1).

Kiryandongo District lies within one of Uganda's malaria-endemic regions, characterized by perennial malaria transmission with seasonal peaks following the bimodal rainfall pattern. Bweyale Town Council hosts part of the Kiryandongo Refugee Settlement, one of Uganda's largest refugee-hosting settlements, accommodating predominantly refugees from South Sudan and the Democratic Republic of Congo alongside the host community. This unique humanitarian setting presents additional challenges to malaria prevention and control because of high population mobility, overcrowding, and increased demand for health services[26–28].

The three study facilities were purposively selected because they are the principal public health facilities providing ANC services within Bweyale Town Council and collectively serve a large, heterogeneous catchment population of refugees and host communities. Their inclusion was intended to provide findings that are representative of routine ANC attendees in this high malaria transmission setting.
Figure 1

Study population and eligibility criteria

The study population comprised pregnant women aged 15–49 years attending ANC services at Panyadoli Health Centre IV, Nyakadot Health Centre III, and Kichwabugingo Health Centre II during the study period.

Eligible participants were women with a gestational age of at least 13 completed weeks, corresponding to the second trimester when intermittent preventive treatment in pregnancy with IPTp-SP is recommended by the WHO and the Uganda Ministry of Health. Participants were required to provide written informed consent before enrolment. Pregnant women who were critically ill or otherwise unable to participate in the interview or provide informed consent were excluded from the study.

Sample size estimation and Sampling procedure

The sample size was determined using the Kish Leslie formula for estimating a single population proportion[29]. In the absence of a previous prevalence estimate for malaria among pregnant women in the study area, a prevalence of 50% was assumed to obtain the maximum sample size, with a 95% confidence level and a 5% margin of error. The minimum sample size obtained was 384 participants. After adjusting for an anticipated 10% non-response rate[30], the final sample size was 422 pregnant women.

A consecutive sampling approach was employed to recruit study participants. All pregnant women attending ANC clinics at Panyadoli Health Centre IV, Nyakadot Health Centre III, and Kichwabugingo Health Centre II during the study period were consecutively screened for eligibility. Women who met the inclusion criteria and provided written informed consent were enrolled sequentially until the predetermined sample size was attained.

Data collection procedure

Data were collected by five trained research assistants using a pretested structured electronic questionnaire programmed in KoboToolbox. Before data collection, the research assistants received standardized training on the study protocol, research ethics, informed consent, interview techniques, electronic data capture, and malaria rapid diagnostic testing. The questionnaire was pretested at a comparable health facility outside the study area, and necessary revisions were made to improve its clarity and functionality.

Eligible pregnant women were consecutively recruited after routine ANC consultations. Written informed consent was obtained before administering the interviewer-administered questionnaire to collect data on socio-demographic characteristics, obstetric history, malaria prevention practices, and other study variables.

Malaria infection was determined using the SD BIOLINE Malaria Ag P.f/Pan Rapid Diagnostic Test (Abbott Diagnostics, Republic of Korea) according to the manufacturer's instructions. The test detects

Plasmodium falciparum histidine-rich protein II (HRP-II) and pan-Plasmodium lactate dehydrogenase (pLDH) antigens. Test kits were stored at the recommended temperature (2–30°C), expiry dates were verified before use, and standard quality assurance procedures were maintained throughout the study. Test results were recorded immediately in both the electronic questionnaire and the laboratory tally sheet.

Data quality was ensured through standardized training of research assistants, pretesting of the data collection tool, daily supervision, and routine review of completed questionnaires for completeness, accuracy, and consistency. The KoboToolbox application incorporated skip patterns, validation checks, and mandatory fields to minimize data entry errors, while the principal investigator conducted daily verification of electronic records and resolved any inconsistencies promptly.

Study variables

The primary outcome variable was laboratory-confirmed malaria infection in pregnancy, defined as a positive SD BIOLINE Malaria Ag P.f/Pan rapid diagnostic test (RDT) result and coded as a binary variable (positive = 1; negative = 0).

The secondary outcome variables were HIV infection, hepatitis B HBV infection, and syphilis, determined from the documented routine antenatal screening results recorded on participants' ANC cards. Malaria coinfection was defined as the concurrent presence of laboratory-confirmed malaria and at least one of these infections (HIV, HBV, or syphilis).

The independent variables included socio-demographic characteristics (age, marital status, education level, occupation, and residence), obstetric factors (gravidity, parity, gestational age, and ANC attendance), health system factors (receipt of malaria health education and access to malaria prevention services), and behavioural factors (use of LLIN, uptake of intermittent preventive treatment in pregnancy with IPTp-SP, and other malaria prevention practices).

Data management plan and data analysis

Data were collected electronically using KoboToolbox and exported to Microsoft Excel for cleaning, coding, and validation. The cleaned dataset was password-protected, with access restricted to the study team, and securely backed up on an external hard drive and encrypted cloud storage. Data were subsequently imported into Stata version 15.0 (StataCorp LLC, College Station, TX, USA) for statistical analysis.

Descriptive statistics were used to summarize participants' characteristics. Continuous variables were assessed for normality and summarized using medians and interquartile ranges (IQRs), while categorical variables were summarized as frequencies and percentages. The prevalence of malaria, HIV, HBV, syphilis, and malaria coinfections was estimated as the proportion of participants with positive test results and reported with 95% confidence intervals (CIs).

Bivariable analysis was performed using Pearson's chi-square test or Fisher's exact test, as appropriate, to assess the association between each independent variable and laboratory-confirmed malaria. Variables with $p < 0.20$ at bivariable analysis, together with biologically plausible covariates identified from the literature, were included in the multivariable model. Modified Poisson regression with robust variance estimation was used to estimate crude prevalence ratios (cPRs) and adjusted prevalence ratios (aPRs) with 95% confidence intervals, as it provides direct and unbiased estimates of prevalence ratios for common binary outcomes in cross-sectional studies. Statistical significance was considered at $p < 0.05$.

Prior to model fitting, multicollinearity was assessed using variance inflation factors (VIFs), with a VIF > 10 considered indicative of problematic multicollinearity. Missing data were assessed before analysis, and variables with < 5% missing observations were analysed using complete-case analysis, as the proportion of missing data was considered unlikely to materially influence the study findings.

Results

Participant Flow

A total of 441pregnant women attending ANC clinics at the three participating health facilities were assessed for eligibility during the study period. Of these, 19women were excluded, comprising 4 with gestational age < 13 completed weeks and 6 who declined to participate. 9 participants were excluded because of critical illness. 422 eligible pregnant women were enrolled, completed the interview, underwent malaria rapid diagnostic testing, and were included in the final analysis (Fig. 2).

Baseline characteristics of study participants

A total of 422 pregnant women were enrolled in the study. The median age was 24 years (IQR: 20–27). Half of the participants (50.2%, 212/422) were recruited from Panyadoli Health Centre IV. Most participants were married (95.3%, 402/422), had attained primary education (57.6%, 243/422), were unemployed (69.2%, 292/422), and resided in rural areas (79.2%, 334/422) (Table 1).

Table 1
shows socio-demographic factors of pregnant women receiving care at health centres within Bweyale town council between April and May 2026

Variable and Categories	Frequency (n)	Percentage (%)
Age; median (IQR), years	**24**	**20–27**
< 20	88	20.9
20–34	306	72.5
> 34	28	6.6
Health facility		
Kichwabugingo health centre II	80	19.0
Nyakadot health centre III	130	30.8
Panyadoli health centre IV	212	50.2
Marital status		
Married	402	95.3
Not married	20	4.7
Education level		
No formal education	43	10.2
Primary	243	57.6
Secondary	108	25.6
Tertiary	28	6.6
Employment		
Formal	24	5.7
Informal	106	25.1
Unemployed	292	69.2
Residence		
Rural	334	79.2
Urban	88	20.8

Clinical and healthcare characteristics

Table 2 shows the individual clinical characteristics and healthcare-related factors of pregnant women receiving care at health centres within Bweyale town council between April and May 2026

The median gestational age was 24 weeks (IQR: 20–30), and the median gravidity was 2 pregnancies (IQR: 1–3). Nearly half of the participants (44.1%, 186/422) perceived malaria as a common illness during pregnancy. Most women had received IPTp-SP (92.4%, 390/422), initiated ANC during the second trimester (44.6%, 188/422), reported sleeping under a long-lasting insecticidal net (85.8%, 362/422), and had heard about IPTp-SP (76.1%, 321/422), predominantly from healthcare workers (72.7%, 307/422).

Routine ANC screening identified HIV, HBV, and syphilis in 4.0%, 2.8%, and 2.6% of participants, respectively (Table 2).

Variable	Frequency (n)	Percentage (%)
Malaria is common	186	44.1
Previously treated malaria	156	37.0
Missed ANC visit	73	17.3
Uses a net use	362	85.8
Age category		
< 20	88	20.9
20–34	306	72.5
> 34	28	6.6
Parity		
Primigravida	119	28.2
Multigravida	303	71.8
Current trimester		
Second trimester	311	73.7
Third trimester	111	26.3
Number of ANC visits		
< 4	230	54.5
>=4	192	45.5
Timing for 1st ANC		
1st trimester	180	42.7
2nd trimester	188	44.6
3rd trimester	54	12.8
IPT dose		
Optimal	140	35.7
Suboptimal	250	64.3
Proximity to facility		
Far	260	61.6
Near	162	38.4
Means of transport		

Variable	Frequency (n)	Percentage (%)
Foot	193	40.3
Bodaboda	277	57.8
Public transport	6	1.3
Private means	3	0.6
ANC malaria result		
Positive	65	15.4
Negative	357	84.6
1st ANC Hepatitis B result		
Positive	12	2.8
Negative	367	87.0
Not done	43	10.2
1st ANC HIV result		
Positive	17	4.0
Negative	405	96.0
1st ANC syphilis result		
Positive	11	2.6
Negative	404	95.7
Not done	7	1.7

Prevalence of malaria among pregnant women receiving care at health centres within Bweyale town council between April and May 2026

The prevalence of malaria among the pregnant women receiving care at health centres within Bweyale town council between April and May 2026 was 12.6% ((53/422; 95% CI: 10.0%–16.0%). Figure 3

Prevalence of malaria coinfections

Among the 422 participants, HIV, HBV, and syphilis prevalences were 4.0% (17/422), 2.8% (12/422), and 2.6% (11/422), respectively. Malaria–HIV coinfection occurred in 0.5% (2/422) of participants, while malaria–syphilis coinfection occurred in 1.0% (4/422). No malaria–HBV coinfection was identified.

Bivariable analysis of factors associated with malaria among pregnant women receiving care at health centres within Bweyale town council between April and May 2026

At bivariable analysis, perceived malaria as a common illness during pregnancy ($p = 0.011$), perceived effects of malaria on the unborn child ($p = 0.012$), awareness of IPTp-SP ($p = 0.030$), obtaining IPTp-SP from an alternative source ($p = 0.031$), mosquito net use ($p < 0.001$), parity ($p = 0.048$), residence ($p = 0.068$), marital status ($p = 0.091$), education level ($p = 0.063$), recommendation of IPTp-SP ($p = 0.053$), and reported IPTp-SP side effects ($p = 0.092$) met the prespecified criterion ($p < 0.20$) for inclusion in the multivariable model (Table 3).

Table 3
shows bivariable analysis of factors associated with malaria among pregnant women receiving care at health centres within Bweyale town council between April and May 2026

Variable	Total (N = 422)	Malaria = 1 (n = 53)	Malaria = 0 (n = 369)	p-value
Health facility				0.321
Kichwabugingo	80 (19.0)	14 (26.4)	66 (17.9)	
Nyakadot	130 (30.8)	14 (26.4)	116 (31.4)	
Panyadoli	212 (50.2)	25 (47.2)	187 (50.7)	
Maternal age category				0.321
< 20	88 (20.9)	15 (28.3)	73 (19.8)	
20–34	306 (72.5)	34 (64.2)	272 (73.7)	
> 34	28 (6.6)	4 (7.5)	24 (6.5)	
Marital status				0.091
Married	402 (95.3)	48 (90.6)	354 (95.9)	
Not married	20 (4.7)	5 (9.4)	15 (4.1)	
Education level				0.063
No formal education	43 (10.2)	9 (17.0)	34 (9.2)	
Primary	243 (57.6)	33 (62.3)	210 (56.9)	
Secondary	108 (25.6)	7 (13.2)	101 (27.4)	
Tertiary	28 (6.6)	4 (7.5)	24 (6.5)	
Employment				0.847
Formal	24 (5.7)	3 (5.7)	21 (5.7)	
Informal	106 (25.1)	15 (28.3)	91 (24.7)	
Unemployed	292 (69.2)	35 (66.0)	257 (69.6)	
Residence				0.068
Rural	334 (79.1)	47 (88.7)	287 (77.8)	
Urban	88 (20.9)	6 (11.3)	82 (22.2)	
Parity				**0.048**
Primigravida	119 (28.2)	21 (39.6)	98 (26.6)	
Multigravida	303 (71.8)	32 (60.4)	271 (73.4)	

Variable	Total (N = 422)	Malaria = 1 (n = 53)	Malaria = 0 (n = 369)	p-value
Trimester				0.189
Second trimester	311 (73.7)	43 (81.1)	268 (72.6)	
Third trimester	111 (26.3)	10 (18.9)	101 (27.4)	
ANC visits				0.358
< 4	230 (54.5)	32 (60.4)	198 (53.7)	
>=4	192 (45.5)	21 (39.6)	171 (46.3)	
Malaria is common				**0.011**
Yes	186 (44.1)	32 (60.4)	154 (41.7)	
No	236 (55.9)	21 (39.6)	215 (58.3)	
Previously Treated malaria				0.300
Yes	156 (37.0)	23 (43.4)	133 (36.0)	
No	266 (63.0)	30 (56.6)	236 (64.0)	
Missed ANC				0.477
Yes	73 (17.3)	11 (20.8)	62 (16.8)	
No	349 (82.7)	42 (79.2)	307 (83.2)	
IPT uptake				0.420
Yes	140(33.2)	15(28.3)	125(33.9)	
No	282(66.8)	38(71.7)	244(66.1)	
Net use				**< 0.001**
Yes	362 (85.8)	37 (69.8)	325 (88.1)	
No	60 (14.2)	16 (30.2)	44 (11.9)	

Multivariable analysis of factors associated with malaria among pregnant women receiving care at health centres within Bweyale town council between April and May 2026

After adjusting for potential confounders, non-use of LLINs remained the only factor independently associated with laboratory-confirmed malaria. Pregnant women who did not sleep under an LLIN had a 2.45-fold higher prevalence of malaria than those who reported sleeping under an LLIN (aPR = 2.45, 95% CI: 1.47–4.09; p = 0.001) (Table 4).

Table 4
shows multivariable analysis of factors associated with malaria among pregnant women receiving care at health centres within Bweyale Town Council between April and May 2026

Variable	aPR (95% CI)	p-value	aPR (95% CI)	p-value
Age category (years)				
< 20	1.00		1.00	
20–34	0.65 (0.37–1.14)	0.134	1.07 (0.61–1.86)	0.821
≥ 35	0.84 (0.30–2.32)	0.734	1.77 (0.61–5.18)	0.297
Parity				
Primigravida	1.00		1.00	
Multigravida	**0.60 (0.36–1.00)**	**0.048**	0.63 (0.37–1.09)	0.100
Trimester at first ANC visit				
First trimester	1.00		1.00	
Second trimester	0.65 (0.34–1.25)	0.199	0.67 (0.33–1.36)	0.267
Residence				
Urban	1.00		1.00	
Rural	2.06 (0.91–4.67)	0.082	2.11 (0.93–4.76)	0.072
Marital status				
Married	1.00		1.00	
Not married	2.09 (0.94–4.68)	0.072	1.14 (0.54–2.39)	0.736
IPT uptake				
Optimal	1.00		1.00	
Suboptimal	1.26 (0.72–2.21)	0.425	1.11 (0.61–2.02)	0.738
Net use				
Yes	1.00		1.00	
No	2.61 (1.55–4.39)	**< 0.001**	2.44 (1.46–4.08)	**0.001**

Discussion

This study assessed the prevalence of laboratory-confirmed malaria, malaria coinfections, and factors associated with malaria among pregnant women attending antenatal care in Bweyale Town Council, a high malaria transmission setting hosting both refugee and host populations. Approximately one in eight

pregnant women had laboratory-confirmed malaria, while HIV, hepatitis B virus, and syphilis prevalences remained relatively low. Malaria-HIV and malaria-syphilis coinfections existed though were uncommon, and non-use of LLINs was the only factor independently associated with malaria.

The observed prevalence of 12.6% suggests that malaria remains an important public health problem among pregnant women despite widespread implementation of LLIN distribution and IPTp-SP. Although lower than the prevalence reported at Gulu Regional Referral Hospital [32], the finding is consistent with reports from Ethiopia [33, 34]. Differences across studies likely reflect variations in malaria transmission intensity, seasonality, study populations, diagnostic methods, and levels of healthcare delivery. The relatively lower prevalence in Bweyale town council compared to Gulu may be explained by the timing of data collection, and variations in rainfall patterns that is, in Gulu regional referral hospital from July to August and in Bweyale town council from April to May and malaria peaks in the Gulu around June to July then September to October [35] thus the difference between the two study periods may also have influenced malaria transmission dynamics. It is also important to note that the current study determined malaria prevalence using rapid diagnostic tests (RDTs), which provide objective laboratory-confirmed results, whereas the Gulu study used a combination of RDT and microscopy with consecutive sampling at a regional referral hospital, which typically receives more complicated cases and may have a higher burden of malaria compared to lower-level health facilities.

The HIV prevalence reported in this study was 4.0%, which is comparable to 6.6% reported in Ethiopia [15] and 2.4% reported by an earlier study in Uganda [14]. The prevalence in other settings such as Canada is comparably lower, 0.5% [13]. The observed similarities and differences could trace back to the variability in study populations, settings, access and availability of HIV treatment and testing services. The prevalence of Hepatitis B was 2.8%. This is notably lower than earlier prevalences reported by earlier studies in the region, for example, 11.8% and 12.5% reported in Uganda and Ethiopia, respectively[17, 18]. The method of assessing for Hepatitis B in the current study could account for this, as it was assessed from patients' records and not through laboratory confirmation. Additionally, the syphilis prevalence reported in this study was 2.6%, which is consistent with earlier Ugandan studies, 4.0% and 5.1% [20, 21] however, lower than the prevalence reported in Sudan. Again, methodological differences could explain these differences. Overall, across the discussed studies, the recorded STI prevalence is relatively low, which we postulate could be an output of the triple testing for HIV/Hepatitis B/Syphilis that has been recommended by WHO. With this, any identified cases are identified and treated early, reducing the prevalence of these STIs.

Regarding the coinfections, the prevalence of malaria-HIV coinfection and malaria-Syphilis coinfection were 0.5% and 1.0%, respectively. Limited data exists on malaria coinfections in sub-Saharan Africa; however, a prevalence of malaria-HIV coinfection ranging from 0.94% to 37% has been reported by a recent African systematic review [36]. Though our study did not find malaria-Hepatitis B coinfection, an earlier study in Ghana reported a prevalence of 0.7%[37]. Despite the reported figures being relatively low, more data on malaria-STI coinfection is needed to improve antenatal care for all pregnant mothers and

consequently improve pregnancy outcomes. This is of particular interest as having coinfection has been shown to have higher odds of poor pregnancy outcomes than having a single infection [39].

In our study, mothers who did not use mosquito nets were more than twice as likely to have malaria than those who used mosquito nets. This is consistent with earlier studies[33] [24]. Mosquito nets are a major preventive measure commonly used in low-resource settings to protect mothers from mosquito bites and subsequent malaria infection. Non-use therefore increases exposure to mosquito bites, which directly contributes to increased susceptibility to malaria infection. Although there is an existing program to distribute mosquito nets to all pregnant mothers in Uganda, our study highlights the need to intensify the program and increase access for all pregnant mothers, which could potentially decrease malaria infection.

Strengths and limitations

This study employed the use of RDTs to objectively determine the prevalence of malaria, reducing the reliance on self-reported symptoms. Additionally, the study setting in Bweyale Town Council, which hosts a diverse population of both nationals and refugees, provides valuable insights into malaria prevention in a complex, multicultural environment. This study, however, had some limitations. The cross-sectional design limits the ability to establish causal relationships for malaria. Reporting coinfection based on history hinders our reporting of actual cases within our study population, as many went unrecorded. Additionally, since our study was conducted in Bweyale, our findings may not be generalizable to other regions with different socio-cultural and health system dynamics.

Conclusions

Approximately one in eight pregnant women attending antenatal care in Bweyale Town Council had laboratory-confirmed malaria.The prevalence of malaria-STI coinfection, though low, remains significant and calls for targeted interventions to address both infections. Non-use of mosquito nets revealed an association with malaria. This calls for intensification in the distribution of mosquito nets, as some populations remain with evident lack of access.

Abbreviations

aPR: Adjusted Prevalence Ratio, ANC: Antenatal Care, CI: Confidence Interval, cPR; crude prevalence ratio, DHIS2; District Health Information System, DHO; District Health Officer, GUREC; Gulu University Research and Ethics Committee, HC; Health Centre, IQR; Interquartile Range, IPTp-SP; Intermittent Preventive Treatment with Sulfadoxine-Pyrimethamine, DOT; direct observation therapy, MiP; Malaria in Pregnancy, MoH-Ug; ministry of health Uganda, RDT; Rapid Diagnostic Test, WHO; World Health Organization

Declarations

Ethical considerations

Ethical approval was obtained from the Gulu University Research Ethics Committee (GUREC) (Ref: GUREC-2025-895). Administrative permission was obtained from the Kiryandongo District Health Officer and the in-charges of Panyadoli Health Centre IV, Nyakadot Health Centre III, and Kichwabugingo Health Centre II.

Written informed consent was obtained from all participants before enrolment. Pregnant participants aged below 18 years also provided written informed consent, as they are recognized as emancipated minors under the Uganda National Guidelines for Research Involving Humans as Research Participants[31]. Participation was voluntary, and participants were informed of their right to decline or withdraw from the study at any time without affecting their access to routine healthcare services.

Participant confidentiality was maintained by collecting anonymized data, restricting access to password-protected datasets to the study team, and reporting findings in aggregate. Participants who tested positive for malaria during the study were promptly referred for treatment according to the Uganda National Malaria Treatment Guidelines, while those with documented HIV, hepatitis B virus, or syphilis infection received routine care through the existing antenatal care services.

Availability off data and material

All the necessary data are available within the manuscript and all its supporting files. Data will always be available upon request from the first author.

Competing interest

The authors declare that there is no conflict of interest.

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Author contributions

All Authors contributed to formal analysis, drafting and review of the manuscript

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