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Factors Associated with Malaria in Pregnancy among Women Attending Fort Portal Regional Referral Hospital in Fort Portal City, Western Uganda

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ABSTRACT

Globally, there was a significant decrease in the number of malaria-risk pregnancies between 2007 and 2020. The risk of *Plasmodium falciparum* or *Plasmodium vivax* malaria increased by 25% in Africa compared to 2007. Due to the fast-expanding population and associated rise in pregnancies in malaria-endemic areas, the number of people at risk in Africa has increased despite malaria rates declining in the region. This study determined the prevalence and factors associated with malaria in pregnancy among women attending Fort Portal Regional Referral Hospital. This was a single-center health facility-based cross-sectional study. Data was collected using a face-to-face interview through a structured questionnaire from willing participants. After collecting the data, the principal investigator checked the completed questionnaires for consistency and completeness. Data was coded, cleaned, and entered into the computer using Microsoft Excel, and then analyzed using SPSS version 20. Logistic regression analysis was done to ascertain the relationship between dependent and independent variables. Descriptive statistics were summarized in the form of frequency tables, pie charts, p-values, and odds ratios. A total of 253 pregnant mothers attending ANC were enrolled in this study. The majority (38.3%) of the study participants were aged 30-39 years, attained secondary education (52.2%), earned 100,000–200,000 per month (56.9%), and were housewives (51.0%). In this study, the prevalence of malaria in pregnancy was 10.3%. Age, level of education, income status, and residence, use of an ITN, gravidity, and ANC follow-up were significantly associated with malaria in pregnancy at multivariate logistic regression analysis. Malaria continues to be a major public health issue among pregnant mothers. Age, level of education, income status, and residence, use of an ITN, gravidity, and ANC follow-up were factors significantly associated with malaria in pregnancy.

Keywords: Pregnancies, Malaria, Plasmodium, ITN, ANC.

INTRODUCTION

Malaria is an acute febrile illness caused by Plasmodium parasites, which are spread to people through the bites of infected female Anopheles mosquitoes. It is preventable and curable [1–4]. Although the worldwide burden of malaria has decreased recently, over 40% of the world's population continues to be at risk of infection, and over 400,000 people die from the disease each year [5]. Due to immunological changes that occur during pregnancy and the distinct propensity of a subpopulation of *P. falciparum* parasites to sequester in the maternal blood compartments of the placenta, pregnant women are particularly susceptible to malaria infection [6]. This placental malaria infection aids the parasite's resistance to the immune system's clearing and, in particular, spleen filtration. The red cell surface infected by *P. falciparum* parasites expresses a protein termed VAR2CSA that binds to the placental receptor chondroitin sulfate A (CSA) [7]. The cause of malaria is a blood infection by Plasmodium protozoan parasites, which are spread from person to person by female Anopheles mosquitoes. Humans are infected by four types of malaria parasites. *Plasmodium vivax* and *Plasmodium malariae* are the two that have probably attained the greatest global dispersion [8, 9]. Severe malaria in pregnant women, especially in the first pregnancy, and related IUGR and LBWs in children are all caused by changes in physiology and immunology during pregnancy, as well as the ability of P. falciparum-infected erythrocytes to sequester to different organs [10]. Because cortisol levels rise during pregnancy, NK cell function against P. falciparum-infected erythrocytes is directly inhibited, making pregnant women more susceptible to malaria. Cell-mediated immunity (CMI), which is necessary to

maintain the development of the placenta and the fetus, is inhibited in pregnant women. But because CMI is reduced, intracellular pathogens are now more dangerous to pregnant women. The local placental environment has, however, been found to have an increase in CMI in pregnant women who have malaria. The observed placental pathology and unfavorable pregnancy outcomes are caused by increased levels of pro-inflammatory cytokines, particularly in primigravidae, in the placentas of malaria-infected mothers [11]. Plasmodium falciparum-infected erythrocyte sequestration and immune cell infiltration within the intervillous spaces of the placenta are characteristics of malarial infection in the placenta. The malarial pigment deposits on the placenta, turning it black. When compared to peripheral blood, the placenta has a substantially higher parasite density [12]. Syncytial knotting, perilous fibrinoid deposits, and placental basement membrane thickening all lead to impaired feto-maternal communication. IUGR is brought on by the placenta's inability to properly nourish the fetus [13]. Globally, there was a significant decrease in the number of malaria-risk pregnancies between 2007 and 2020 [14]. The risk of P falciparum or P vivax malaria increased by 25% in Africa compared to 2007. Due to the fast-expanding population and associated rise in pregnancies in malaria-endemic areas, the number of people at risk in Africa has increased despite malaria rates declining in the region. Pregnancy is a physiological condition marked by various changes, including a decline in immunity culminating in susceptibility to various health challenges [15, 16]. Pregnancy-related malaria infection is a significant public health issue, particularly in sub-Saharan Africa (SSA), where it was estimated that 11.6 million pregnancies were affected by the infection in 2020 [17]. In sub-Saharan Africa, 819,000 low-birthweight babies were born in 2020 as a result of malaria during pregnancy [18]. In malaria-endemic areas, WHO advises early detection and treatment of malaria in pregnancy, as well as malaria prevention with long-lasting insecticide-treated nets and intermittent preventive treatment with sulfadoxine-pyrimethamine beginning in the second trimester [17]. Although Uganda is thought to be a malaria-endemic area, there are large regional variations in the transmission rates of the disease. For the prevention of malaria during pregnancy, the Uganda Ministry of Health advises giving three or more doses of Fansidar as part of an intermittent preventive therapy (IPTp3) regimen [19]. In Uganda, the prevalence of malaria is high, and both pregnant women and unborn children who contract the disease suffer severe consequences. Despite the consequences of malaria, there is limited literature on the factors associated with malaria in pregnancy among mothers in Western Uganda. Thus, this study determined the factors associated with malaria in pregnancy among mothers attending Fort Portal Regional Referral Hospital.

METHODOLOGY

Study Design

This was a single-centre health facility-based cross-sectional study

Area of Study

The study was conducted at Fort Portal Regional Referral Hospital in Fort Portal City, Western Uganda. It is approximately 148 kilometres by road west of Mubende Regional Referral Hospital and 294 kilometres west of Mulago National Referral Hospital in Kampala, Uganda's capital city.

Study Population

The study population was all pregnant women seeking care at Fort Portal Regional Referral Hospital.

Inclusion criteria

All pregnant women who consented to the study.

Exclusion criteria

Pregnant women who did not consent to the study.

Sample Size Determination

The researcher used the Kish-Leslie formula [20] to determine the required sample size.

$n=Z^2P(1-P)/E^2$

n=Estimated minimum sample size required

P=20.8%[21])

Z=1.96(For 95% confidence interval)

e=Margin of error set at 5%

$n=1.96^2\times0.208(1-0.208)/0.05^2$

n=253

Therefore, a sample of 253 participants was used in the study.

Sampling Procedures

The researcher adopted a convenient sampling method to obtain study participants for the study. All pregnant women attending ANC at Fort Portal Regional Referral Hospital were enrolled on the study daily till the required minimum sample population was attained.

Data Collection Tools

Data was collected using a face-to-face interview through a structured questionnaire from willing participants. The Questionnaire was divided into two sections. Section A for socio-demographic factors and Section B for Obstetric factors. Medical laboratory technicians and the lead investigator collected capillary blood to detect and identify Plasmodium species. The side of a pregnant woman's fingertip was pierced with a sterile lancet after being cleansed with 70% ethyl alcohol. The first blood drop which contains tissue fluids was wiped away. Two and one microliters litres of blood were used for the preparation of thick and thin blood films respectively. The blood films were dried by air and absolute methanol was used to fix thin films. Following that, 10% Giemsa was used to stain the smears and examined by standard operating procedures under a light microscope. A result was concluded following an examination of at least 100 oil immersion fields. Thick blood films were used for parasite quantification while thin films were used for species identification.

Data Analysis and Management

After collecting the data, the principal investigator checked the complete questionnaires for consistency and completeness. Data was coded, cleaned and entered into the computer using Microsoft Excel and then analyzed using SPSS version 20. Bivariate logistic regression analysis was carried out for each independent variable and variables with p-values less than 0.2 were included in multivariate logistic regression analysis. Variables with P-values less than 0.05 at multivariate analysis were considered statistically significant. Descriptive statistics was summarized in the form of frequency tables, pie charts, p-values and odds ratios.

Quality Control

Data collection tools were pre-tested outside the study setting to ensure accuracy and consistency. After each field day, data collection equipment was reviewed for completeness and accuracy and kept safely. The principal investigator trained the data collectors before the study.

Ethical Considerations

All the required permissions to carry out research were sought from the research and ethics committee of KIU, as well as the hospital administration of Fort Portal Regional Referral Hospital. Before collecting data, consent was sought from the respondents. Respondents were interviewed individually to ensure privacy and confidentiality.

RESULTS

Distribution of socio-demographic characteristics of the respondents

A total of 253 pregnant mothers attending ANC were enrolled on this study. The majority (38.3%) of the study participants were aged 30-39 years, attained secondary education (52.2%), earned 100,000-200,000/= per month (56.9%) and were housewives (51.0%). The majority (90.5%) were married, residing in rural areas (66.4%) and 28.5% were not using insecticide-treated nets as shown in the table below.

Table 1: Distribution of socio-demographic characteristics of the respondents

Variable	N=253	Percentage (%)
Age(Years)		
≤20	41	16.2
21-29	77	30.4
30-39	97	38.3
≥40	38	15.0
Level of education		
No formal education	09	3.6
Primary	65	25.7
Secondary	132	52.2
Tertiary	47	18.6
Income status		
≤100,000/=	37	14.6
100,000-200,000/=	144	56.9
≥200,000/=	72	28.5
Occupation		
Peasant	61	24.1
Business	28	11.1
Housewife	129	51.0
Formally employed	35	13.8
Marital status		
Married	229	90.5
Single	24	9.5
Area of residence		
Urban	85	33.6
Rural	168	66.4
Use of an ITN		
Yes	181	71.5
No	72	28.5

Obstetric characteristics of the respondents

The majority of the participants (73.9%) were multiparous, multigravida (80.6%), in the second trimester (49.0%) and attended ANC less than 3 times (83.4%) as shown in the table below.

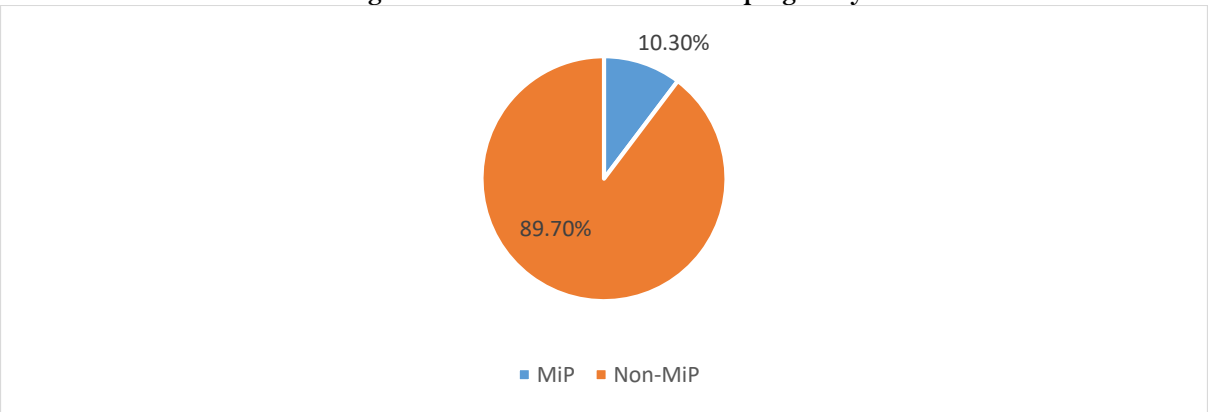
Table 2: Obstetric characteristics of the respondents

Variable	N=253	%
Parity		
Primiparous	66	26.1
Multiparous	187	73.9
Gravidity		
Primegravida	49	19.4
Multigravida	204	80.6
Gestational age		
First trimester	66	26.1
Second trimester	124	49.0
Third trimester	63	24.9
ANC follow-up		
≤3times	211	83.4
≥4times	42	16.6

Prevalence of malaria in pregnancy

In this study, the prevalence of malaria in pregnancy was 10.3% as shown in the figure below.

Figure 1: Prevalence of malaria in pregnancy



Bivariate analysis of socio-demographic factors associated with malaria in pregnancy

At bivariate analysis, age, level of education, income status, marital status, area of residence and use of an ITN were significantly associated with MiP as shown in the table below.

Table 3: Bivariate analysis of socio-demographic factors associated with malaria in pregnancy

Variable	N=253	MiP n(%)	cOR(95% CI)	P-Value
Age(Years)				
≤20	41	08(19.5)	2.15(1.04-4.51)	0.001
21-29	77	10(13.0)	1.50(0.82-2.36)	0.046
30-39	97	06(6.2)	1.23(0.72-1.80)	0.142
≥40	38	02(5.3)	Reference	
Level of education				
No formal education	09	04(44.4)	2.44(1.42-5.71)	0.085
Primary	65	09(13.8)	1.10(0.56-2.66)	0.126
Secondary	132	11(8.3)	0.87(0.22-1.28)	0.106
Tertiary	47	03(6.4)	Reference	
Income status				
≤100,000/=	37	07(18.9)	2.09(1.55-5.72)	0.005
100,000-200,000/=	144	13(9.0)	1.80(1.01-3.40)	0.014
≥200,000/=	72	06(8.3)	Reference	
Occupation				
Peasant	61	10(16.4)	1.00(0.77-2.08)	0.294
Business	28	04(14.3)	0.91(0.41-1.60)	0.408
Housewife	129	10(7.8)	0.56(0.22-1.29)	0.227
Formally employed	35	02(5.7)	Reference	
Marital status				
Married	229	17(7.4)	Reference	
Single	24	09(37.5)	2.18(1.17-4.56)	0.006
Area of residence				
Urban	85	06(7.1)	Reference	
Rural	168	20(11.9)	1.94(1.35-4.92)	0.003
Use of an ITN				
Yes	182	09(4.9)	Reference	
No	72	17(23.6)	3.71(1.70-7.23)	0.001

Bivariate analysis of Obstetric factors associated with malaria in pregnancy

Gravidity, gestational age and ANC follow-up were significant in bivariate analysis and they were therefore considered for multivariate analysis as shown below.

Table 4: Bivariate analysis of obstetric factors associated with malaria in pregnancy

Variable	N=253	MiP n(%)	cOR(95% CI)	P-Value
Parity				
Primiparous	66	12(18.2)	0.57(0.19-1.05)	0.817
Multiparous	187	14(7.5)	Reference	
Gravidity				
Primegravida	49	09(18.4)	1.31(0.71-2.53)	0.021
Multigravida	204	17(8.3)	Reference	
Gestational age				
First trimester	66	08(12.1)	1.42(1.01-4.18)	0.184
Second trimester	124	13(10.5)	1.10(0.56-2.38)	0.015
Third trimester	63	05(7.9)	Reference	
ANC follow-up				
≤3times	211	23(10.9)	1.24(0.94-3.16)	0.049
≥4times	42	03(7.1)	Reference	

Multivariate analysis of factors associated with malaria in pregnancy.

Age, level of education, income status, area of residence, use of an ITN, gravidity and ANC follow-up were significantly associated with malaria in pregnancy at multivariate logistic regression analysis as shown in the table below.

Table 5: Multivariate analysis of factors associated with malaria in pregnancy

Variable	N=253	MiP n(%)	aOR(95% CI)	P-Value
Age(Years)				
≤20	41	08(19.5)	1.74(0.89-3.42)	0.002
21-29	77	10(13.0)	1.16(0.61-2.17)	0.015
30-39	97	06(6.2)	1.07(0.40-1.55)	0.031
≥40	38	02(5.3)	Reference	
Level of education				
No formal education	09	04(44.4)	1.80(1.23-4.81)	0.004
Primary	65	09(13.8)	0.94(0.34-2.37)	0.008
Secondary	132	11(8.3)	0.61(0.07-1.06)	0.027
Tertiary	47	03(6.4)	Reference	
Income status				
≤100,000/=	37	07(18.9)	1.62(1.20-4.61)	0.001
100,000-200,000/=	144	13(9.0)	1.45(0.90-2.73)	0.029
≥200,000/=	72	06(8.3)	Reference	
Marital status				
Married	229	17(7.4)	Reference	
Single	24	09(37.5)	1.76(0.89-3.25)	0.068
Area of residence				
Urban	85	06(7.1)	Reference	
Rural	168	20(11.9)	1.50(1.04-4.41)	0.001
Use of an ITN				
Yes	182	09(4.9)	Reference	
No	72	17(23.6)	2.97(1.33-6.80)	0.002
Gravidity				
Primegravida	49	09(18.4)	1.14(0.43-1.92)	0.006
Multigravida	204	17(8.3)	Reference	
Gestational age				
First trimester	66	08(12.1)	1.03(0.74-3.52)	0.076
Second trimester	124	13(10.5)	0.85(0.31-1.79)	0.058
Third trimester	63	05(7.9)	Reference	
ANC follow-up				
≤3times	211	23(10.9)	1.06(0.60-2.45)	0.003
≥4times	42	03(7.1)	Reference	

DISCUSSION

Prevalence of malaria in pregnancy

The prevalence of malaria, according to this study, was 10.3%. This study has shown a prevalence of malaria that is lower than the prevalence of 26.1% and 11.1% reported by previous studies in Uganda, respectively [22, 23]. However, the finding is higher compared to 9% and 8.73% reported in Central and

Eastern Uganda, respectively [24, 25]. The geographic location of the research areas could be the cause of this discrepancy.

Socio-demographic factors associated with malaria in pregnancy

There is strong evidence linking the socioeconomic divide with the likelihood of contracting an infectious disease [26]. In this study, women of old age had lower odds of developing malaria during pregnancy. This is in line with a study in Ethiopia that showed that women of young age are at a high risk of malaria infection as well as having the highest parasite densities [27]. This may be explained by the fact that older mothers have better access to healthcare resources and have a better understanding of the condition and its preventative measures. Additionally, older mothers who have been exposed to malaria regularly in the past may become immune to the disease. However, age did not significantly correlate with malaria infection, according to studies carried out in the rural areas surrounding Arbaminch Town in Ethiopia [28] and Sudan [29]. ITN adoption is one of three measures recommended by the WHO, MoH, and President Malaria Initiatives (PMI) to combat malaria in Ethiopia. This study revealed that women who were not using ITNs had higher odds of developing malaria during pregnancy. The study's findings are in agreement with a study conducted in Ethiopia, which showed that the use of bed nets has a significant impact on decreasing malaria infection [30]. ITNs' ability to effectively minimize human-mosquito interaction, which can prevent infections, may be a possible explanation. In the present study, education status was significantly associated with malaria in pregnancy. Women with no formal education had increased malaria susceptibility compared to those who had primary education and above. A similar finding was reported by studies done in Ethiopia [21]. The present study found that the prevalence of malaria was inversely proportional to income status. This is consistent with a study conducted in Uganda [22]. This may be because it is less probable for poor people to have adequate housing and fair access to healthcare.

Obstetric factors associated with malaria in pregnancy

In the current study, gravidity had a significant association with malaria in pregnancy. It is similar to a study in Ethiopia, where Primigravida mothers were more vulnerable to malaria [31-34]. The non-immune nature of primigravida mothers may be the cause of this. Mothers become immune and less susceptible to contracting malaria as gravidity increases [35-37]. In contrast to primigravidae, multigravid women experienced immunity during their third or subsequent pregnancies, which suggests that prenatal exposure results in the development of variant-specific immune responses. Pregnant women express a variant surface antigen that interacts with the syncytiotrophoblasts lining the placental blood spaces to bind to chondroitin sulfate A. Pregnant women are the only ones who can have this variant surface antigen, also known as VAR2CSA (Variant surface antigen 2-chondroitin sulfate A). Primigravid women are extremely vulnerable to malaria because they lack antibodies to VAR2CSA. Multigravidae who have more than one pregnancy experience increased immunity, which lowers their risk of contracting malaria. My study found that women who had attended ANC more than four times had lower odds of malaria infection. This is concordant with a study in Uganda that revealed that malaria in pregnancy is more likely among women who initiated ANC late [22]. The use of insecticide-treated bednets (ITNs) and intermittent preventive treatment for malaria in pregnancy (IPTp) are two malaria prevention measures that are promoted through attendance at ANCs. Women receive health education about early health-seeking behaviors, insecticide-treated bednet maintenance, and household sanitation while receiving prenatal care. All of this could lower the risk of malaria in pregnant women who start their prenatal treatment early.

CONCLUSION

Malaria continues to be a major public health issue among pregnant mothers. Age, level of education, income status, residence, use of an ITN, gravidity, and ANC follow-up were factors significantly associated with malaria in pregnancy.

RECOMMENDATION

During ANC, medical practitioners should discuss malaria preventive strategies and pay particular attention to pregnant women who have the stated risk factors. Distribution of insecticide-treated bed nets to all pregnant mothers, as well as early ANC attendance to allow for access to malaria preventative treatment and related pregnancy-related measures.

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