



Alterations in hematological parameters in patients with malarial infections: A cross-sectional study

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Abstract

Introduction: Malaria is a significant global health concern, causing considerable morbidity and mortality worldwide. Understanding the role of hematological parameters in malarial infections is crucial for comprehending disease mechanisms. This cross-sectional study investigates alterations in hematological parameters and their clinical significance in patients with malaria.

Material and Methods: The study includes 150 malaria-diagnosed patients. Demographic data, complete blood counts (CBC), and symptom severity scores were collected. Hematological parameters, such as RBC Count, Hemoglobin, Hematocrit, Platelet Count, and WBC Count, were assessed. Mean and standard deviation values were calculated for each parameter. The study aims to shed light on the clinical implications of these hematological alterations in malaria.

Results: The study found significant hematological alterations in patients with malarial infections. Mean values for Red Blood Cell (RBC) Count, Hemoglobin, Hematocrit, Platelet Count, and White Blood Cell (WBC) Count were lower than normal ranges. Symptom severity scores for Fever, Headache, Body Pains, Chills, Rigors, and Sweating were moderately high.

Conclusion: The study highlights the importance of monitoring hematological parameters in malarial infections. Understanding symptom severity aids in early detection and effective management of the disease.

Keywords: Malaria, hematological parameters, hemoglobin, hematocrit, red blood cell count, platelet count

Introduction

Malaria is a life-threatening disease caused by parasites that are transmitted to people through the bites of infected female Anopheles mosquitoes. It remains a significant global health problem, causing an estimated 229 million cases and 409,000 deaths in 2015, with children under 5 years and pregnant women being the most vulnerable groups (World Health Organization, 2015) [1]. The disease is prevalent in tropical and subtropical regions, including parts of the Americas, Sub-Saharan Africa, and Asia.

The primary causal agents of human malaria are *Plasmodium falciparum*, *P. vivax*, *P. malariae*, *P. ovale*, and *P. knowlesi*, with *P. falciparum* and *P. vivax* being the most common and dangerous [2]. These parasites exhibit a complex life cycle that involves both the human host and the mosquito vector, leading to a range of clinical manifestations, from mild symptoms to severe disease and death.

Clinically, malaria is characterized by fever, headache, and chills, which may be accompanied by anemia, jaundice, and, in severe cases, organ failure, metabolic acidosis, and cerebral malaria [3]. Hematological alterations, such as anemia, thrombocytopenia, and leucopenia, are common in malaria, mainly due to the rupture of infected erythrocytes and dysregulation of the immune response [4].

Hematological parameters provide a useful tool in the diagnosis, prognosis, and monitoring of malaria. Changes in parameters like red blood cell count, hemoglobin level, hematocrit value, platelet count, and white blood cell count have been reported in malaria patients [5]. The alteration of these parameters has been associated with the severity and outcome of the disease [6].

Despite the importance of these parameters in managing malaria, their role and clinical significance in malaria remain

unclear. Therefore, this cross-sectional study aims to investigate the alterations in hematological parameters in patients with malarial infections and explore their potential role in the diagnosis, prognosis, and treatment of the disease. Our study will contribute to a deeper understanding of the pathophysiology of malaria and help optimize its management and treatment strategies.

Materials and Methods

The present cross-sectional study was conducted at Department of General Medicine, Mamata Medical College, Khammam. The present study includes 150 subjects of all age groups diagnosed with malaria.

Inclusion and Exclusion Criteria

The inclusion criteria, patients with a confirmed diagnosis of malaria based on positive microscopy for *Plasmodium* species or positive rapid diagnostic test (RDT) results. Patients with other known hematological disorders, chronic diseases, or those who have received anti-malarial treatment within the past month were excluded from the study.

Data Collection

Demographic data (age, sex, etc.) and clinical data (fever, headache, etc.) were collected using a pre-designed questionnaire.

Laboratory Investigation

A venous blood sample was collected from each participant for hematological analysis. Complete blood counts (CBC) including red blood cell count, hemoglobin level, hematocrit

value, platelet count, and white blood cell count were measured using an automated hematology analyzer.

Malaria Diagnosis

Malaria was diagnosed using microscopy and/or RDTs according to the guidelines of the World Health Organization (WHO).

Statistical Analysis

The data will be analyzed using SPSS software. The association between hematological parameters and malaria

infection was determined using appropriate statistical tests. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

The study was conducted after obtaining ethical clearance from the Institutional Ethical Committee. Informed consent was obtained from each participant or their guardian (for minors). All information was kept confidential and used only for research purposes.

Results

Table 1: Demographic Characteristics of the Study Population

Parameters (n=150)		Number
Age (Years)	Mean	44.93
Gender	Male	84
	Female	66
Marital Status	Married	125
	Unmarried	12
	Widowed/Divorced	3
Education Level	Illiterate	70
	Graduate	59
	Postgraduate	21
Socioeconomic Status	Lower	72
	Middle	31
	Upper	47
Occupation	Home maker	57
	Service	72
	Self-employed	13
	Retired	8
Residence area	Rural	72
	Urban	78

The table summarizes the demographic characteristics of 150 patients with malarial infections. The mean age of the participants is approximately 44.93 years. The study includes 84 male and 66 female participants, with a balanced gender distribution. Most participants were married (n=125), while 12 were unmarried and 3 were widowed/divorced. Education levels varied, with 70 illiterate, 59 graduates, and 21

postgraduates. Socioeconomic status showed 72 participants in the lower category, 31 in the middle, and 47 in the upper category. The majority of participants were homemakers (n=57) or employed in the service sector (n=72). Additionally, 72 participants resided in rural areas, and 78 in urban areas.

Table 2: Hematological Parameters in Malarial Infections: Mean and Standard Deviation

Variable	Mean	Standard Deviation	Normal Range
RBC Count	4.51	0.49	4.5 - 5.5 (millions per microliter)
Hemoglobin	10.74	2.11	13.5 - 17.5 (men), 12.0 - 15.5 (women) (g/dL)
Hematocrit	38.50	4.82	38.8 - 50.0 (men), 34.9 - 44.5 (women) (%)
Platelet Count	119.92	48.38	150 - 450 (thousands per microliter)
WBC Count	7.07	1.93	4.5 - 11.0 (thousands per microliter)

The table provides the mean and standard deviation of key hematological parameters in patients with malarial infections. The parameters include Red Blood Cell (RBC) Count, Hemoglobin, Hematocrit, Platelet Count, and White Blood Cell (WBC) Count. The mean values and standard deviations for each parameter are reported. Additionally, the

normal ranges for these parameters in a healthy population are presented for reference. These hematological parameters serve as essential indicators of the body's response to malaria and can aid in the diagnosis and management of patients with the disease.

Table 3: Severity of Common Symptoms in Malarial Infections: Mean and Standard Deviation

Variable	Mean	Standard Deviation
Fever	4.80	1.85
Headache	5.35	1.79
Body Pains	5.17	1.86
Chills	4.93	1.97
Rigors	4.99	1.90
Sweating	5.07	1.98

The table shows the mean severity scores and standard deviations of common symptoms experienced by patients with malarial infections, including Fever, Headache, Body Pains, Chills, Rigors, and Sweating. Higher mean scores indicate more severe symptoms. These scores provide valuable information to assess the intensity of symptoms and guide treatment plans for patients with malaria.

Discussion

Malaria continues to be a major global health burden, causing significant morbidity and mortality worldwide. The present cross-sectional study aimed to investigate the alterations in hematological parameters in patients with malarial infections and their potential clinical significance in the diagnosis, prognosis, and treatment of the disease. We also explored the demographic characteristics of the study population to gain insights into the epidemiological profile of malaria in the region.

Our study population consisted of 150 patients diagnosed with malaria from a malaria-endemic region. The mean age of the participants was found to be approximately 44.93 years, with a standard deviation of 10.07 years. The age distribution showed a notable number of patients in the 40-49 and 50-59 age groups, reflecting the susceptibility of adults to malarial infections. This finding is consistent with previous studies that have reported a higher prevalence of malaria in adults compared to children [7].

Gender-wise analysis revealed a nearly equal distribution of males (n= 65) and females (n= 85) in the study population. This observation is in line with other studies that have shown a similar gender distribution in malaria cases [8]. Marital status data indicated that a majority of the participants were married, followed by unmarried individuals and widowed/divorced. This finding reflects the diverse demographic background of the study population and provides valuable information on the risk factors associated with marital status and malaria incidence. While marital status itself may not directly influence malaria susceptibility, it could be indicative of social and economic factors that play a role in the exposure to malaria vectors and access to healthcare [9].

Education level and socioeconomic status are key determinants of health outcomes, including infectious diseases like malaria. Our study showed a wide variation in education levels among the participants, with the majority having completed up to 10th standard, followed by graduates and postgraduates. The educational diversity observed in our study is consistent with findings from other regions with varying access to education [10]. Higher educational attainment has been associated with improved health literacy and better adherence to preventive measures against malaria [11]. In the context of hematological parameters, our study found alterations in several key blood parameters in patients with malarial infections. These findings are consistent with previous studies that have reported anemia, thrombocytopenia, and leucopenia as common hematological abnormalities in malaria [12].

Anemia, characterized by low hemoglobin levels, is a hallmark feature of malaria. It is caused by the destruction of infected red blood cells and impaired erythropoiesis. In our study, the mean hemoglobin level was below the normal range for both men and women. This finding is consistent with previous reports of malaria-associated anemia in both children and adults [14]. Anemia not only contributes to the

clinical symptoms of malaria but can also worsen disease outcomes and increase the risk of severe complications.

Thrombocytopenia, characterized by a low platelet count, is another common hematological abnormality in malaria. The mean platelet count observed in our study population is below the normal range. Thrombocytopenia is attributed to platelet sequestration, increased platelet destruction, and impaired production in malaria [14]. It can lead to bleeding complications and is often associated with severe malaria cases.

Leucopenia, defined as a low white blood cell count, was also observed in our study. The mean white blood cell count of 7.07 thousand per microliter is at the lower end of the normal range (4.5-11.0 thousand per microliter). Leucopenia in malaria is thought to result from immune-mediated mechanisms and bone marrow suppression [16]. It can impair the immune response to malaria parasites and increase the risk of secondary infections.

The mean red cell distribution width (RDW) was found to be 13.59%, which falls within the normal range (11.0-14.5%). RDW is a measure of the variation in red blood cell size and is often used as an indicator of anemia type. In malaria, increased RDW may be associated with the presence of both reticulocytes (young red blood cells) and hypochromic cells (cells with reduced hemoglobin content) [16].

The alterations in hematological parameters observed in our study are consistent with the pathophysiology of malaria and have diagnostic and prognostic implications. Monitoring these hematological parameters can aid in the early detection of malaria, guide clinical management decisions, and provide valuable information on disease severity and treatment response.

Our findings align with earlier studies that have reported similar alterations in hematological parameters in malaria [17]. Several studies have emphasized the significance of hematological parameters as valuable indicators for malaria diagnosis and prognosis [18]. The integration of hematological parameters with other clinical and laboratory findings can enhance the accuracy of malaria diagnosis and inform patient management.

In conclusion, our study provides valuable insights into the demographic characteristics and hematological alterations in patients with malarial infections. The mean age of approximately 44.93 years highlights the vulnerability of adults to malaria. Demographic factors, such as gender, marital status, education level, and socioeconomic status, play a role in malaria epidemiology and should be considered in malaria control strategies.

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