

Malaria and Anemia among Pregnant Women in the Fouban Health District: West-Cameroon

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Abstract

Malaria is one of the deadliest endemic diseases in Africa. The causative agent of this disease, *Plasmodium*, contributes to severe complications such as anemia, particularly in vulnerable groups. In Cameroon, the health system aims to protect patients through the free distribution of long-lasting insecticide-treated mosquito nets and intermittent preventive treatment for malaria. However, access to these interventions remains limited. The objective of our study was to determine the distribution of malaria in pregnancy and its association with anemia. **Methods:** This was a descriptive cross-sectional study targeting pregnant women attending consultations, selected by convenience sampling, from February to May 2021 in three major health facilities in the Fouban health district of West Cameroon. Data were collected through questionnaires administered to the pregnant women, results from malaria rapid diagnostic tests (RDTs), thick drop microscopy for malaria diagnosis, and blood counts. The prevalence of malaria and anemia was estimated, as well as the association between malaria infection and the occurrence of anemia. **Results:** A total of 395 (91.86%) out of 430 pregnant women were enrolled in the study. The prevalence of malaria and anemia was 5.06% and 30.37%, respectively. Anemia was diagnosed in 120 women (30.37%), including 73 (60.83%) with mild anemia, 46 (38.33%) with moderate anemia, and 1 (0.83%) with severe anemia. Among women with malaria, 8 (40%) had anemia. Malaria infection was found to be associated with an increased risk of developing mild anemia (OR = 1.80 [0.66 - 4.85]) and a decreased risk of developing moderate anemia (OR = 0.74 [0.16 - 3.33]), although these associations were not statistically significant. **Conclusion:** A relatively low

malaria prevalence was registered in the study population while anemia was more prevalent. Lack of association between malaria and anemia may be linked to low malaria prevalence.

Keywords

Malaria, Anemia, Prevalence, Association

1. Introduction

Malaria remains one of the most prevalent and deadly parasitic diseases in sub-Saharan Africa, and its eradication [1] is still far from being achieved. One of the major complications of constant exposure to *Plasmodium* in endemic areas is the development of anemia. During their life cycle, *Plasmodium* parasites infect red blood cells, causing them to burst [2], leading to the cyclical depletion [2] of erythrocytes.

The maternal mortality rate in Cameroon is approximately 669 per 100,000 live births. Between 2017 and 2020, the number of malaria cases in Cameroon increased by 3.8%, from 250 to 260 per 1000 people, contributing to a 0.8% rise in mortality and increased complications associated with the disease [3].

The Ministry of Health in Cameroon has implemented several strategies to reduce maternal and infant mortality, including the distribution of mosquito nets [4], malaria prevention treatments [5], and iron supplementation for pregnant women during their first antenatal visit. However, cases of maternal or infant death, spontaneous abortion, premature delivery, and other consequences of malaria and anemia during pregnancy are still reported [6].

Several studies have demonstrated that anemia in pregnancy is largely caused by malaria in endemic areas. For instance, a study conducted in Congo by Bouyou-Akottet and colleagues in 2003 found that 63% of malaria-infected pregnant women were anemic, compared to 41% in the healthy group [7]. Similarly, Makoutode's study in Benin showed that 34.8% of anemia cases in pregnant women were attributed to malaria. This evidence underscores the importance of the simultaneous and systematic prevention of both malaria and anemia in endemic regions [8].

To identify the most effective method for preventing maternal and infant mortality and to optimize strategies for preventing malaria and anemia, it is crucial to determine whether anemia in the target region is primarily due to malaria exposure during pregnancy or if both conditions independently warrant separate investigations. This study was conducted to address this gap, with the objective of examining the distribution of malaria and anemia among pregnant women and investigating the association between the two conditions.

2. Methodology

2.1. Study Design

This was a descriptive cross-sectional study with a nested case-control component,

targeting pregnant women attending consultations at the selected health facilities. The cross-sectional component focused on pregnant women in their first and third trimesters, who were included by convenience sampling. Those who consented were administered a face-to-face questionnaire, approved by the investigators, to assess their knowledge of anemia and malaria. The case-control analysis was used to assess the association between malaria and the presence of anemia in pregnant women.

2.2. Study Setting and Period

The study was conducted in the outpatient services of Kuéka, Njissé, and the District Hospital of Foumban, located in the Noun department, from February to May 2021. Samples were collected in the laboratories of these health facilities and analyzed at the Njissé health center and the District Hospital.

2.3. Sample Size

The minimum sample size was estimated to be 385 participants, based on an assumed prevalence of gestational malaria of 49.9%, a 95% confidence interval, and a precision of 5%. For the case-control component, the minimum sample size was estimated at 71 participants per group, assuming an anticipated prevalence of 35%, as reported in previous studies in Cameroon, a precision of 50%, and an expected odds ratio (OR) of 1.

2.4. Sampling

In the analytical component, any pregnant woman who presented during consultation with anemia (hemoglobin levels below 11 g/dL in the first and third trimesters, or below 10.5 g/dL in the second trimester) and with the presence of *Plasmodium* trophozoites was considered a case. For each case, two controls were selected with matching biological characteristics, such as age range and trimester of pregnancy, but with hemoglobin levels equal to or greater than 11 g/dL and without malaria. In both groups, the presence of trophozoites was assessed without specificity regarding concentration.

2.5. Data Collection and Outcome Assessment

Eligible pregnant women were approached for the study, and a face-to-face questionnaire was administered to collect participants' health information. The questionnaire presented at the appendix comprised four main components: anthropometric characteristics, social characteristics, knowledge and practical skills regarding malaria and anemia, and medical history. Subsequently, a blood sample was taken for hematological analyses and malaria diagnostic tests. After the analyses, the results were communicated to the patients for medical follow-up. Additional information was gathered from the patients' health diaries.

2.6. Malaria Diagnosis

Two methods were used for the diagnosis of malaria infection; the thick smear [9]

and the rapid diagnostic test (RDT). The procedures were done and counts applied as per routine and manufacturer recommendations for the RDT [10]. All women whom both the Thick Gout examination and the malaria RDT were positive were considered to have malaria.

2.7. Hematological Tests

The blood count was performed using an automated counter, which provided erythrocyte parameters, including hemoglobin level, mean corpuscular volume (MCV), hematocrit, and mean corpuscular hemoglobin concentration (MCHC). The reference values for these parameters are defined in the Winthrop erythrocyte constants.

2.8. Data Management and Analysis

Data collected on hard copies were entered into Excel 2016 and analyzed using EPI Info 7.3.5 and Excel 2016. Incomplete data were supplemented using the patients' records. The odds ratio (OR), p-value, and confidence interval were calculated to assess the association between anemia and malaria across different scenarios (mild and moderate anemia), with two individuals matching the same characteristics used as controls.

2.9. Ethical Considerations

The protocol for this study was approved by the Cameroon National Ethics Committee for Research in Human Health (No. 2021/08/93 UECNERSH/SP). Informed consent was obtained from all women prior to their inclusion in the study.

3. Results

3.1. Characteristics of the Study Population

During this study conducted in Foumban, 430 women visiting the health centers were approached, of whom 395 (91.86%) agreed to participate. The average age of the participants was 26.73 years. Most women (357 [89.62%]) resided in the city center of Foumban. A total of 292 (73.92%) of the women were in their third trimester of pregnancy, the majority had secondary education (323 [81.77%]) as highest level of education, while fewer had higher education (34 [8.61%]) as highest level of education. **Table 1** presents the characteristics of included women.

3.2. Prevalence of Malaria in Pregnant Women

Out of the 395 women tested, 20 (5.06%) were positive for malaria infection, as confirmed by both thick film and rapid diagnostic tests (RDTs). The prevalence of malaria was 7.01% in the first trimester, 4.34% in the second trimester, and 4.79% in the third trimester of pregnancy.

3.3. Prevalence of Anemia in Pregnant Women

In the study population, 120 women (30.37%) developed anemia. The mean

hemoglobin level was 11.53 g/dL, with a minimum of 6.7 g/dL and a maximum of 16.4 g/dL. Among the anemia cases, 73 women (60.83%) had mild anemia, 46 (38.33%) had moderate anemia, and only one (0.83%) had severe anemia. In the first trimester, there were 13 cases out of 57 (22.80%), 14 cases out of 46 (30.43%) in the second trimester, and 93 cases out of 292 (31.84%) in the third trimester. **Table 2** presents the distribution of types of anemia with respect to the trimester of pregnancy. Among the 120 cases of anemia, 87 (72.00%) were classified as normocytic anemia, with 81 out of 87 cases (93%) being normocytic normochromic. Additionally, 4 cases (3.33%) were macrocytic, and 28 cases (23.33%) were microcytic.

Table 1. Characteristics of the study population.

Characteristics	Frequency	Proportion(%)
<i>Age groups</i>		
<20	44	11.13
20-29	216	54.68
30-39	124	31.39
≥40	11	2.78
<i>Area of residence</i>		
Foumban	357	89.62
Rural	38	9.62
<i>Pregnancy trimester at time of inclusion</i>		
Trimester 1	57	14.43
Trimester 2	46	11.64
Trimester 3	292	73.92
<i>Religion</i>		
Muslim	317	80.75
Christian	78	19.24
<i>Marital status</i>		
Married	319	80.75
Single	76	19.24
<i>Level of education</i>		
Primary	38	9.62
Secondary	323	81.77
Higher education	34	8.6

Continued

<i>Mosquito net Usage</i>		
Yes	218	55.18
No	177	44.81

Table 2. Distribution of women according to trimester of pregnancy and severity of anemia.

Trimester	Mild anemia (%)	Moderate anemia (%)	Severe anemia (%)	Total (%)
Trimester 1	8	5	0	13 (10.83)
Trimester 2	9	5	0	14 (11.66)
Trimester 3	56	36	1	93 (77.50)
Total (%)	73 (60.83)	46 (38.33)	1 (0.83)	120 (100%)

3.4. Association between Malaria and Anemia

Among the 120 cases identified with anemia, 8 cases also had malaria. These malaria cases were primarily associated with normocytic anemia, with only one case linked to microcytic anemia. **Table 3** presents the association between malaria infection and the presence of mild or moderate anemia. Malaria infection was associated with an increased risk of developing mild anemia (OR = 1.80 [0.66 - 4.85]) and a decreased risk of developing moderate anemia (OR = 0.74 [0.16 - 3.33]); however, these associations were not statistically significant.

Table 3. Association between malaria infection and anemia in pregnant women.

	Presence of Anemia		OR	IC	P-value	
	No n (%)	Yes n (%)				
Mild anemia						
Plasmodium infection	No	281 (80.75)	67 (19.25)	1.80	0.66-4.85	0.24
	Yes	14 (70.00)	6 (30.00)			
Moderate anemia						
Plasmodium infection	No	303 (87.07)	45 (12.93)	0.74	0.16 - 3.33	0.70
	Yes	418 (90.00)	2 (10.00)			

4. Discussion

This study aimed to determine the association between the occurrence of malaria and the development of anemia among pregnant women. The prevalence of malaria was 5.06%. Anemia was diagnosed in 120 women (30.37%), with 73 (60.83%) cases classified as mild, 46 (38.33%) as moderate, and 1 (0.83%) as severe. Among the 20 cases identified with malaria, 8 (40%) had anemia. No significant association was found between malaria infection and anemia in pregnant women.

Malaria is a disease commonly endemic in sub-Saharan countries including Cameroon [11]. Malaria represents a significant serious risk for pregnant women and the foetus [12]. In these women, it can lead to complications that include fetal loss, premature delivery, impaired fetal growth, and the birth of low-weight infants, which are significant risk factors for mortality. In the present study, the prevalence of malaria among pregnant women was assessed, yielding a rate of 5.06%. This prevalence is lower than the 36.5% reported by Zara Maman *et al.* in Niger (Niamey) in 2020 and the 34.7% reported in another locality in Cameroon [13]. This difference may be attributed to the relatively short duration of our study, which does not necessarily reflect the peak transmission season, typically occurring during the early rainy season rather than the dry season. The difference may also be attributed to the difference in contexts and targets of the studies. The relatively low prevalence observed could suggest that preventive measures, such as the use of long-lasting insecticidal nets (LLINs) distributed during the first antenatal care (ANC) visit and intermittent preventive treatment for malaria, are being effectively adopted [5]. More than half (55.18%) of the women in this study reported regular use of long-lasting insecticidal nets. However, we did not collect data on the administration of intermittent treatment or the availability of mosquito nets to verify these hypotheses.

Anemia like malaria represents serious dangers for the future of the pregnant woman and the fetus [14]. It is associated with increased morbidity and fetal death [3]. The overall prevalence of anemia in pregnant women in this study was 30.37%, predominantly normocytic 72% (normocytic normochromic 93%). It is lower than the prevalence reported by Koura *et al.* in his study on the etiologies of anemia in Benin in 2011 which was 65.7% [15], and that obtained by Nguefack *et al.* on the prevalence of anemia and associated factors at the Douala General Hospital in 2013 which was 39.8% [16]. This difference can be explained by the difference in settings and approaches. The relatively high prevalence of anemia can question the adapted and complete diet of pregnant women in the covered locality contributing to the sufficient intake of iron [8]. Also, this questions the availability and administration of iron supplements which are provided for, in the care system for pregnant women in health facilities [5]. The fact that most anemias cases are mild anemia reduces the alarm since they could be attributed to the increase in blood volume that evolves with pregnancy. It would nevertheless be beneficial to carry out additional studies to investigate the content of the diet of pregnant women.

Malaria and anemia are two factors that can weaken the immunity of pregnant women, and together, they represent significant risk factors and outcomes of pregnancy [17] [18]. As previously, the causal relationship between the two conditions is difficult to establish or may be linked to each other. The results of this study indicate an absence of association between malaria and anemia (OR = 1.80 [0.66 - 4.85]). This finding contradicts research conducted in other settings that identified malaria as a risk factor for the development of anemia in pregnant women.

The lack of a significant association of co-infection in the present study should be interpreted with caution as it may be linked to methodological biases of the study. The sample size used for the various analysis was relatively small, and only a limited number of malaria cases were identified during the study period and included in the analysis. Consequently, the study's power may not be sufficient to adequately address the research question.

The interpretation of results in the present study should consider several limitations. The study was conducted over a short period during a low transmission period for malaria, which does not accurately reflect the seasonal dynamics of malaria transmission in Cameroon. Additionally, the sample size estimated for the case-control component was not achieved, which could lead to sampling fluctuations and result in over- or under-estimation of the findings, as well as wider confidence intervals.

5. Conclusion

Plasmodium infection is a prevalent issue in the Noun department, particularly in the town of Foumban in Cameroon. The low prevalence of malaria observed in this study makes the interpretation of the association between malaria infection and anemia in pregnant women ambiguous.

State of Knowledge on the Subject

- Malaria remains one of the leading causes of mortality among pregnant women in sub-Saharan Africa and Cameroon.
- The presence of Plasmodium trophozoites exacerbates the frequency of anemia, complicating pregnancy further.
- The prevalence of both malaria and anemia is notably higher among pregnant women in their third trimester.

Contribution of Our Study to Knowledge

- This study determines the prevalence of malaria and anemia in pregnant women in Foumban (West Cameroon);
- The present study determines the prevalence of anemia in pregnant women with malaria in Foumban.
- The present study analyzes the association between malaria and anemia in pregnant women.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix

Questionnaire

1) Name of health facility: _____,

2) General characteristics

- a) Age:..... years
- c) weight:kg
- d) number of ANC performed:.....
- e) number of pregnancies:.....
- f) pregnancy age:.....

3) Social characteristics:

- a) Village/neighbourhood/town:
- b) Highest level of education: not attended primary secondary
higher education
- c) Profession:.....
- d) Religion:
- e) Marital status: single married (monogamy polygamy)
divorced

4) Practical knowledge and skills

Anaemia and history

- a) Do you have a blood disorder? yes no
Thalassaemia, sickle cell anaemia other (please specify).....

Malaria research and history

- a) Do you sleep under a mosquito net? yes no
If yes, impregnated? Yes no
How old is it? less than one year , 2 years more than 2 years
more than 3 years
- b) How often do you sleep under your net per week? rarely (<4)
regularly (>4)
- c) Do you use insecticides? Yes no

5) Laboratory analysis

Malaria tests conducted: Yes no

Results of malaria RDT:

parasite count (microscopy):

Blood sample collected? Yes no

Results of tests:

Hemoglobin level: _____

Corpuscular volume (MCV): _____

Hematocrit: _____

Corpuscular hemoglobin concentration (MCHC): _____