

Factors Associated with the Occurrence of Malaria Among Pregnant Women Attending Antenatal Care at New Bell District Hospital, Douala, Cameroon

Mohnchimbare Christina Mbongueh¹, Mbabazi Asiati², Fankep Dihewou Alphonse Bertin³,
Henri Lucien Kamga Fouamno⁴

¹School of Allied Health Sciences, Kampala International University, Western Campus, Ishaka, Uganda

²Faculty of Education, Kampala International University, Western Campus, Ishaka, Uganda

³Faculty of Health Sciences, University of Buea, Cameroon

⁴Faculty of Biomedical Sciences, Kampala International University, Western Campus, Ishaka, Uganda

doi: 10.51505/ijmshr.2026.10405

URL: <http://dx.doi.org/10.51505/ijmshr.2026.10405>

Received: Jun 10, 2026

Accepted: Jun 23, 2026

Online Published: July 20, 2026

Abstract

Malaria remains a major public health problem among pregnant women in sub-Saharan Africa and is a significant cause of maternal and neonatal morbidity and mortality. Physiological and immunological changes during pregnancy increase susceptibility to malaria infection, resulting in adverse outcomes such as maternal anemia, spontaneous abortion, stillbirth, preterm delivery, low birth weight, and neonatal mortality. Despite the implementation of preventive measures, including insecticide-treated mosquito nets (ITNs), intermittent preventive treatment in pregnancy with sulfadoxine-pyrimethamine (IPTp-SP), and routine antenatal care (ANC) services, malaria continues to pose a considerable challenge in Cameroon. This study aimed to determine the prevalence of malaria and identify factors associated with malaria occurrence among pregnant women attending antenatal care services at the New Bell District Hospital in Douala, Cameroon. A hospital-based analytical cross-sectional study was conducted among 280 pregnant women attending ANC between November 2024 and July 2025. Data were collected using a structured interviewer-administered questionnaire covering socio-demographic characteristics, obstetric history, environmental conditions, malaria prevention practices, and knowledge of malaria. Malaria diagnosis was confirmed through microscopic examination of Giemsa-stained thick and thin blood smears. Data were analyzed using descriptive statistics, Pearson's Chi-square test, and multivariate logistic regression, with statistical significance set at $p < 0.05$. Among the 280 participants, 118 tested positives for malaria parasites, yielding an overall prevalence of 42.1% (95% CI: 36.3–47.9). *Plasmodium falciparum* accounted for 94.1% of infections. Malaria occurrence was significantly associated with younger maternal age, unmarried status, inadequate ANC attendance, inconsistent ITN utilization, insufficient IPTp-SP uptake, and exposure to mosquito breeding environments. Multivariate analysis showed that age

≥30 years (AOR = 0.48; $p = 0.024$), married status (AOR = 0.41; $p = 0.005$), regular ITN use (AOR = 0.36; $p = 0.001$), at least four ANC visits (AOR = 0.54; $p = 0.032$), and receipt of at least three IPTp-SP doses (AOR = 0.44; $p = 0.009$) were independently protective against malaria. Strengthening ANC utilization, IPTp-SP coverage, ITN use, and environmental sanitation is essential for reducing malaria burden during pregnancy.

Keywords: Malaria, Pregnancy, Antenatal Care, Prevalence, Risk Factors, Insecticide-Treated Mosquito Nets, IPTp-SP, Cameroon.

1. Introduction

1.1 Global Burden of Malaria During Pregnancy

Malaria remains one of the most significant vector-borne diseases worldwide and continues to pose a major challenge to global public health. According to the World Health Organization (WHO), approximately 263 million malaria cases and 597,000 malaria-related deaths were reported globally in 2023, with sub-Saharan Africa accounting for nearly 94% of all cases and deaths (WHO, 2024). Despite considerable progress achieved through international malaria control programs, malaria remains endemic in many tropical and subtropical regions, particularly in low- and middle-income countries where environmental and socioeconomic conditions favor transmission. Pregnant women constitute one of the populations most vulnerable to malaria infection. During pregnancy, physiological and immunological changes reduce a woman's ability to effectively control parasitic infections, thereby increasing susceptibility to *Plasmodium* species, particularly *Plasmodium falciparum*, the most virulent malaria parasite in Africa. Infection during pregnancy may lead to placental sequestration of parasites, causing placental malaria and compromising maternal and fetal health. The consequences include maternal anemia, miscarriage, preterm delivery, intrauterine growth restriction, low birth weight, and increased neonatal mortality (Agarwal et al., 2021; WHO, 2024). Globally, it is estimated that more than 30 million pregnancies occur annually in malaria-endemic regions of Africa. In 2023 alone, approximately 12 million pregnant women in sub-Saharan Africa were exposed to malaria infection, resulting in thousands of preventable maternal and neonatal complications (WHO, 2024). Consequently, malaria prevention during pregnancy remains a priority within international maternal and child health initiatives.

1.2 Malaria During Pregnancy in Sub-Saharan Africa

Sub-Saharan Africa bears the greatest burden of malaria during pregnancy due to high transmission intensity, favorable climatic conditions, widespread poverty, and limited healthcare resources. Although several malaria prevention strategies have been implemented across the continent, malaria remains a leading cause of maternal morbidity and adverse birth outcomes. Recent studies conducted in Nigeria, Ghana, Uganda, Tanzania, and Ethiopia have reported malaria prevalence among pregnant women ranging from 20% to 50%, depending on geographical location, season, diagnostic methods employed, and coverage of preventive interventions (Owusu et al., 2022; Nankabirwa et al., 2022; Wekesa et al., 2023). These studies

consistently demonstrate that younger women, primigravidae, women with inadequate antenatal care attendance, and those who fail to utilize insecticide-treated mosquito nets are at increased risk of malaria infection. The WHO recommends a comprehensive package of malaria prevention interventions during pregnancy, including the use of insecticide-treated mosquito nets, intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP), prompt diagnosis and treatment of malaria cases, and regular antenatal care attendance. Despite these recommendations, implementation remains suboptimal in many African countries due to healthcare system limitations, stock-outs of preventive medications, poverty, and inadequate awareness among pregnant women. Environmental conditions also play an important role in malaria transmission. Poor drainage systems, stagnant water collections, inadequate waste management, and overcrowded housing conditions provide suitable breeding habitats for mosquito vectors and contribute to sustained malaria transmission within communities (Afoakwah et al., 2022).

1.3 Malaria in Cameroon

Malaria remains one of the leading causes of morbidity and mortality in Cameroon and constitutes a major public health concern. The disease accounts for approximately 30–40% of outpatient consultations, 20% of hospital admissions, and a substantial proportion of maternal and childhood deaths annually (Ministry of Public Health Cameroon, 2023). Pregnant women and children under five years of age are disproportionately affected due to increased biological vulnerability. Cameroon possesses ecological and climatic characteristics that favor year-round malaria transmission. The country experiences diverse transmission patterns ranging from seasonal transmission in the northern regions to perennial transmission in the southern forest and coastal zones. The economic capital, Douala, is characterized by heavy rainfall, high humidity, poor drainage systems, and rapid urbanization, creating ideal conditions for mosquito breeding and malaria transmission.

Several studies conducted in different regions of Cameroon have reported malaria prevalence among pregnant women ranging from 25% to 60% (Nguefack et al., 2021; Tchinda et al., 2022). Although the government has strengthened malaria prevention efforts through free distribution of insecticide-treated mosquito nets, implementation of IPTp-SP, and integration of malaria prevention into routine antenatal care services, malaria remains highly prevalent among pregnant women.

Persistent challenges include inadequate utilization of preventive measures, delayed antenatal care attendance, poor environmental sanitation, and socioeconomic barriers limiting access to healthcare services. Consequently, malaria continues to contribute significantly to maternal anemia, placental malaria, low birth weight, and neonatal mortality throughout the country.

1.4 Factors Associated with Malaria Occurrence During Pregnancy

The occurrence of malaria during pregnancy is influenced by a complex interaction of biological, socioeconomic, behavioral, healthcare-related, and environmental factors. Previous studies have identified maternal age, gravidity, educational level, marital status, socioeconomic status, antenatal care attendance, and utilization of malaria prevention measures as important determinants of malaria infection during pregnancy.

Younger pregnant women and primigravidae have consistently been shown to be at increased risk of malaria due to limited acquired immunity against malaria parasites. Likewise, inadequate uptake of IPTp-SP and inconsistent utilization of insecticide-treated mosquito nets significantly increase susceptibility to infection (Kayentao et al., 2021; Gutman et al., 2023).

Environmental factors such as proximity to stagnant water bodies, poor drainage systems, improper waste disposal, and overcrowded housing conditions have also been associated with increased malaria transmission. Furthermore, social determinants including poverty, low educational attainment, and limited access to healthcare services may reduce the ability of pregnant women to effectively implement preventive measures.

Several recent African studies have consistently demonstrated that maternal age, gravidity, antenatal care attendance, utilization of insecticide-treated mosquito nets (ITNs), uptake of intermittent preventive treatment during pregnancy (IPTp-SP), and environmental conditions are important determinants of malaria infection among pregnant women. A multicentre study conducted in Ghana reported that inadequate ANC attendance, poor ITN utilization, lower educational status and delayed IPTp-SP uptake significantly increased malaria risk among pregnant women (Abu Bonsra et al., 2025). Likewise, Almaw et al. (2022) found that younger maternal age, rural residence, poor malaria prevention practices and inadequate antenatal care attendance were independently associated with malaria infection among symptomatic pregnant women in Ethiopia. These findings suggest that malaria during pregnancy remains influenced by multiple socio-demographic, behavioural and environmental factors across sub-Saharan Africa. However, limited information exists regarding these determinants among pregnant women attending antenatal care services in the New Bell Health District of Douala, Cameroon.

The present study aimed to determine the prevalence of malaria and identify socio-demographic, obstetric, behavioral, healthcare-related, and environmental factors associated with malaria occurrence among pregnant women attending antenatal care services at the New Bell District Hospital in Douala, Cameroon.

2. Methods

2.1 Study Design

A hospital-based analytical cross-sectional study was conducted to determine the prevalence of malaria and identify factors associated with malaria occurrence among pregnant women

attending antenatal care (ANC) services at the New Bell District Hospital in Douala, Cameroon. The study employed a quantitative approach to assess relationships between malaria infection and selected socio-demographic, obstetric, behavioral, healthcare-related, and environmental factors.

2.2 Study Area

The study was conducted at the New Bell District Hospital, a public healthcare facility located in the New Bell Health District of Douala, Littoral Region, Cameroon. Douala is the economic capital and largest city in Cameroon, with an estimated population exceeding four million inhabitants.

The city experiences a humid equatorial climate characterized by high temperatures, abundant rainfall, and elevated humidity levels throughout most of the year. Annual rainfall ranges from 3,000 to 4,000 mm, creating favorable conditions for mosquito breeding and malaria transmission.

New Bell is one of the most densely populated urban communities in Douala and is characterized by rapid urbanization, inadequate drainage systems, poor waste management practices, overcrowded housing, and numerous stagnant water collections. These environmental conditions facilitate the proliferation of *Anopheles* mosquitoes and contribute to sustained malaria transmission.

The New Bell District Hospital provides comprehensive healthcare services, including antenatal care, delivery services, postnatal care, malaria diagnosis and treatment, family planning, immunization, and health education.

2.3 Study Population

The study population consisted of pregnant women attending antenatal care services at the New Bell District Hospital during the study period. The source population included all pregnant women presenting for routine antenatal consultations between November 2024 and July 2025.

2.3.1 Inclusion Criteria

Pregnant women were eligible to participate in the study if they were attending antenatal care services at the New Bell District Hospital during the study period, had a confirmed pregnancy regardless of gestational age, voluntarily provided informed consent to participate, and underwent malaria laboratory screening through microscopic examination of blood smears.

2.3.2 Exclusion Criteria

Pregnant women were excluded from the study if they declined to provide informed consent, had received antimalarial treatment within the two weeks preceding recruitment, were severely ill

and therefore unable to participate in the interview process, had incomplete questionnaire or laboratory data, or were referred to another health facility before completion of the data collection procedures.

2.3.3 Sample Size Determination

The minimum sample size was calculated using Cochran's formula for estimating a single population proportion:

$$n = (Z^2 \times P \times (1 - P)) / d^2$$

Where:

n = Minimum required sample size

Z = Standard normal deviate at 95% confidence level (1.96)

P = Estimated prevalence of malaria among pregnant women from a previous study (24% or 0.24) study conducted in Cameroon (Nguefack et al., 2021)

d = Margin of error (0.05)

Substituting the values:

$$n = (1.96^2 \times 0.24 \times (1 - 0.24)) / (0.05^2) = 280.08$$

Therefore, the minimum sample size required for the study was approximately 280 pregnant women. Consequently, a total of 280 pregnant women were recruited into the study.

2.4 Sampling Technique

A consecutive sampling technique was employed. All eligible pregnant women attending antenatal care services during the study period were approached and invited to participate until the required sample size was attained. Participants who fulfilled the inclusion criteria and provided informed consent were enrolled sequentially into the study.

2.5 Study Variables

The dependent variable in this study was malaria occurrence among pregnant women, categorized as either positive or negative based on the results of microscopic examination of blood samples. Malaria occurrence served as the primary outcome measure used to assess the burden of infection and identify factors associated with malaria among pregnant women attending antenatal care services.

The independent variables comprised socio-demographic, obstetric, behavioral, environmental, and knowledge-related factors that could potentially influence malaria occurrence. Socio-demographic variables included age, marital status, educational level, occupation, and religion. Obstetric variables consisted of gravidity, trimester of pregnancy, number of antenatal care (ANC) visits, and uptake of intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP). Behavioral variables included utilization of insecticide-treated mosquito nets (ITNs), use of mosquito repellents, and environmental sanitation practices. Environmental variables assessed the presence of stagnant water around the residence, waste disposal practices, drainage

conditions, and housing characteristics. Knowledge-related variables included knowledge of malaria transmission, knowledge of malaria prevention, and awareness of malaria-related complications during pregnancy. These variables were evaluated to determine their association with malaria occurrence among the study participants

2.6 Data Collection Instrument

Data were collected using a structured interviewer-administered questionnaire developed following an extensive review of relevant literature. The questionnaire consisted of five sections: Section A: Socio-demographic characteristics, Section B: Obstetric and reproductive history, Section C: Knowledge regarding malaria transmission and prevention, Section D: Malaria preventive practices, and Section E: Environmental and housing characteristics. The questionnaire was prepared in English and translated into French to facilitate communication with participants.

2.7 Malaria Diagnosis and Determination of Prevalence

2.7.1 Malaria diagnosis

Malaria diagnosis was established through microscopic examination of Giemsa-stained thick and thin blood smears prepared from capillary blood samples collected from all participants. After cleaning the fingertip with 70% alcohol and allowing it to dry, capillary blood samples were obtained using sterile lancets. Thick and thin blood films were prepared on clean glass slides according to standard laboratory procedures. The blood smears were air-dried and stained using 10% Giemsa solution. Microscopic examination was performed using oil immersion microscopy (100× objective lens) following World Health Organization guidelines. The thick blood smear was used for parasite detection and parasite density estimation due to its high sensitivity, while the thin blood smear was used for species identification. A slide was considered positive when at least one asexual stage of *Plasmodium* parasites was detected. A slide was considered negative only after examination of at least 100 high-power fields without detection of malaria parasites.

2.7.2 Calculation of Malaria prevalence

The prevalence of malaria was calculated using the following formula: Malaria Prevalence (%) = (Number of pregnant women with laboratory-confirmed malaria / Total number of pregnant women examined) × 100

2.8 Quality Control

To ensure reliability and validity of laboratory results, all blood smears were independently examined by two experienced Medical Laboratory Scientists. Discrepant results were reviewed by a senior laboratory scientist and a consensus result was recorded. All laboratory reagents were checked for quality prior to use, and microscope maintenance procedures were performed regularly throughout the study period. The questionnaire was pretested among 20 pregnant

women attending a neighboring health facility. Necessary modifications were made before commencement of data collection.

2.9 Data Management and Statistical Analysis

Completed questionnaires were checked daily for completeness and consistency before data entry. Data were entered into Microsoft Excel 2016, cleaned, and exported to RStudio version 4.3 for analysis. Descriptive statistics were generated and presented as frequencies, percentages, means, and standard deviations. Pearson's Chi-square test was used to assess associations between malaria occurrence and independent variables. Variables with p-values less than 0.20 during bivariate analysis were entered into a multivariate logistic regression model to identify independent predictors of malaria occurrence. Results were presented as Crude Odds Ratios (COR), Adjusted Odds Ratios (AOR), 95% Confidence Intervals (95% CI), and p-values. Statistical significance was established at $p < 0.05$.

2.10 Ethical Considerations

Ethical approval for the study was obtained from the Institutional Review Board of the Faculty of Medicine and Pharmaceutical Sciences, University of Douala. Administrative authorization was obtained from the Littoral Regional Delegation of Public Health; the New Bell Health District Service and the Management of the New Bell District Hospital. Participation was voluntary, and written informed consent was obtained from all participants before enrollment. Confidentiality and anonymity were strictly maintained throughout the study. No personal identifiers were recorded on questionnaires, and collected data were used solely for research purposes. Participants diagnosed with malaria during the study were referred for appropriate clinical management according to the national malaria treatment guidelines of Cameroon.

3. Results

3.1 Socio-Demographic Characteristics of Participants

A total of 280 pregnant women participated in the study. The mean age of respondents was 26.8 ± 5.7 years, with ages ranging from 16 to 42 years. More than half of the participants (51.8%) were aged 20–29 years, while 22.1% were below 20 years of age. The majority of respondents were married (67.1%), had attained secondary education (52.9%), and identified as Christians (85.4%). Regarding occupation, housewives constituted the largest proportion (33.6%), followed by traders (31.1%).

Table 1. Socio-demographic characteristics of participants (N = 280)

Variable	Category	Frequency (n)	Percentage (%)
Age Group	<20 years	62	22.1
	20–29 years	145	51.8
	≥30 years	73	26.1
Marital Status	Married	188	67.1
	Single	92	32.9
Education Level	Primary	71	25.4
	Secondary	148	52.9
	Higher	61	21.7
Occupation	Housewife	94	33.6
	Trader	87	31.1
	Civil servant	46	16.4
	Student	53	18.9
Religion	Christianity	239	85.4
	Islam	34	12.1
	Others	7	2.5

The study population was predominantly composed of young women of reproductive age, most of whom were married and had attained at least secondary education.

3.2 Obstetric Characteristics of Participants

The obstetric characteristics of participants are presented in Table 2. Multigravidae constituted 58.9% of respondents, while primigravidae represented 41.1%. Nearly half of the participants (46.4%) were in the second trimester of pregnancy. Most women (61.8%) had attended four or more antenatal care visits. Furthermore, 52.1% had received at least three doses of IPTp-SP during the current pregnancy.

Table 2. Obstetric characteristics of participants (N = 280)

Variable	Category	Frequency (n)	Percentage (%)
Gravidity	Primigravidae	115	41.1
	Multigravidae	165	58.9
Trimester	First	54	19.3
	Second	130	46.4
	Third	96	34.3
ANC Visits	<4 visits	107	38.2
	≥4 visits	173	61.8
IPTp-SP Doses	<3 doses	134	47.9
	≥3 doses	146	52.1

3.3 Knowledge and Preventive Practices Regarding Malaria

Most participants demonstrated good knowledge regarding malaria transmission and prevention. Mosquito bites were correctly identified as the primary mode of malaria transmission by 91.8% of respondents. A total of 88.2% recognized insecticide-treated mosquito nets as an effective malaria prevention measure, while 75.4% were aware that malaria could negatively affect pregnancy outcomes.

Table 3. Knowledge and preventive practices regarding malaria (N = 280)

Variable	Yes n (%)	No n (%)
Knows mosquito bites transmit malaria	257 (91.8)	23 (8.2)
Knows malaria affects pregnancy outcomes	211 (75.4)	69 (24.6)
Knows ITNs prevent malaria	247 (88.2)	33 (11.8)
Regular ITN use	192 (68.6)	88 (31.4)
Uses mosquito repellents	104 (37.1)	176 (62.9)
Practices environmental sanitation	186 (66.4)	94 (33.6)
Received malaria education during ANC	219 (78.2)	61 (21.8)

Despite relatively high knowledge levels, preventive practices such as regular ITN utilization and mosquito repellent use remained suboptimal.

3.4 Prevalence of Malaria Among Pregnant Women

Microscopic examination of Giemsa-stained thick and thin blood smears revealed that 118 of the 280 pregnant women were infected with malaria parasites, yielding an overall malaria prevalence of 42.1% (95% CI: 36.3–47.9).

Table 4. Prevalence of malaria among participants

Malaria Status	Frequency (n)	Percentage (%)
Positive	118	42.1
Negative	162	57.9
Total	280	100.0

The findings indicate that approximately two out of every five pregnant women attending antenatal care services had laboratory-confirmed malaria infection during the study period.

3.5 Parasite Density Distribution Among Malaria-Positive Participants

Among the 118 malaria-positive participants, moderate parasite density (1,000–9,999 parasites/ μ L) was the most frequently observed category, accounting for 44.1% of infections.

Table 5. Parasite density distribution among malaria-positive women (N = 118)

Parasite Density	Frequency (n)	Percentage (%)
Low (<1,000 parasites/ μ L)	48	40.7
Moderate (1,000–9,999 parasites/ μ L)	52	44.1
High ($\geq$ 10,000 parasites/ μ L)	18	15.2
Total	118	100.0

Most infections were therefore characterized by low-to-moderate parasite densities.

3.6 Distribution of *Plasmodium* Species

Microscopic examination of thin blood films identified *Plasmodium falciparum* as the predominant species.

Table 6. Plasmodium species identified among positive Cases (N = 118)

Species	Frequency (n)	Percentage (%)
<i>Plasmodium falciparum</i>	111	94.1
<i>Plasmodium malariae</i>	5	4.2
Mixed Infection	2	1.7
Total	118	100.0

The overwhelming predominance of *P. falciparum* is consistent with malaria epidemiology in Cameroon and most of sub-Saharan Africa.

3.7 Bivariate Analysis of Factors Associated with Malaria Occurrence

Several variables demonstrated significant associations with malaria occurrence at the bivariate level. Age, marital status, educational level, ITN utilization, ANC attendance, IPTp-SP uptake, and environmental exposure variables were significantly associated with malaria occurrence

Table 7. Bivariate analysis of factors associated with malaria occurrence

Variable	Malaria Positive n (%)	Malaria Negative n (%)	χ^2	p-value
Age <30 years	97 (82.2)	110 (67.9)	7.42	0.006
Single status	52 (44.1)	40 (24.7)	11.38	0.001
Primary education	40 (33.9)	31 (19.1)	7.81	0.005
ITN non-use	56 (47.5)	32 (19.8)	18.56	<0.001
<4 ANC visits	62 (52.5)	45 (27.8)	16.14	<0.001
IPTp-SP <3 doses	71 (60.2)	63 (38.9)	12.07	0.001
Stagnant water near residence	81 (68.6)	72 (44.4)	15.29	<0.001

3.8 Environmental Factors Associated with Malaria Occurrence

Environmental conditions surrounding participants' residences were further examined.

Table 8. Environmental factors associated with malaria occurrence

Environmental Factor	Positive (%)	Negative (%)	OR (95% CI)	p-value
Stagnant water nearby	68.6	44.4	2.73 (1.66–4.48)	<0.001
Poor drainage system	64.4	39.5	2.78 (1.68–4.60)	<0.001
Improper waste disposal	58.5	34.6	2.66 (1.61–4.40)	<0.001
Overcrowded housing	55.1	36.4	2.14 (1.30–3.53)	0.003

Participants exposed to unfavorable environmental conditions were significantly more likely to have malaria infection.

3.9 Multivariate Logistic Regression Analysis

Variables found to be significant during bivariate analysis were entered into a multivariate logistic regression model to identify independent predictors of malaria occurrence.

Table 9. Multivariate logistic regression analysis of factors associated with malaria occurrence

Variable	AOR	95% CI	p-value
Age ≥ 30 years	0.48	0.25–0.91	0.024
Married status	0.41	0.22–0.76	0.005
Regular ITN use	0.36	0.20–0.67	0.001
≥ 4 ANC visits	0.54	0.31–0.95	0.032
≥ 3 IPTp-SP doses	0.44	0.24–0.82	0.009
Good malaria knowledge	0.83	0.48–1.43	0.501

After controlling for potential confounding variables, age, marital status, regular utilization of insecticide-treated mosquito nets, adequate antenatal care attendance, and receipt of at least three doses of IPTp-SP remained independently associated with reduced malaria risk.

Women aged 30 years and above were 52% less likely to have malaria compared with younger women. Similarly, married women were 59% less likely to be infected than unmarried women. Regular ITN utilization reduced the odds of malaria infection by approximately 64%, while adequate ANC attendance and IPTp-SP uptake also demonstrated significant protective effects. The Hosmer–Lemeshow goodness-of-fit test indicated adequate model fit ($p = 0.71$), suggesting that the logistic regression model appropriately explained the observed variation in malaria occurrence among study participants.

4. Discussion

The present study assessed the prevalence of malaria and factors associated with malaria occurrence among pregnant women attending antenatal care services at the New Bell District Hospital in Douala, Cameroon. Microscopic examination of Giemsa-stained thick and thin blood smears revealed a malaria prevalence of 42.1%, indicating that malaria remains a significant public health challenge among pregnant women in this urban setting. Although lower than estimates reported in some highly endemic rural communities, the prevalence remains substantial and confirms that malaria continues to pose serious risks to maternal and fetal health despite ongoing prevention and control efforts. The study further identified maternal age, marital status, antenatal care attendance, utilization of insecticide-treated mosquito nets, uptake of intermittent preventive treatment during pregnancy, and environmental factors as important determinants of malaria occurrence.

4.1 Prevalence of Malaria Among Pregnant Women

The malaria prevalence of 42.1% observed in this study demonstrates that malaria remains a major public health concern among pregnant women in Douala. This prevalence is comparable to findings reported in several malaria-endemic countries within sub-Saharan Africa. Studies conducted in Ghana reported prevalence rates ranging from 30% to 45% among pregnant women attending antenatal clinics (Owusu et al., 2022), while investigations in Nigeria documented prevalence rates between 28% and 50% depending on geographical location and transmission intensity (Abdullahi et al., 2023; Fana et al., 2022). Similar prevalence estimates have been reported in Uganda, Kenya, and Tanzania, where malaria prevalence among pregnant women generally ranges between 20% and 45% (Nankabirwa et al., 2022; Wekesa et al., 2023; Mosha et al., 2023).

Within Cameroon, previous studies have reported varying prevalence rates according to ecological zones, seasonality, and diagnostic methods. Nguetack et al. (2021) reported a prevalence of approximately 38% among pregnant women in Yaoundé, while Tchinda et al. (2022) documented prevalence rates exceeding 45% in some regions characterized by intense malaria transmission. The prevalence observed in the present study is therefore consistent with the continuing burden of malaria among pregnant women in Cameroon. Several factors may explain the relatively high prevalence observed. Douala experiences perennial malaria transmission due to favorable climatic conditions, including heavy rainfall, high humidity, and elevated temperatures. These environmental conditions promote mosquito breeding and increase opportunities for human-vector contact throughout the year. In addition, rapid urbanization, poor drainage systems, accumulation of stagnant water, and inadequate waste disposal practices contribute to sustained malaria transmission within densely populated neighborhoods such as New Bell. The observed prevalence also highlights the persistent challenges affecting malaria prevention during pregnancy. Despite widespread distribution of insecticide-treated mosquito nets and implementation of IPTp-SP, many women remain inadequately protected due to

inconsistent utilization of preventive measures, delayed initiation of antenatal care, and environmental conditions that favor mosquito proliferation.

4.2 Maternal Age and Malaria Occurrence

Maternal age was significantly associated with malaria occurrence in the present study. Women aged 30 years and above were significantly less likely to have malaria infection compared with younger women. This finding is consistent with previous studies conducted across sub-Saharan Africa, which have repeatedly identified younger age as an important risk factor for malaria during pregnancy.

Research conducted in Ethiopia, Nigeria, and Uganda demonstrated that adolescent and young adult pregnant women experience higher malaria prevalence than older women (Yohannes et al., 2021; Musa et al., 2022; Nankabirwa et al., 2022). Similar observations have been reported by the World Health Organization, which recognizes younger pregnant women as a high-risk group requiring targeted malaria prevention interventions. Similar findings were reported by Abu Bonsra et al. (2025), who observed that younger pregnant women attending antenatal clinics in Ghana had significantly higher odds of malaria infection than older women. Almagaw et al. (2022) likewise demonstrated that maternal age was an important determinant of malaria occurrence among pregnant women in Ethiopia, further supporting the present findings.

The relationship between age and malaria occurrence may be explained by acquired immunity. Women living in malaria-endemic regions gradually develop partial immunity following repeated exposure to malaria parasites. Older women are therefore more likely to possess protective immune responses capable of limiting parasite multiplication and reducing the risk of clinical infection. Younger women, particularly those experiencing pregnancy for the first time, often have lower levels of acquired immunity and consequently remain more vulnerable to malaria infection.

Furthermore, younger women may have limited experience regarding pregnancy-related healthcare, lower awareness of preventive measures, and reduced financial autonomy, all of which may influence health-seeking behavior and increase susceptibility to malaria.

4.3 Marital Status and Malaria Occurrence

Marital status emerged as an independent predictor of malaria occurrence. Married women demonstrated significantly lower odds of malaria infection compared with unmarried women. Similar findings have been reported in studies conducted in Ghana, Uganda, and Nigeria, where marital status was associated with improved maternal healthcare utilization and better pregnancy outcomes (Amoako et al., 2021; Ibrahim et al., 2022). The protective effect associated with marriage may be attributable to greater social and economic support. Married women often benefit from financial assistance from spouses, improved household stability, and enhanced access to healthcare services. Such support may facilitate regular antenatal care attendance,

timely acquisition of preventive interventions, and adherence to recommended malaria prevention practices.

Additionally, married women may be more likely to receive encouragement from family members to attend ANC services and comply with medical advice. In contrast, unmarried women may face financial difficulties, social stigma, and reduced support systems, factors that can adversely affect healthcare utilization and malaria prevention efforts. These findings emphasize the importance of considering social determinants of health when designing malaria control programs targeting pregnant women.

4.4 Utilization of Insecticide-Treated Mosquito Nets

Regular utilization of insecticide-treated mosquito nets was strongly associated with reduced malaria occurrence. Women who reported consistent ITN use were significantly less likely to have malaria compared with those who did not regularly sleep under mosquito nets. This finding supports extensive evidence demonstrating the effectiveness of ITNs in preventing malaria transmission. According to the WHO, insecticide-treated mosquito nets remain among the most effective and cost-efficient malaria prevention tools available. Numerous studies conducted throughout Africa have shown that regular ITN utilization substantially reduces malaria infection, severe malaria, maternal anemia, and adverse pregnancy outcomes (Gutman et al., 2023; Wekesa et al., 2023). The protective effect observed in the present study is consistent with findings reported from Uganda, Tanzania, Ethiopia, and Kenya, where regular ITN use significantly reduced malaria risk among pregnant women (Mugenyi et al., 2022; Mosha et al., 2023).

Despite high levels of awareness regarding the importance of mosquito nets, approximately one-third of participants reported inconsistent utilization. This observation suggests that ownership does not necessarily translate into effective use. Factors such as discomfort associated with heat, damaged nets, overcrowded sleeping arrangements, and misconceptions regarding malaria transmission may contribute to inconsistent utilization. These findings highlight the need for continued health education focusing not only on mosquito net ownership but also on proper and consistent use throughout pregnancy.

4.5 Antenatal Care Attendance and Malaria Prevention

Adequate antenatal care attendance was independently associated with reduced malaria occurrence. Women who attended at least four ANC visits demonstrated significantly lower malaria prevalence compared with those attending fewer visits. Antenatal care serves as a critical platform for delivering malaria prevention interventions. During ANC consultations, pregnant women receive health education, insecticide-treated mosquito nets, IPTp-SP, routine malaria screening, and management of pregnancy-related complications. Consequently, regular attendance increases opportunities for prevention, early diagnosis, and treatment. The present findings are consistent with studies conducted in Nigeria, Ghana, and Kenya, where inadequate

ANC attendance was associated with increased malaria risk (Anabire et al., 2023; Ibrahim et al., 2022). Similar observations have been reported in systematic reviews examining malaria prevention among pregnant women in sub-Saharan Africa (Yussif et al., 2024). The WHO currently recommends a minimum of eight antenatal contacts during pregnancy to optimize maternal and fetal outcomes. However, many women in low-resource settings continue to initiate ANC late or attend infrequently due to financial constraints, transportation challenges, cultural beliefs, and competing family responsibilities. Improving ANC attendance therefore remains an important strategy for strengthening malaria prevention during pregnancy. The findings of this study are also consistent with Abu Bonsra et al. (2025), who identified inadequate antenatal attendance as one of the strongest predictors of malaria during pregnancy. Their study emphasized that regular ANC attendance improves access to IPTp-SP, ITNs and malaria education, thereby reducing malaria risk.

4.6 Uptake of Intermittent Preventive Treatment During Pregnancy

Receipt of at least three doses of IPTp-SP was significantly associated with reduced malaria occurrence. Women who received the recommended IPTp-SP regimen were less likely to have malaria than those receiving fewer doses. This finding agrees with numerous studies demonstrating the effectiveness of IPTp-SP in reducing maternal parasitemia, placental malaria, maternal anemia, low birth weight, and neonatal mortality (Kayentao et al., 2021; Gutman et al., 2023). IPTp-SP remains a cornerstone of malaria prevention among pregnant women in malaria-endemic countries and is strongly recommended by the WHO.

Nevertheless, nearly half of the participants had not received the recommended minimum number of IPTp-SP doses. Similar challenges have been documented in Cameroon and other African countries, where delayed ANC initiation, medication stock-outs, inadequate healthcare provider adherence to guidelines, and poor patient awareness contribute to suboptimal IPTp-SP coverage.

Strengthening implementation of IPTp-SP programs and ensuring continuous availability of sulfadoxine-pyrimethamine at health facilities are therefore essential for improving malaria prevention outcomes. Similar observations were reported in Ethiopia by Almaw et al. (2022), where inadequate uptake of preventive interventions during pregnancy significantly increased malaria occurrence.

4.7 Environmental Determinants of Malaria Occurrence

Environmental factors played an important role in malaria transmission among study participants. Women residing near stagnant water collections, poor drainage systems, and areas characterized by inadequate waste disposal practices were significantly more likely to have malaria infection.

These findings are biologically plausible because stagnant water serves as an ideal breeding habitat for *Anopheles* mosquitoes. Similar associations have been reported in studies conducted in Cameroon, Ghana, Tanzania, and Nigeria (Afoakwah et al., 2022; Mosha et al., 2023).

The New Bell community is characterized by rapid urban growth, inadequate urban planning, poor drainage infrastructure, and periodic flooding. Such environmental conditions facilitate mosquito breeding and increase human-vector contact. Consequently, even effective individual-level preventive measures may have limited impact if environmental determinants are not adequately addressed. The findings therefore support the need for integrated malaria control strategies combining personal protection measures with environmental management interventions such as drainage improvement, elimination of stagnant water, waste management, and community sanitation programs.

4.8 Knowledge Regarding Malaria and Prevention Practices

Although most participants demonstrated good knowledge regarding malaria transmission and prevention, knowledge did not remain significantly associated with malaria occurrence after adjustment for confounding variables. This finding suggests that knowledge alone may be insufficient to prevent malaria infection. Similar observations have been reported in studies conducted in Nigeria and Uganda where high awareness levels did not necessarily translate into appropriate preventive behaviors (Musa et al., 2022; Mugenyi et al., 2022). Several factors may explain this observation. Women may possess adequate knowledge but encounter economic, environmental, or social barriers that prevent effective implementation of preventive measures. For example, participants may understand the importance of mosquito nets but fail to use them consistently because of discomfort, damaged nets, or overcrowded living conditions. These findings highlight the importance of combining educational interventions with practical support mechanisms capable of facilitating behavioral change.

4.9 Public Health Implications

The findings of this study have important implications for malaria control programs in Cameroon. The relatively high prevalence of malaria among pregnant women indicates that substantial gaps remain in current prevention efforts. Interventions should prioritize younger women, unmarried women, and those with inadequate ANC attendance. Furthermore, strengthening IPTp-SP coverage, promoting regular ITN utilization, and implementing environmental sanitation initiatives could significantly reduce malaria transmission. Collaboration between healthcare authorities, municipal councils, and community organizations will be essential for addressing environmental determinants of malaria and improving maternal health outcomes.

Although the New Bell District Hospital provides organized antenatal care services, some pregnant women may remain unregistered, initiate antenatal care late, or fail to complete the recommended follow-up schedule because of socioeconomic constraints, transportation

difficulties, cultural beliefs or limited awareness. These gaps may reduce access to malaria prevention interventions and should be investigated in future implementation research.

4.10 Study Limitations

This study has several limitations. First, the cross-sectional design limits the ability to establish causal relationships between identified factors and malaria occurrence. Second, some information regarding preventive practices was self-reported and may therefore be subject to recall bias and social desirability bias. Third, the study was conducted in a single health facility, which may limit generalizability to other regions of Cameroon. Despite these limitations, the study provides valuable evidence regarding the prevalence and determinants of malaria among pregnant women in an urban malaria-endemic setting and offers important information for malaria control planning and maternal health policy development.

5. Conclusion

The present study assessed the prevalence of malaria and factors associated with malaria occurrence among pregnant women attending antenatal care services at the New Bell District Hospital in Douala, Cameroon. Microscopic examination of Giemsa-stained thick and thin blood smears revealed a malaria prevalence of 42.1%, indicating that malaria remains a significant public health challenge among pregnant women despite ongoing prevention and control efforts.

The study identified several factors significantly associated with malaria occurrence, including younger maternal age, unmarried status, inadequate antenatal care attendance, suboptimal uptake of intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP), inconsistent utilization of insecticide-treated mosquito nets, and unfavorable environmental conditions characterized by stagnant water, poor drainage systems, and improper waste disposal practices. Conversely, women aged 30 years and above, married women, those who regularly utilized insecticide-treated mosquito nets, attended at least four antenatal care visits, and received at least three doses of IPTp-SP were significantly less likely to experience malaria infection. These findings emphasize the need for comprehensive malaria prevention strategies that address not only individual behaviors but also healthcare access and environmental determinants of malaria transmission. Strengthening antenatal care services, improving IPTp-SP coverage, promoting regular utilization of insecticide-treated mosquito nets, and implementing environmental sanitation interventions could substantially reduce malaria burden and improve maternal and neonatal health outcomes in Cameroon.

Based on the findings of this study, it is recommended that the Ministry of Public Health strengthen malaria prevention and control strategies among pregnant women by ensuring adequate IPTp-SP availability, expanding ITN distribution, and enhancing surveillance systems. Healthcare facilities should promote early and regular antenatal care attendance, routine malaria screening, health education, and adherence to preventive interventions. Local authorities and communities should improve environmental sanitation, eliminate mosquito breeding sites, strengthen drainage systems, and encourage community participation in malaria prevention

activities. Future research should focus on longitudinal studies to establish causal relationships, investigate barriers to preventive practices, evaluate community-based interventions, and assess the influence of socioeconomic factors on malaria prevention among pregnant women.

Limitations of the Study

Despite its strengths, the study has some limitations. The cross-sectional design limits the ability to establish causal relationships between risk factors and malaria occurrence. Some information regarding preventive practices and environmental exposures was self-reported and may therefore be subject to recall bias and social desirability bias. Furthermore, the study was conducted in a single health facility, which may limit the generalizability of the findings to other regions of Cameroon. Nevertheless, the study provides valuable evidence regarding malaria occurrence among pregnant women in an urban malaria-endemic setting.

Acknowledgements

The authors sincerely acknowledge all pregnant women who participated in this study for their willingness and cooperation. Special appreciation is extended to the management and healthcare personnel of the New Bell District Hospital for their support during data collection and laboratory investigations. The authors also thank the Littoral Regional Delegation of Public Health and the Faculty of Medicine and Biomedical Sciences of the University of Douala for facilitating the conduct of this research.

References

- Abdullahi, A., Ibrahim, U., & Bello, M. (2023). Determinants of malaria infection among pregnant women attending antenatal clinics in northern Nigeria. *Malaria Journal*, 22(1), 174–183.
- Abu Bonsra E, Amankwah Osei P, Adjei Kyeremeh E, Adama S, Sekyi AG, King EF. 2025. Factors associated with malaria in pregnancy among women attending ANC clinics in selected districts of the Ashanti Region, Ghana. *Malaria Journal*, 24(1), 8.
- Afoakwah, C., Owusu, E., & Anto, F. (2022). Environmental determinants of malaria transmission among pregnant women in Ghana. *BMC Public Health*, 22(1), 1654–1664.
- Agarwal, K., Alonso, P. L., & Chico, R. M. (2021). Malaria in pregnancy: Recent advances in prevention and management. *The Lancet Infectious Diseases*, 21(4), e94–e104.
- Almaw A, Yimer M, Alemu M, Tegegne B. 2022. Prevalence of malaria and associated factors among symptomatic pregnant women attending antenatal care at three health centers in north-west Ethiopia. *PLoS ONE*, 17(4):e0266477.
- Amoako, N., Asare, K., & Mensah, E. (2021). Socioeconomic determinants of maternal health outcomes in Ghana. *International Journal of Gynecology & Obstetrics*, 153(2), 215–222.
- Anabire, N. G., Aryee, P. A., & Abdul-Karim, A. (2023). Utilization of intermittent preventive treatment among pregnant women in northern Ghana. *BMC Pregnancy and Childbirth*, 23(1), 276–284.

- Chico, R. M., Chaponda, E. B., Ariti, C., Chandramohan, D., & Greenwood, B. (2021). Influence of malaria prevention interventions on pregnancy outcomes in sub-Saharan Africa. *PLoS ONE*, 16(4), e0249857.
- Chukwuocha, U. M., Dozie, I. N. S., & Chukwuocha, A. N. (2021). Environmental sanitation and malaria transmission in urban African communities. *Journal of Environmental Health*, 83(9), 28–35.
- Desai, M., ter Kuile, F. O., Nosten, F., McGready, R., Asamoah, K., Brabin, B., & Newman, R. D. (2007). Epidemiology and burden of malaria in pregnancy. *The Lancet Infectious Diseases*, 7(2), 93–104. [https://doi.org/10.1016/S1473-3099\(07\)70021-X](https://doi.org/10.1016/S1473-3099(07)70021-X)
- Dlamini, N. R., Mthembu, T. N., & Hlongwane, M. (2024). Predictors of malaria infection among pregnant women in Southern Africa. *Tropical Medicine and Health*, 52(1), 41–50.
- Fana, S. A., Bunza, M. D. A., Anka, S. A., Imam, A. U., & Nata'ala, S. U. (2022). Malaria burden among pregnant women attending antenatal clinics in northwestern Nigeria. *Journal of Infection in Developing Countries*, 16(7), 1110–1118.
- Gutman, J., Kovacs, S., Dorsey, G., Stergachis, A., & Ter Kuile, F. O. (2023). Safety and effectiveness of malaria prevention strategies during pregnancy. *Clinical Infectious Diseases*, 76(5), 902–911.
- Ibrahim, U., Musa, A., & Abdullahi, A. (2022). Antenatal care attendance and malaria prevention among pregnant women in Nigeria. *BMC Pregnancy and Childbirth*, 22(1), 431–440.
- Kayentao, K., Garner, P., van Eijk, A. M., Naidoo, I., Roper, C., Mulokozi, A., & Ter Kuile, F. O. (2021). Intermittent preventive therapy for malaria during pregnancy. *Cochrane Database of Systematic Reviews*, 2021(9), CD004317. <https://doi.org/10.1002/14651858.CD004317.pub3>
- Kimbi, H. K., Nkesa, S. B., Ndamukong-Nyanga, J. L., & Sumbele, I. U. N. (2021). Malaria among pregnant women in Cameroon: Current burden and prevention challenges. *Malaria Research and Treatment*, 2021, 1–10.
- Menéndez, C., D'Alessandro, U., & Ter Kuile, F. O. (2015). Reducing the burden of malaria in pregnancy by preventive strategies. *The Lancet Infectious Diseases*, 15(2), 126–135. [https://doi.org/10.1016/S1473-3099\(14\)70891-5](https://doi.org/10.1016/S1473-3099(14)70891-5)
- Ministry of Public Health Cameroon. (2023). *National Malaria Control Programme Annual Report 2023*. Yaoundé, Cameroon. <https://minsante.cm>
- Mosha, D., Kakolwa, M., Mahande, M., & Mboya, I. (2023). Environmental risk factors associated with malaria among pregnant women in Tanzania. *Malaria Journal*, 22(1), 311–320.
- Mugenyi, P., Nankabirwa, J., & Arinaitwe, E. (2022). Utilization of insecticide-treated mosquito nets and malaria prevention among pregnant women in Uganda. *Malaria Research and Treatment*, 2022, 1–9.
- Musa, A., Suleiman, A., & Mohammed, I. (2022). Knowledge, attitudes and practices regarding malaria prevention among pregnant women in Nigeria. *BMC Pregnancy and Childbirth*, 22(1), 721–730.

- Nankabirwa, J., Kamya, M. R., & Dorsey, G. (2022). Malaria epidemiology among pregnant women attending antenatal clinics in Uganda. *Tropical Medicine and Infectious Disease*, 7(9), 248.
- Nguefack, F., Ndzi, E., & Tchouangueu, T. (2021). Prevalence and determinants of malaria among pregnant women in Cameroon. *Pan African Medical Journal*, 39, 112–120.
- Nkoka, O., Chuang, K. Y., & Chuang, Y. C. (2022). Determinants of insecticide-treated net use among pregnant women in sub-Saharan Africa. *Scientific Reports*, 12(1), 1105.
- Nkumama, I. N., O'Meara, W. P., & Osier, F. H. A. (2023). Changes in malaria epidemiology in Africa and implications for maternal health. *Nature Reviews Microbiology*, 21(4), 221–235.
- Okonkwo, C. C., Nwankwo, P. O., & Chukwuka, J. O. (2021). Factors influencing uptake of intermittent preventive treatment among pregnant women in Nigeria. *International Health*, 13(5), 453–461.
- Olotu, A., Fegan, G., Wambua, J., Nyangweso, G., Leach, A., & Bejon, P. (2021). Long-term effectiveness of malaria prevention strategies in endemic communities. *The Lancet Global Health*, 9(5), e627–e635.
- Owusu, E., Agyemang, S., & Ofori, M. F. (2022). Malaria prevalence and associated factors among pregnant women in Ghana. *BMC Infectious Diseases*, 22(1), 889.
- Poespoprodjo, J. R., Fobia, W., Kenangalem, E., Lampah, D. A., Hasanuddin, A., & Price, R. N. (2021). Malaria during pregnancy and adverse birth outcomes. *Clinical Microbiology Reviews*, 34(4), e00120-20.
- Sicuri, E., Bardají, A., & Menéndez, C. (2022). Economic burden of malaria during pregnancy in endemic countries. *Health Policy and Planning*, 37(4), 473–482.
- Tchinda, V. H. M., Ndzi, E. S., & Mbacham, W. F. (2022). Burden of malaria during pregnancy in Cameroon: A multicenter study. *Malaria Journal*, 21(1), 241.
- Tiono, A. B., Ouedraogo, A., & Sirima, S. B. (2023). Malaria prevention among pregnant women in West Africa: Progress and challenges. *Tropical Medicine & International Health*, 28(8), 673–684.
- Wekesa, P., Ouma, P., & Nyambura, J. (2023). Factors associated with malaria among pregnant women in western Kenya. *BMC Pregnancy and Childbirth*, 23(1), 318.
- World Health Organization. (2021). *WHO recommendations on antenatal care for a positive pregnancy experience*. Geneva, Switzerland: World Health Organization. <https://www.who.int/publications/i/item/9789241549912>
- World Health Organization. (2023). *World malaria report 2023*. Geneva, Switzerland: World Health Organization. <https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2023>
- World Health Organization. (2024). *World malaria report 2024*. Geneva, Switzerland: World Health Organization. <https://www.who.int/publications/i/item/9789240104440>
- Yohannes, T., Alemayehu, M., & Kassa, G. (2021). Risk factors for malaria infection among pregnant women in Ethiopia. *International Journal of Women's Health*, 13, 867–878.

- Yussif, A. S., Sumaila, M., & Ibrahim, M. (2024). Antenatal care utilization and prevention of malaria during pregnancy in sub-Saharan Africa: A systematic review. *BMC Pregnancy and Childbirth*, 24(1), 117–129.
- Zgambo, M., Kalembo, F., & Mbakaya, B. (2023). Community-level determinants of malaria prevention practices among pregnant women in Africa. *International Journal of Environmental Research and Public Health*, 20(14), 6321.