

Malaria Prevalence and Associated Factors among Pregnant Women Attending their First Antenatal Care in Kole and Kyenjojo Districts in Uganda

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Abstract

Malaria during pregnancy has negative consequences to both the mother and fetus. In 2019, there were an estimated 33million pregnancies globally, of which 35% were exposed to malaria in Africa. To avert the consequences, the Uganda Ministry of Health is implementing approaches for effective prevention with intermittent preventive treatment, use Insecticide-Treated Nets (ITN), prompt diagnosis, and treatment through antenatal care (ANC). This study was conducted to determine the prevalence of malaria and associated factors among pregnant women attending their first ANC visit in Kole and Kyenjojo Districts in Uganda. A cross-sectional study design was conducted among 760 randomly selected pregnant women. Quantitative data was collected using a structured questionnaire to gather participants' demographic, obstetric, coverage, and use of malaria preventive methods and laboratory results on malaria, anaemia, and HIV. Data was analyzed using STATA 15. Chi-square, odds ratio, and logistic regression were used to test for associations. The overall prevalence of malaria was 11.1%, varying from 6.8% in Kyenjojo to 15.3% in Kole District. Most cases were caused by *P. falciparum*. Factors associated with malaria were age of mother (aOR: 0.44, 95% CI: 0.21-0.88), residence in Kyenjojo (aOR: 0.48, 95% CI: 0.26-0.88), multiparity (aOR: 0.38, 95% CI: 0.16-0.91), anaemia (aOR: 2.12, 95% CI: 1.12-4.00) and ITN non-use (aOR: 6.17, 95% CI: 2.76-13.86). Malaria prevalence was low and varied between districts. Age, gravidity, gestational age, and ITN use had a significant association with malaria. Therefore, early screening and identification of mothers at most risk of complications during pregnancy is needed, plus improving ANC.

Keywords: Antenatal Care, Malaria in Pregnancy, Pregnant Women, Risk Factors, Uganda.

Introduction

Malaria remains a major preventable cause of maternal morbidity and adverse birth outcomes in Africa, where an estimated 12.4 million pregnant women were exposed to malaria in 2019 [1]. Although most malaria infections during pregnancy remain asymptomatic in endemic areas, these infections are associated with maternal anaemia and poor birth outcomes. The administration of

intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP), use of Insecticide-Treated Nets (ITNs), and early diagnosis and effective treatment are the four-pronged approaches being implemented by the Uganda Ministry of Health (MoH). Malaria in Uganda is endemic in approximately 95% of the country, affecting over 90% of the population. It is rank 4th globally. It is the single most important cause of morbidity and mortality among children under five and

pregnant women [2]. Every year, malaria accounts for 30-50% outpatient visits, 15-20% inpatient admissions, and 9-14% inpatient deaths [2]. Despite knowing the proven preventive interventions, their uptake has struggled. Therefore, knowing the predictors can aid in the identification and application of control measures.

The factors associated with increased odds of malaria prevalence in pregnant women have been documented in the literature with conflicting findings. Young age, primiparity, no uptake of SP has been reported to significantly increase the odds. Other studies found no such association. In Uganda, there are few studies examining the risk factors in relation to pregnant women attending their first ANC visit. Most studies of malaria during pregnancy have explored factors associated with uptake of anti-malarial interventions [3-7] and perceptions of malaria during pregnancy. In this study, maternal and health-related risk factors for malaria were evaluated in a high and low malaria transmission setting in Kole and Kyenjojo districts in Uganda, respectively. This study is one of the first to examine the association between maternal characteristics and malaria in pregnancy in Uganda in two regions of varying malaria transmission.

Materials and Methods

Study Setting

The study was conducted among pregnant women attending their first antenatal care clinics in two Districts with varying malaria transmission intensity. Kole District is in Northern Uganda, with a population estimate of 297,479. It has 19 health facilities. In 2020, 14,458 pregnant women in the Kole district attended the first ANC visit, with an average of 1,204 per month. Two high-volume facilities were selected as study sites. Alito HC III and Bala HC III. While Kyenjojo District is in Western Uganda with a population estimate of 525,400. It has 49 health facilities. In 2020, 21,716 pregnant women attended the first ANC

visit with an average of 1,809 per month. Similarly, two high-volume facilities were selected, Katooke HC III and Butunduzi HC III.

Design

A cross-sectional research design was adopted, and a quantitative data collection method was used. A structured questionnaire was used to collect data from pregnant women. Laboratory samples were collected to test for the presence of malaria parasites, HIV, and anaemia.

Sample Size Determination and Sampling Technique

The sample size of this study was calculated by using the formula to estimate a single population proportion, with the following assumption, malaria prevalence of 50%, with a confidence level of 95%, and margin of error of 5. A total sample size of 760 pregnant women were selected by using a systematic random sampling technique. The national HMIS form 071: integrated antenatal register was used as the sampling frame. After randomly selecting the start point, thereafter every third unit in the list was included.

Data Collection

A pre-tested structured questionnaire was administered by trained midwives to obtain data on socio-demographic, obstetric, health-related characteristics of the pregnant women as well as coverage and use of malaria prevention measures. Finger pricked blood samples were taken to detect the presence of malaria parasites (thin and thick blood slides), to measure haemoglobin level using HemoCue® 201 machine, and HIV testing by a trained Phlebotomist.

Data Management and Analysis

Quantitative data was collected using ODK software, exported to Microsoft Excel, and then transferred to STATA version 15 statistical package for further analysis. The outcome variable for this study was malaria infection

which was assessed using microscopy. The independent variables include socio-demographic factors (age, marital status, educational status, and occupational status); obstetric factors (gravidity, parity, trimester of pregnancy, history of abortion); malaria prevention measures (ITN ownership and use). Descriptive statistics were done to explain the study population in relation to relevant variables. Both bi-variate and multi-variate logistic regressions were used to assess the association. Odds ratios generated were used to reflect the likelihood of risk factors to malaria prevalence in pregnant women.

Ethical Approval

Mildmay Uganda Institutional Review Committee (REF 0209-2020), Uganda National Council for Science and Technology, and University Ethical committee Texila American University Guyana approved the study. Written informed consent was obtained from all study

participants. Data collected from each participant and results of laboratory tests were kept confidential.

Results

Socio-Demographic Characteristics of the Pregnant Women

A total of 760 pregnant women (379 in Kole and 381 in Kyenjojo) were included in this study, with a response rate of 99%. The age of the participants ranged from 15 to 46 years with a median age of 23, the majority (41.1%) of them between 20–24 years. The majority (94.5%) of the women were married, and about 77% of the women completed their primary and secondary level education, and 97% were farmers. Forty-three percent of the mothers were multigravidae, 50.36% of them were in their second trimester for their first ANC (Table 1). Over 85% of pregnant women owned at least one ITN (Figure 1).

Table 1. Background Characteristics of Pregnant Women

Socio-demographics	Kole (N=379)		Kyenjojo (N=381)		Total (N= 760)	
	Frequency	Percent (%)	Frequency	Percent (%)	Freq	Percent (%)
Age						
Median	23	-	-	-	23	-
Min	15	-	15	-	15	-
Max	46	-	40	-	46	-
Mean	24	-	25	-	24	-
Age Group						
≤19	88	23.2	58	17.9	156	20.5
20 – 24	153	40.4	159	41.6	312	41.1
25 – 29	80	21.1	76	20.0	156	20.5
30 – 34	36	9.5	48	12.6	84	11.1
≥35	22	5.8	30	7.9	52	6.8
Occupation						
Farmers	368	97.1	323	84.8	691	90.9
Traders/Professional	11	2.9	30	7.8	41	5.4
Unemployed	0	0.0	28	7.4	28	3.7
Education Level						
None	90	23.7	86	22.6	176	23.2
Primary	266	70.2	228	59.8	494	65.0
Secondary or Higher	23	6.1	67	17.6	90	11.8
Marital status						

Not married	4	1.1	38	10.0	42	5.5
Married	375	98.9	343	90.0	718	94.5
Gravidity						
Primigravidae	142	37.5	91	23.9	233	30.7
Secundigravidae	57	15.0	143	37.5	200	26.3
Multigravidae	180	47.5	147	38.6	327	43.0
Trimester						
1st	186	49.1	126	33.1	312	41.0
2nd	168	44.3	214	56.2	382	50.3
3rd	25	6.6	41	10.7	66	8.7

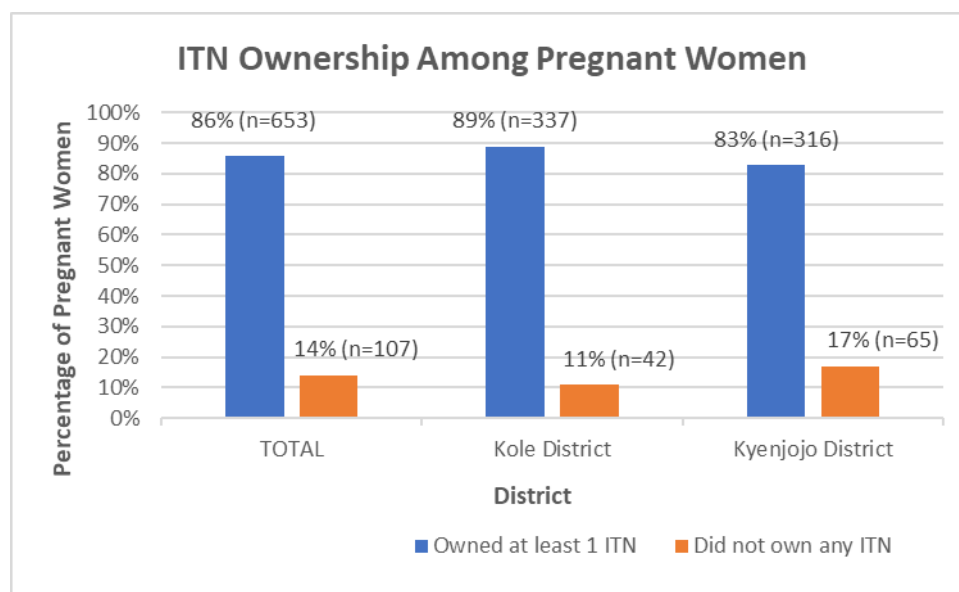


Figure 1. ITN Ownership among Pregnant Women

Prevalence of Malaria Infection among Asymptomatic Pregnant Women

Malaria prevalence in pregnant women as determined by mRDT and microscopy was 18.2% 95% CI: 15.6–21.1) and 11.1% (95% CI: 9.0–13.5) respectively (Figure. 2). High at 15.3% in Kole and 6.8% in Kyenjojo. The majority, 96.4%, of cases were due to *P. falciparum*.

Bi-variate Analysis of Factors associated with Malaria Prevalence among Pregnant Women

In this study, the age group ($p < 0.0001$) of the pregnant women was found to be significantly associated with malaria prevalence. More

prevalent in the younger age (15 – 19 years) compared to other age groups. The prevalence decreased with increasing age. The other variables (including marital status, educational level attained and occupation) yielded no significant association. The mother's gravidity and gestation period were found to be associated with malaria prevalence ($p < 0.001$). More prevalent in primigravidae compared to multigravidae. Pregnant women in their 1st trimesters were more susceptible to malaria than their counterpart in 2nd or 3rd trimesters. ITN use was found to be statistically significant at $p < 0.001$, only in Kyenjojo but not in Kole District (Table 2 and 3).

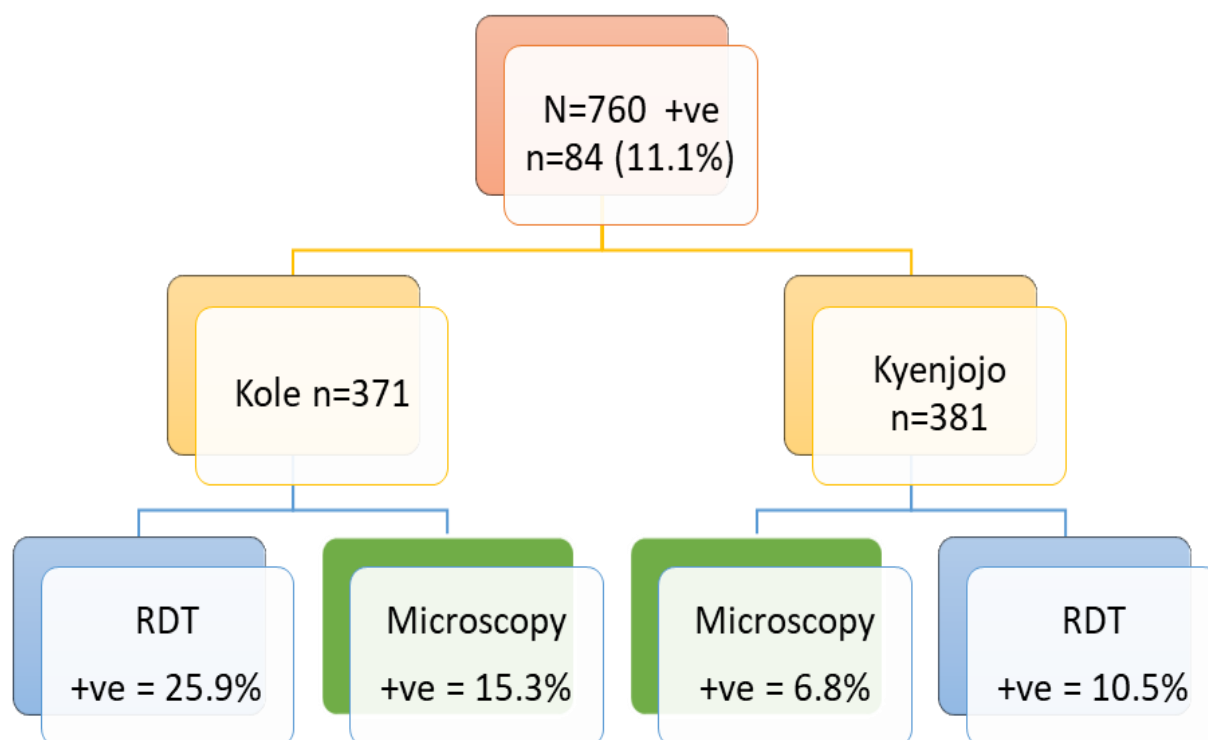


Figure 2. Malaria Prevalence among Pregnant Women by Microscopy and RDT

Table 2. Bivariate Analysis of Socio-demographic Factors associated with Malaria Prevalence in Pregnant Women

Socio-demographic characteristics	Total		Kole District		Kyenjojo District	
	Malaria (by microscopy)		Malaria (by microscopy)		Malaria (by microscopy)	
	Positive	p-value**	Positive	p-value**	Positive	p-value**
	N (%)		N (%)		N (%)	
Age (years)						
Adolescents (15-19)	40 (25.64)	$P<0.001^{**}$	26 (29.55)	$P<0.001^{**}$	14 (20.59)	$P<0.001^{**}$
Adults (≥ 20)	28 (8.97)		32 (11.00)		12 (3.83)	
Marital status						
Not married	3 (7.14)	$P=0.611$	0 (0.00)	$P=0.393$	3 (7.9)	$P=0.734$
Married	81 (11.28)		58 (15.47)		23 (6.7)	
Educational level						
No education	12 (6.82)	$P=0.074^*$	8(8.89)	$P=0.114$	4 (4.65)	$P=0.656$
Primary level	64 (12.96)		46 (17.29)		18 (7.89)	
Secondary & higher	8 (9.52)		4 (20.0)		4 (6.25)	
Occupation						
Farmer	78 (11.29)	$P=0.82$	58 (0.00)	$P=0.228$	20 (6.19)	$P=0.426$
Traders/Professional	2 (10.71)		0 (0.00)		3 (10.00)	
Unemployed	3 (7.32)		0 (0.00)		3 (10.71)	

Note: Row percent used, ** Pearson's chi-square test at alpha = 0.05, N values are weighted

Table 3. Bivariate Analysis of Obstetric and Health-Related Factors Associated with Malaria Prevalence in Pregnant Women

Obstetric and other Characteristics	Total		Kole District		Kyenjojo District	
	Malaria (by microscopy)		Malaria (by microscopy)		Malaria (by microscopy)	
	Positive	p-value**	Positive	p-value**	Positive	p-value**
	N (%)		N (%)		N (%)	
Gravidity						
Primigravidae	55 (23.61)	P<0.001**	37 (26.06)	P<0.001**	18 (19.78)	P<0.001**
Secundigravidae	14 (7.00)		10 (17.54)		4 (2.80)	
Multigravidae	15 (4.59)		11 (6.11)		4 (2.72)	
Gestation period						
First Trimester	56 (17.95)	P<0.001**	41 (22.04)	P=0.002**	15 (11.90)	P=0.024*
Second Trimester	24 (6.28)		15 (8.93)		9 (4.21)	
Third Trimester	4 (6.06)		2 (8.00)		2 (4.88)	
HIV serostatus						
Positive	4 (50.0)	P<0.001**	4 (50.00)	P=0.022*	0 (0.00)	P=0.296
Negative	80 (10.6)		80 (10.6)		26 (12.31)	
Haemoglobin levels						
Any anaemia	56 (17.95)	P<0.001**	26 (25.49)	P=0.001**	10 (4.85)	P<0.001**
No anaemia	24 (6.28)		32 (11.55)		16 (4.85)	
ITN ownership						
Yes	67 (10.26)	P=0.085*	49 (14.54)	P=0.242	18 (5.70)	P=0.054*
No	17 (15.89)		9 (21.43)		8 (12.31)	
Number of ITN owned						
None	17 (15.89)	P=0.005**	9 (21.43)	P<0.001**	8 (12.31)	P=0.072
One	41 (14.49)		29 (20.86)		12 (8.33)	
Two	21 (9.77)		18 (16.98)		3 (2.75)	
Three & more	5 (3.23)		2 (2.17)		3 (4.76)	
ITN Use						
Yes	50 (8.25)	P<0.001**	43 (13.87)	P=0.253	7 (2.36)	P<0.001**
No	17 (36.17)		6 (22.2)		11 (55.0)	

Note: Row percent used, ** Pearson's chi-square test at alpha = 0.05, N values are weighted

Multi-variate Analysis of Factors Associated with Malaria Prevalence among Pregnant Women

Multiple logistic regression analysis was performed to identify independent predictors of malaria among pregnant women. Ten explanatory variables that were associated with malaria in bivariable analyses at 10% level of significance were entered into the multiple logistic regression models. In the last step of the analysis, two variables were excluded. Age,

area of residence, gravidity, gestation age, and use of ITN showed a significant association with the prevalence of malaria at $p<0.05$. Accordingly, being an adult (older mothers aged ≥ 20 years or more) had a 56% (AOR: 0.44, 95% CI: 0.21-0.88) protection from malaria infection compared to adolescents (young mothers 15-19 years). Staying in Kyenjojo district had a 52% (AOR: 0.48, 95% CI: 0.26-0.88) less likely to be infected with malaria compared to pregnant women in the Kole district. Multigravidae 62% (AOR: 0.38,

95% CI: 0.16-0.91) less likely to be infected with malaria compared to Primigravidae and Secundigravidae. Women not using ITNs were

6 times (AOR: 6.17, 95% CI: 2.76-13.86) more likely to be infected with malaria as compared to those using ITNs (Table 4).

Table 4. Multi-variate Analysis of Risk Factors Associated with Malaria Prevalence in Pregnant Women

Factors	Crude Estimates			Adjusted Estimates		
	OR	95% CI	p-value	aOR	95% CI	p-value
Age in years						
Adolescents (15-19)	1	-	-	1	-	-
Adults (>20 yrs)	0.23	0.14 - 0.37	<i>P</i> <0.001**	0.44	0.21 – 0.88	<i>P</i> =0.021*
Location						
Kole	1	-	-	1	-	-
Kyenjojo	0.23	0.14 – 0.66	<i>P</i> <0.001**	0.48	0.26 – 0.88	<i>P</i> =0.018*
Educational level						
No education	1	-	-	1	-	-
Primary	2.03	1.07 - 3.87	<i>P</i> =0.03*	1.26	0.55 – 2.91	<i>P</i> =0.589
Secondary/Higher	1.44	0.56 - 3.66	<i>P</i> =0.446	1.23	0.40 – 3.77	<i>P</i> =0.718
Gravidity						
Primigravidae	1	-	-	1	-	-
Secundigravidae	0.24	0.13 - 0.45	<i>P</i> <0.001**	0.68	0.30 – 1.58	<i>P</i> =0.372
Multigravidae	0.16	0.09 - 0.28	<i>P</i> <0.001**	0.38	0.16 – 0.91	<i>P</i> =0.03**
Gestation period						
First Trimester	1	-	-	1	-	-
Second Trimester	0.31	0.19 – 0.51	<i>P</i> <0.001**	0.51	0.27 – 0.96	<i>P</i> =0.035**
Third Trimester	10.29	0.10 – 0.84	<i>P</i> =0.023	0.58	0.12 – 2.62	<i>P</i> =0.476
HIV serostatus						
Positive	1	-	-	1	-	-
Negative	0.12	0.03 – 0.49	<i>P</i> =0.003**	0.08	0.01 – 0.43	<i>P</i> =0.003**
Haemoglobin level						
No anaemia	1	-	-	1	-	-
Any anaemia	3.58	2.22 – 5.77	<i>P</i> <0.001**	2.12	1.12 – 4.00	<i>P</i> =0.021*
ITN Use						
Yes	1	-	-	1	-	-
No	6.30	3.25 – 12.2	<i>P</i> <0.001**	6.27	2.82 – 13.94	<i>P</i> <0.001**

Note: Row percent used, ** Pearson's chi square test at alpha = 0.05, N values are weighted

Discussion

The overall prevalence of malaria was found to be 11.1%, with prevalence higher in Kole district at 15.3% compared to 6.8% in Kyenjojo district (*P*<0.001). The results are similar to studies conducted in the Central region of Uganda (10%) [8], West Ethiopia (10.8%) [9], Sudan (13.7%) [10], a systematic review and meta-analysis in Ethiopia 12.7% [11] and in

Ghana (8.9%) [12]. However, our results were higher than studies conducted in Ethiopia (2.83%) [13], coastal Ghana (5%) [14], South-West Nigeria (7.7%) [15], Southern Laos (8.3%) [16] and India (5.4%) [17]. This difference might be attributed to the difference in geographical location among the study areas. On the other hand, the prevalence in our study was found to be much lower than the findings from one study conducted in Uganda, which

showed a prevalence that varied from varied from 20% in Mulago [18], 21.3% in Mbale [19] to 66% in Tororo [20]. This difference may be due to the scale-up of prevention measures like increased ITN, in our study, over 83% coverage of at least 1 ITN and use of 92% for those mothers who had access.

Factors associated with the prevalence of malaria among pregnant women - at multi-variate analysis, age of the pregnant woman, residence/district, gravidity, gestational age, anaemia, and ITN utilization were found to be significantly associated with malaria infection. Age of the mother - In this study, mothers with an increased age were found to have lower odds of developing malaria infection. This is in line with studies conducted in different tropical African countries [21, 22, 23] which reported pregnant women of a young age are at the greatest risk of malaria infection. This may be attributed to mothers with increased age have better exposure, good awareness about malaria prevention, and previous frequent malaria exposures leading to developing immunity to malaria. However, according to the studies conducted in Ethiopia [24], and Sudan [10], age had no significant association with malaria infection.

Gravidity and gestational age as risk factors to MiP – In our study, pregnant women who were in the 1st trimester were at increased odds of developing malaria infection compared to mothers in their 2nd or 3rd trimester. Besides this, prime gravidae had increased odds of malaria infection compared to the multigravid. Similar results were found from studies done in sub-Saharan Africa countries [24-27], which showed a higher risk of malaria infection among primigravidae than multigravidae. Low risk of malaria among multigravidae mothers may be associated with the development of pre-immunity to malaria with increased gravidity and previous exposures. Primigravidae mothers lack antiadhesion antibodies against CSA binding parasites, which develop only after successive pregnancies, and this makes them

more susceptible to infection [28].

ITN – Not using ITN in our study increased the odds of developing malaria infection during pregnancy. Our finding was also in agreement with the study conducted in Nigeria [24] and Ethiopia [21], which showed that the use of bed nets had an impact on decreasing infection. The possible explanation could be ITNs effectively reduce human-mosquito contact, which can prevent diseases. In this study, the coverage of ITNs was very high in both districts (Kole at 89% and Kyenjojo at 83%), while ITN use among those who owned at least 1, ITN was very good at 93.7%. This may explain the high protective effect observed in our study. However, our results are different from those reported in Ghana, where ITN use was associated with a higher risk of malaria parasitaemia [29]. However, this surprising result was attributed to the state of the ITN used because about 12% of participants in their study reported the nets in which they slept were torn.

Conclusion

The study findings show that malaria prevalence among pregnant women in both districts was low, varying among the two districts – higher in Kole districts and lower in Kyenjojo and *P. falciparum* is the most predominant Plasmodium species. Age of pregnant woman, gravidity, gestational age, ITN use, and anaemia had a significant association with malaria infection. The timing of the first visit for ANC is critical for early screening and identification of mothers at most risk of complications during pregnancy, including malaria. Hence any mother screened with these risks' factors should be considered "most at risk" and included as part of the criteria for admission of those with them. There is value if the information on the prevalence of malaria at the ANC booking becomes more widely available through simple screening as done in this study were to be adopted in areas for broader malaria surveillance and monitoring deployment of interventions.

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Conflict of Interest

The authors declare no conflicts of interest in this work.

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