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# Burden of Anemia in Malarial Parasite Infection

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## Abstract

**Background:** Malaria, being a major health problem in developing world, is a debilitating and at times lethal Infectious disease.

**Objective:** To observe the frequency and type of anaemia in patients who had malarial infection which may deteriorate the condition.

**Design:** Cross sectional study

**Place and Duration:** This study was conducted in two different tertiary care hospitals. From June 2009 to July 2011.

**Patients and Method:** A total of 834 malaria positive blood samples were taken after taking consent from patients and their demographic characteristics were noted. Laboratory investigations were done including complete blood count. Complete blood count was performed by automated Coulter counter. The samples with low levels of haemoglobin in the blood were categorized as "anaemic". All malarial positive cases were reviewed by a haematologist and data was analyzed using SPSS 16.0.

**Results:** The analysis revealed that, out of total 834 malarial positive samples, 65% females and 35% were males. Age range was 6 months to 50 years in male subjects and 1 year to 70 years in female subjects. 69% come to be *Plasmodium vivax* and 31% as *Plasmodium falciparum*. 120 cases (41.5%) in males show low level of haemoglobin (10.5 g%) and 40% among them show the well defined picture of hypochromic microcytic anaemia, while 72 cases (60%) give the picture of normochromic normocytic. In females, 516 cases (94.64%) show the low level of haemoglobin (9.0 g%) and 396 cases show Hypochromic microcytic anaemia, while 120 cases (23.21%) shows the normocytic normochromic blood picture.

**Conclusion:** In our sample population *P.vivax* found to be more frequent with hypochromic microcytic anaemia picture associated anaemia (58%), with low haemoglobin levels. Females showed greater prevalence of hypochromic microcytic anaemia as well as low Hb levels as compared to males significantly due to dietary deficiencies and other sources of blood loss.

## Key words:

Malaria infection; Microcytic anemia; *Plasmodium vivax*

## Introduction

Malaria is debilitating and sometimes lethal infectious disease transmitted to human by the female Anopheles mosquito. It is a serious infectious disease – accounting for approximately 3 million, mostly children dying each year [1]. According to World Health Organization, approximately half of the world's population is at the risk of malaria. Most malaria cases and deaths occur in sub-Saharan Africa. However, Asia, Latin America, and to a lesser extent the Middle East and parts of Europe are also affected. Uncomplicated malaria is characterized by recurrent symptoms of chills, fever and occasionally an enlarged spleen.

Among the species of malarial parasite, *Plasmodium vivax* and *Plasmodium falciparum* are the most common species worldwide. *P. vivax* malaria is prevalent on the Indian subcontinent and in Central America, while *P. falciparum* is prevalent mostly in Africa, Haiti and Papua New Guinea. Initial studies widely suggested that Anemia is a major cause of morbidity and mortality in malarial endemic areas of Southern Africa. Associated anemia may be missed in a patient showing other signs and symptoms of malaria [1].

Anemia in malaria is caused by the destruction of Red Blood Cells (RBCs) (hemolytic) in the body or the depression of RBCs production in the bone marrow. When a human is bitten by an Anopheles mosquito, the malarial parasite in the mosquito's saliva enters the blood stream and travel to the liver, where they reproduce in liver cells. Eventually, these cells burst, releasing parasite that subsequently infect RBCs and degrade hemoglobin, the iron containing protein. The

resulting iron and oxygen deficiency lead to anemia, chills and fever. As the picture of anemia augment, the patient weakens. In severe cases the patients in unable to deal with basic life essentials task and may even die. However, the anemia associated with malarial infection may be multifactorial with hemolysis, decreased RBC production, unmasking of borderline folic acid deficiency and genetic factors playing a contributory role [1,2].

In Pakistan, malaria is the top most life threatening parasitic infections. According to World Health Organization (WHO), despite considerable progress in malaria control over the past decade, malaria remains a serious problem in our part of the world [1]. Unfortunately, anemia is another debilitating problem as well. Individuals facing both the pathologies face serious consequences, especially when belonging to low socio-economic group [3].

Therefore, our objective in this study was to observe the frequency and type of anaemia in patients who had malarial infection which may deteriorate the condition.

## Methodology

It was a cross sectional study conducted in two different tertiary care hospitals. It was also approved by the IRB of Baqai Medical University (BMU).As malarial infection is very common in our part so a total of 834 cases from all age groups were selected upon the presence of malaria parasite (MP) in routine complete blood picture (CBC) examination. At the time of collection of blood samples a full detail of each person, i.e. age, sex, locality, economic status and medical history was obtained with the help of prepared performa.

From the blood samples obtained, thin smear were made and slides were then stained with Leishman's stain. For specific identification of MP, these smears were examined under × 100 oil immersion objectives.

Record information about blood counts, complete blood count and reticulocyte count was performed using an automated Coulter counters. All malarial positive smears were reviewed by a hematologist. Data were entered and analyzed using SPSS 16.0.

## Results

In this study, 834 patients of malaria were studied for type of malarial parasite and anemia. Blood samples were collected and screened for positive malarial infection and other blood indices. Out of 834 samples 545 were of female were 289 were of male patients. Demographic information showed that about 95% were of lower class and 5% belonged to middle class society.

All collected samples were first screened for the presence of MP and then for type of anemia. The screening shows that out of 834 positive slides of malaria 576 (69%) blood samples were *P. vivax* and 258 (31%) *P. falciparum*. This shows that tertian malaria parasite is more commonly found in our area of study.

When the CBC was performed on each sample, the following result was revealed: Out of 289 blood samples for males patients screened, 120 cases showed the low levels of hemoglobin (10.5 gm%) while 169 cases showed normal levels of haemoglobin [5]. Among those 120 cases which had low levels of Hb, cases (40%) showed the hypochromic microcytic anemia, while 72 blood samples (60%) showed the normocytic normochromic anemia.

The similar blood count in females revealed that out of total blood samples from female patients, 516 cases (94.64%) shows the decreased levels of hemoglobin (9.0 gm%) while 29 cases (8.98%) shows the normal levels of hemoglobin. Among those 516 cases showing low levels of hemoglobin, 396 cases (76.78%) showed the blood picture of hypochromic microcytic anemia, while, 120 cases (23.21%) showed normocytic normochromic anemia.

Furthermore, other blood indices showed that in males 34.6% showed the low levels of Red blood cells count, while 65.90 % showed the normal level of RBC count. Similarly, 38.64 % male blood samples showed the low levels of packed cell volume (PCV), while in remaining 61.36% PCV was in normal limits (Figure 1).

In blood samples belonging to females, only 8.93% had the decreased levels of RBC count, while 91.07 % had the RBC count within normal limits. The PCV in females was low in 92.85% while rest of 7.14 % was with normal PCV.

Henceforth, out of total 834 malaria infected blood samples, 636 (76.25%) showed the picture of moderate to severe malaria which signifies the relationship of hemolytic anemia with *P. vivax* and *P. falciparum* infection.

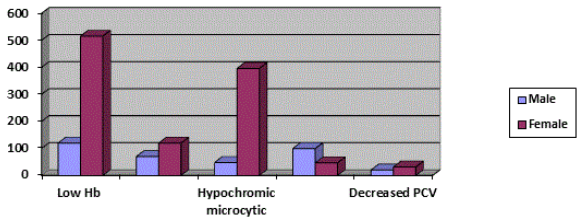


**Figure 1:** Bar chart showing red cell indices of males and females in malarial infection.

## Discussion

Malaria is a common health problem in most part of Pakistan, both in terms of prevalence and the amount of morbidity and mortality it causes [1]. Though clinically it is the protozoan parasite that causes the most virulent form of human malaria, the majority of population belongs to Gadap town and Orangi town presented to us with the infection of *Plasmodium vivax* - which appeared to be frequent in that particular area.

There appear to be three major pathologies involved behind anemia in Pakistan: [2]

- Insufficient red blood cell production due to inadequate intake, poor utilization of dietary iron as well as frequent blood loss in women during their reproductive ages.
- Excessive RBC destruction due to helminthes infections (mainly hookworm and schistosmiasis)
- Excessive RBC destruction due to malaria which displaces the hemoglobin (Hb).

Anemia in malarial infection is caused by the destruction of RBC (hemolysis) in the body and depression of RBC production in the bone marrow. Malarial sporozoites are found in the saliva of Anopheles mosquitoes. These sporozoites are injected into bloodstreams when a person is bitten by female infected mosquito. Sporozoites are home to

the liver where in couple of weeks they become merozoites. These merozoites multiply and lyse the hepatocytes to regain entrance in the bloodstream. Here the circulating merozoites are capable of parasitizing the RBCs [1,4,6].

Hypothesis can be made that malaria can be one of the leading causes of anemia in endemic regions of Pakistan. A study conducted in Kenya, estimated the mortality of malaria-associated anemia range from 190,000-974,000 annually in children less than 5 years of age [1]. In our target population, the major cause of widespread anemia seen was inadequate intake or poor utilization of dietary iron. However, a significantly high number also suggest association with malaria. Presently the it also showed 58% cases with microscopic picture of hypochromic microcytic anemia with prevalence higher in females (Graph 1).

It should be taken in consideration that red cell morphology in malaria patients may be influenced by their nutritional status, i.e. patients could be iron, folic acid, Vitamin B12 or other micronutrient deficient or they may have a concurrent thalassemia which aggravates the severity of anemia [1,7]. Our results also significantly showed that females had greater prevalence of hypochromic microcytic anemia as well as low Hb levels as compared to males. This can also be unmasking dietary deficiency and other sources of blood loss in women during their reproductive years.

A study performed on febrile Gabonese children showed the relationship of anemia to *P. falciparum* infection [8]. It concluded that anemia was more common in P. falciparum infected children (91%) than in uninfected children (77.7%) [2-4]. Malaria could cause anemia through cytokine mediated suppression of hematopoiesis by predisposing the victim to other infections. Malaria is a curable disease and its manifestations like anemia only shows clinically when the infection deteriorates. The reasons seen in our part of endemic area are – misdiagnosis, late treatment, unawareness and unavailability to health care facility [9].

Moreover, certain other areas within Pakistan where malaria is endemic, other associating factors should also be taken in consideration; such as bacteremia, hookworm, HIV and nutritional deficiency [10]. An uncomplicated malaria is manageable, however should be given a prompt and priority treatment. Clinicians as well as general public must be aware that deteriorating, severe malaria can manifest multiple additional pathologies such as cerebral malaria along with anemia [2,11]. Chronic anemia can be manages by blood-transfusion but on the other hand portrays the risk of HIV and other blood-borne infections in less privileged areas [2]. In a recent study from Ghana on school going children showed the prevalence of 41.5% malarial burden with moderate to mild anemia (7.0-10.9 g/dl) [12,13].

## Conclusion

This study provides a significant relationship between anemia which is of hypochromic microcytic type coupled with iron deficiency anemia (IDA) and malaria infection in our target population. Understanding of this relationship will aid our physicians to be more effective in dealing with this public health problem on regular basis. Integrated preventive strategies can save the disease from going into chronic stage and to some extent release the burden of anemia from our society.

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