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Malaria Infection Prevalence and Risk Factors in Pregnant Women at Kampala International University Hospital

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ABSTRACT

Malaria and pregnancy are mutually aggravating conditions, with pregnancy reducing immunity to malaria, making pregnant women more susceptible to infection. In sub-Saharan Africa, malaria affects 24 million pregnant women, with the region accounting for 90% of all deaths. A study aimed to determine the prevalence and risk factors associated with malaria infection among pregnant women attending antenatal care at Kampala International University Teaching Hospital (KIU-TH). The study found a 4.1% prevalence of malaria among the 241 pregnant women, with factors such as young age, urban residency, unemployment, low education, lower gravidity, less or equal to three ANC visits, non-usage of ITNs, and not taking intermittent preventive treatment (IPT) as major risk factors. The malaria prevalence was low among the pregnant women studied, suggesting the need for strengthening the use of intermittent preventive treatment and ITNs among all pregnant women.

Keywords: Malaria in pregnancy, maternal mortality, pregnant women, Antenatal care.

INTRODUCTION

The first description of malaria was in ancient Chinese medical records of 2700 BC, and 1200 years later in the Ebers Papyrus [1]. The military leader Alexander the Great died from malaria. The evidence that this disease was present within all layers of society is in the fact that Christopher Columbus, Albrecht Dürer, Cesare Borgia, and George Washington all suffered from it [2]. Although the ancient people frequently faced malaria and its symptoms, the fever that would occur in patients was attributed to various supernatural forces and angry divinities. For example, in 270 BC, the Chinese medical canon known as the Nei Chin linked tertian (every third day) and quartan (every fourth day) fevers with enlargement of the spleen (a common finding in malaria), blamed malaria's headaches, chills, and fevers on three demons—one carrying a hammer, another a pail of water, and the third a stove[1]. In the 4th century BC, Hippocrates described this disease in a way that completely rejected its demonic origins and linked it with evaporation from swamps which, when inhaled, caused the disease. That interpretation was maintained until October 20, 188,0 when Charles Louis Alphonse Laveran (1845-1922), a French army doctor during the Franco-Prussian War discovered the cause of the disease by observing crescent-shaped bodies that were nearly transparent except for one small dot of pigment [1], In preceding decades the brownish-black pigment hemozoin (now known to be the product of haemoglobin digestion by the malaria parasite) had been found in cadaveric spleens and blood of malaria victims by several investigators including Meckel, Virchow, and Frerichs. The Mosquito-malaria theory (or sometimes mosquito theory) was a scientific theory developed in the latter half of the 19th century that solved the question of how malaria was transmitted. The theory basically

proposed that malaria was transmitted by mosquitoes, in opposition to the centuries-old medical dogma that malaria was due to bad air, or miasma [3].

The four species of Plasmodium that infect humans are: vivax, ovale, malariae, and falciparum. Of these, Plasmodium falciparum is the most deadly as it can progress to severe illness leading to dead within 24 hours if not treated early [3, 4]. Malaria is a protozoan disease transmitted by the bite of infected Anopheles mosquitoes[5]. It is the most important of the parasitic diseases of humans, with transmission in 103 countries affecting 1 billion people and causing between 1 and 3 million deaths each year [6, 7]. Recent estimates have put the number of episodes of clinical malaria at 515 million cases per year, with two-thirds of these occurring in sub-Saharan Africa, especially amongst children and pregnant women [8]. Although regarded as the most climate-sensitive vector-borne diseases in pregnancy [9], several other risks factors have been identified as contributing to its emergence and spread. These include environmental, demographic, socio-economic status, and some obstetric and health related factors for example gestational age and parity [5, 10].

There is no time in memory when malaria was not a global health problem. It was common in many parts of the world until well into the 20th century when it was eliminated in Europe, North America, and parts of other continents through deliberate programs of mosquito control and clinical treatment, as well as through generally improved social and living conditions. The muscle behind eradication efforts elsewhere was never applied in Africa's highly endemic areas [11]. Today, sub-Saharan Africa remains the area of greatest malaria concentration, but significant problems exist in Asia, in Latin America, and focally in other areas. Although its chief sufferers today are the poor of sub-Saharan Africa, Asia, the Amazon basin, and other tropical regions, 40 percent of the world's population still lives in areas where malaria is transmitted [11, 12]. In 33 moderate to high transmission countries in African, there were an estimated 33.2 million pregnancies, of which 35% (11.6 million) were exposed to malaria infection[13]. Central Africa takes the lion's share (40%) followed by West Africa (39%), and the prevalence was 24% in East and Southern Africa [14]. In Lagos Nigeria, the prevalence rate was 27.3% and ranges from 19.7% to 72% in Nigeria[15]. It varies from place to place even within the same country and depends on the level of endemicity of the area, environmental and demographic factors, and the social status of the pregnant women. Other determinants such as, mother's age, gestational age, and parity further threaten the wellbeing of the mother and child, leading to some of the highest levels of maternal, infant and child mortality rates globally [14]. It is reported to be more common among primigravidas, with the highest rate of infection during the second trimester [16, 17]. Given this high burden of the disease, the World Health Organization (WHO) recommended the implementation of malaria preventive measures in all African countries where Plasmodium falciparum remains endemic, including the use of long lasting, insecticide-treated nets (LLINs) and intermittent preventive treatment during pregnancy (IPTp) with sulfadoxine-pyrimethamine (SP) [5]. In Uganda, despite significant improvement in the use of long lasting insecticidal nets (LLIN) by pregnant women (80% reported to be using) in 2019 and about 68% of pregnant women who attended ANC received one or more does of IPT in 2017/2018 [18]. The prevalence of malaria infection among pregnant women is reported to be high (30%) [19]. Anemia is the most common symptoms of malaria [20, 21]. A decline in hemoglobin, red blood cells and packed cell volume are markers of anemia [22, 23]. Malaria during pregnancy exacerbates the severity of other diseases like HIV/AIDs, and other negative pregnancy outcomes [24, 25]. This study was aimed at determining the prevalence and the risk factors associated with malaria infection among pregnant women attending antenatal care at Kampala International University Teaching Hospital.

METHODOLOGY

Study design

This was a retrospective descriptive and analytic cross-sectional study which utilized quantitative methods of data collection to establish an association between the study variables

Area of Study

This study was conducted in the antenatal clinic of Kampala International University-Teaching Hospital. KIU-TH is the first and biggest teaching hospital in Uganda, with a bed capacity of 700, according to the Hospital Administrator and is located in the town of Ishaka, Bushenyi District, Western Uganda. It's about 320km from Kampala and 65km from Mbarara.

Bushenyi district had Rubirizi, Buhweju, Sheema, Mitooma and Rukungiri as bordering districts and as of (Uganda bureau of statistics, 2021), the district had population of 250,000 (124,136 males and 125,864 females).

Study Population

The study population included all women who attended ANC at KIU-TH.

Inclusion criteria

Records of pregnant women who attended ANC at KIU-TH from April 2020 to August 2021 and tested for malaria

Exclusion criteria

- Pregnant women who did not test for malaria.
- Pregnant women who attended ANC before April 2020 or after August 2021

Sample Size Determination

The sample size required for the study was calculated based on the formula by Kish to estimate a single population proportion [26].

$$n = \frac{Z^2 p(1-p)}{d^2}$$

Where,

N = estimated sample size

P = anticipated proportion of pregnant women with malaria. A similar study at Ishaka Adventist Hospital found only a prevalence of 19.5% (Byabashaija J, 2018), so P is taken to be 0.195

Z = standard normal variation ant 95% confidence (1.96)

δ = margin of error (5%)

Thus by using this formula,

$$n = \frac{1.96^2\ 0.195\ (1-0.195)}{0.05^2}$$

$$n = \frac{3.8416\ x\ 0.195\ x\ 0.805}{0.0025} n = 241$$

Therefore, data was collected from 241 study participants at KIU-TH.

Sampling Techniques

Convenient sampling was employed to get a list of women who attended ANC and tested for malaria from the register. Then systematic random sampling was used to get the sample required.

Study Procedure

Prior to starting data collection process, the researcher obtained an introductory letter from the dean faculty of clinical medicine and dentistry and the researcher used the letter to seek permission from the Chief Executive Officer, KIU-TH and the in-charge of antennal clinic KIU-TH.

Data collection methods

Data was collected by reviewing records from the antenatal register, using a structured pretested checklist developed according to the research questions and the objectives of the study. The thoroughly trained research assistants extracted the information and entered it into the checklist for approximately 10 minutes each. The checklist consisted of information on socioeconomic factors, demographic factors, obstetric factors, and health-related factors.

Quality control techniques

A pretest was done 2 weeks before the actual study to check if the checklists were easily understood and if the tool was capturing what it was intended to capture. They were then fully developed before the actual study was undertaken. During the period of the actual study, all completed forms from the field were reviewed daily and on the spot, and feedback was provided with follow-up and /or undertaken. Data was verified, coded and entered into the computer.

Data processing and analysis

Data from the hard copy checklists was coded and entered into a computer, and cleaning and analyses were done. Frequencies and percentages of the patient's characteristics were produced.

At a descriptive level, the variables were compared between the entire study samples. This was done using tables.

Ethical consideration

An ethical clearance was obtained from the faculty of clinical medicine and dentistry and a copy was taken to the head of the Department of Obstetrics and Gynaecology and another to the charge of the antenatal clinic. Mother's names were not included anywhere in the data collected. Paper checklists were kept in lockable cabins meanwhile data was entered into password-protected computers.

RESULTS

Demographic characteristics

The demographic characteristics of the pregnant women that participated in this study are summarized in Table 1. The highest number of women was in the age groups of 25-34 (57.3%) while the least number were those of the age group of ≥35 with 16.6 %. More than half of the participants (69.7%) were from urban sitting with a third (30.3%) from rural areas.

Table 1: Demographic characteristics of the study participants

Variables		Frequency	percentage
Age (years)			
	18-24	63	26.1
	25-34	138	57.3
	≥35	40	16.6
Total		**241**	**100%**
Area of residents			
	Urban	168	69.7
	Rural	73	30.3
Total		**241**	**100%**

Social characteristics

The social- economic characteristics of the pregnant women that participated in this study are summarized in Table2. House wives constituted over half of the study participants 145 (60.2%) while only 40 (16.6%) were employed. More than half of the pregnant women (70.1%) had education of primary or below while only (9.1%) had tertiary education.

Table 2: Social characteristics of the study population

Variables		Frequency	percentage
Occupation			
	House wife	145	60.2
	Employed	40	16.6
	Business	56	23.2
Total		**241**	**100%**
Level of education			
	≤ primary	169	70.1
	Secondary	50	20.8
	Tertiary	22	9.1
Total		**241**	**100%**

Obstetric characteristics

The obstetric characteristics of the pregnant women that participated in this study are summarized in Table 3. Multigravida constituted over half of the study participants 167 (69.3%) while only 74 (30.7%) were primigravidae. Most of the participants 121 (50.2%) were in the second trimester while those in the third trimester were only 45 (18.7%). 214 (88.8%) of the women had attended ANC

for ≤3 times and only 27 (11.2%) attended ≥ 4 times.

Table 3: Obstetric characteristics of the study participants

Variables		Frequency	percentage
Gestational age			
	First trimester	75	31.1
	Second trimester	121	50.2
	Third trimester	45	18.7
Total		**241**	**100%**
Gravity			
	Primigravida	74	30.7
	Muti-gravida	167	69.3
Total		**241**	**100%**
Number of ANC attended			
	≤3	214	88.8
	≥4	27	11.2
Total		**241**	**100%**

Health related characteristics

The health related characteristics of the pregnant women that participated in this study are summarized in Table 4. Most of the participants 193 (80.1%) were using ITN, and the majority 193 (80.1%) had taken IPT (80%).

Table 4: Health-related characteristics of the study population

Variables		Frequency	percentage
ITN use			
	Yes	193	80.1
	No	48	19.9
Total		**241**	**100%**
IPTp use			
	Yes	193	80.1
	No	48	19.9
Total		**241**	**100%**

Malaria Prevalence among pregnant women who attended ANC at KIU-TH

During the 1 year and 5-months study period, a total of 241 pregnant women who attended ANC participated in the study. 10 (4.1%) tested positive while 231 (95.9%) tested negative. Therefore, the prevalence of malaria among the pregnant women who attended ANC at KIU-TH was 4.1%.

Table 5: Prevalence of malaria infection among pregnant women who attended ANC at KIU-TH

Malaria diagnosis		Total number of study participants
Yes	No	
10 (4.1%)	**231 (95.9%)**	**241 (100%)**

Factors associated with malaria infection among pregnant women who attended ANC at KIU-TH

Demographic factors

The demographic characteristics associated with malaria infection are reported in Table 5 below. The study participants in the age group 25-34 had the highest number of malaria cases (5.1%) and participants≥35 years had the lowest number of cases 2.5%. In terms of residence, women residing in urban areas had a higher malaria prevalence (4.8%)

compared to those residing in rural settings (2.7%).

Table 6: Demographic factors associated with malaria infection among pregnant women who attended ANC at KIU-TH

Variables	Malaria diagnosis		Total
	Yes	No	
Age (years)			
18-24	2 (3.2%)	61 (96.8%)	63 (100%)
25-34	7 (5.1%)	131 (94.9%)	138 (100%)
≥35	1 (2.5%)	39 (97.5%)	40 (100%)
Total	**10 (4.1%)**	**231 (95.9%)**	**241(100%)**
Resident			
Urban	8 (4.8%)	160 (95.2%)	168 (100%)
Rural	2 (2.7%)	71 (97.3%)	73 (100%)
Total	**10 (4.1%)**	**231 (95.9%)**	**241 (100%)**

Social factors

The social- Economic factors associated with malaria infection are reported in table 6 below. Women who were housewives had the highest percentage of malaria cases (4.8%) compared to 3.6% who were doing business. Participants who were employed had the lowest percentage of malaria (2.5%). In terms of education, the highest number of malaria cases (4.7%) was among pregnant women who had education of primary or below compared to 4.0% of cases for those who had education level of secondary. Participants who had education of tertiary level didn't have any case of malaria (0.0%).

Table 7: Social factors associated with malaria infection among pregnant women who attended ANC at KIU-TH

Variables	Malaria diagnosis		Total
	Yes	No	
Occupation			
Housewife	7 (4.8%)	138 (95.2%)	145 (100%)
Employed	1 (2.5%)	39 (97.5%)	40 (100%)
Business	2 (3.6%)	54 (96.4%)	56 (100%)
Total	10 (4.1%)	231 (95.9%)	241 (100%)
Level of Education			
≤ primary	8 (4.7%)	161 (95.3%)	169 (100%)
Secondary	2 (4%)	48 (96%)	50 (100%)
Tertiary	0 (0%)	22 (100%)	22 (100%)
Total	**10 (4.1%)**	**231 (95.9%)**	**241 (100%)**

Obstetrics factors

The obstetric factors associated with malaria infection are reported in Table 7 below. The prevalence of malaria among primigravidae in this study was (8.1%) while multigravidae had the least percentage (2.4%). Pregnant women in the second trimester had the highest number of cases 5 (4.1%), followed by those in the first trimester 4 (5.3%), and those in the third trimester had the least number of cases 1 (2.2%). Participants who had attended ANC ≤3 times had the highest number of malaria cases 9 (4.2%) compared to those who had attended ≥4 times 1 (3.7%).

Table 8: Obstetric factors associated with malaria infection among pregnant women who attended ANC at KIU-TH

Variables	Malaria diagnosis		Total
	Yes	No	
Gestational age			
First trimester	4 (5.3%)	71 (94.7%)	75 (100%)
Second trimester	5 (4.1%)	116 (95.9%)	121 (100%)
Third trimester	1 (2.2%)	44 (97.8%)	45 (100%)
Total	**10 (4.1%)**	**231 (95.9%)**	**241 (100%)**
Gravity			
Primigravida	6 (8.1%)	68 (91.9%)	74 (100%)
Multi-gravida	4 (2.4%)	163 (97.6%)	167 (100%)
Total	**10 (4.1%)**	**231 (95.9%)**	**241 (100%)**
ANC attendance			
≤3	9 (4.2%)	205 (95.8%)	214 (100%)
≥4	1 (3.7%)	26 (96.3%)	27 (100%)
Total	**10 (4.1%)**	**231 (95.9%)**	**241 (100%)**

Health related factors

The health relator factors associated with malaria infection are reported in Table 8 below.The prevalence of malaria among pregnant women who had not used ITN was 14.6% while only 1.6% of those who used ITN had malaria. Among those who had not used IPT, 16.7% had malaria while only 1.0% of those who took IPT had malaria infection.

Table 9: Health-related factors associated with malaria infection among pregnant women who attended ANC at KIU-TH

Variables	Malaria diagnosis		Total
	Yes	No	
ITN use			
Yes	3 (1.6%)	190 (98.4%)	193 (100%)
No	7 (14.6%)	41 (85.4%)	48 (100%)
Total	**10 (4.1%)**	**231 (95.9%)**	**241 (100%)**
IPTp use			
Yes	2 (1.0%)	191(99.0%)	193 (100%)
No	8 (16.7%)	40 (83.3%)	48 (100%)
Total	**10 (4.1%)**	**231 (95.9)**	**241 (100%)**

DISCUSSION

Prevalence of malaria infection among pregnant women

In this study, the prevalence of malaria was 4.1%. This finding is higher than that reported by a survey conducted in KIU-TH Ishaka-Bushenyi, Uganda from January to September 2013 which found a prevalence of 2.3% [27]. The difference in prevalence could have resulted from COVID 19 pandemic that has led many countries including Uganda to impose restrictions. Lone and Ahmad [28], found sufficient evidence that the COVID-19 pandemic and restrictions related to the response have caused disruptions in essential malaria services for example; insecticide-treated nets needed regular renewal, but distribution campaigns have been delayed or cancelled. For detection and treatment of malaria, individuals may stop attending health facilities, out of fear of exposure to COVID-19, or because they cannot afford transport. Furthermore, early messaging targeted at reducing coronavirus transmission advised the public to stay at home if they had a fever, potentially

disrupting treatment-seeking for febrile diseases such as malaria. The prevalence in this study is comparable to findings by a study in Kiryandongo General Hospital-Kiryandongo district - western Uganda from June to November 2018 which reported a prevalence of 5.4% [29, 30]. This is attributed to the fact that both are areas in western Uganda with cold weather as malaria parasites thrive well in warmer areas compared to cold areas. However, the prevalence in this study was low compared to a survey done in Ishaka Adventist Hospital- Bushenyi district from February to July 2018 which found a prevalence of 19.8% [31]. The low prevalence in this study could be explained by the fact that many pregnant women go to government hospitals compared to private hospitals like Kampala International University-teaching hospitals.

Risk factors associated with malaria infection among pregnant women

Studies have shown that age, residence, occupation, level of education, gravidity, gestation, ANC attendance, ITN use, and the use of IPT are associated with malaria in pregnancy [32]. In this study, older women (≥35 years) had the least cases of malaria (2.5%) compared to younger (5.1%). This may be attributed to mothers with increased age having better exposure to health services and gaining a good awareness about the disease and the ways of prevention. Also, due to previous frequent malaria exposures, older mothers might develop immunity to malaria [33]. In terms of residence, women residing in urban areas had a higher malaria prevalence (4.8%) compared to those residing in rural settings (2.7%). A study of the risk factors associated with malaria infection in north-western Nigeria by [34, 35]., found that subjects residing in urban areas were more prone to malaria compared to those living in rural areas. got the same findings in Nigeria [36]. This may be attributed to the fact that rapidly developing urban areas are crowded with poor houses and a lot of stagnant water that acts as breeding spaces for mosquitoes. This study found that the prevalence of malaria infection was highest among pregnant women who are housewives (4.8%) as compared to those employed (2.5%) and the business class (3.6%). This is attributed to the fact that pregnant women who are employed or are doing business have the power to purchase health-promoting resources and treatment [37]. Egwu et al. [10], discovered that the poor are less likely to use effective preventive measures because they live in poor houses, and vulnerable rooms, and normally can't afford medicines or good hospitals. Pregnant women who were educated either at the level of secondary (4%) or tertiary (0%) had the lowest or no risk as compared to those who were at the level of primary or below (4.7%). This could stem from the fact that an educated pregnant woman knows the ways of reducing malaria cases. For example, she can recognize the signs and symptoms earlier and seek medical attention. And can play an active role in the eradication of breeding grounds for mosquitoes, thus cutting down the risk of transmission among people [38]. This study discovered that pregnant women in the first and second trimesters had the highest number of malaria cases 5.3% and 4.1% respectively as compared to those in the third trimester (2.2%). This could result from the lack of adequate immunity to variant surface proteins expressed by the parasite on the surface of infected red blood cells especially in the first trimester, allowing the infected cells to sequester in the placenta [39,40,41]. The study also showed that primigravidas were at the greatest risk of malaria infection (8.1%) compared to multigravidas who have been noted to have lower effects of malaria in pregnancy (2.4%). A low risk of malaria among multigravidae mothers may be associated with the development of pre-immunity to malaria with increased gravidity and previous exposures [42,43]. In terms of the number of ANC attended, pregnant women who attended ≤3 times had the highest number of malaria cases 4.2% compared to those who attended≥4 times 3.7%. This could result from the fact that those who attended ≤ 3 times might

have missed being given IPT hence predisposing them to malaria infection [14]

(Ssempiira et al., 2017) indicate that the use of ITN substantially reduces the risk of malaria in pregnancy. Indeed, WHO has advocated for a three-pronged approach to tackling malaria and part of the strategy is the use of ITN [12]. In this study, women who did not use ITN had the highest number of cases 14.7% compared to those who had used ITN (1.6%). The use of IPT has been shown to reduce malaria prevalence in pregnancy significantly. In this study, participants who had not taken IPT were 4 times more likely to have malaria than those who had taken IPT. A similar finding was also observed in a study in Mali of IPT use in pregnancy (IPTp) where 3 or more doses of sulfadoxine-pyrimethamine (SP) have been shown to prevent malaria in pregnant women living in high-risk areas [39].

CONCLUSION

- The prevalence of malaria infection among pregnant women who attended ANC at KIU-TH was low (4.1%)
- Young maternal age and urban residency contributed to nearly half of all cases as compared to older women and those who reside in rural areas.
- Women who were not employed and ended primary or lower level of education, had the greatest risk of malaria infection.
- Lower gravidity and less or equal to 3 ANC visits, were found to be significantly related to malaria infection.
- Non-usage of ITNs and not taking IPT were some of the factors associated with an increased risk of malaria infection in pregnancy.

Recommendations

i. Future research should be conducted in different transmission settings to provide current data on the national prevalence of malaria among pregnant women.

ii. Awareness of malaria prevention measures during pregnancy should target young women even before marriage preferably at schools and in social and religious gatherings places. Stagnant water around houses in urban areas should be sprayed with insecticides.

iii. The government and its development partners should promote girl child education and provide loans to unemployed women for them to start businesses.

iv. All pregnant women should start attending ANC early and should be able to attend at least 4.

v. The control measures available in the area should be reviewed and emphasis should.

vi. be placed on adequate sensitization on the usage of ITNs. IPT should be taken from the health facility to ensure high coverage.

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