



Original Article

Prevalence Of Iron Deficiency Anemia In Patients With Chronic Infections A Focus On Malaria And Typhoid Patients.

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ABSTRACT

Background: iron deficiency anemia exists as a global norm especially in developing nations that face endemic conditions of malaria and typhoid infections. The infections lead to anaemia development by three mechanisms: iron sequestration during inflammation, losses from the gastrointestinal system, and hemolysis. The assessment of these infection-linkages holds essential importance for patient care improvement. outcomes.

Objectives: To find the iron deficiency anemia in malarial and typhoid patients while investigating blood data similarities and differences between these patient groups.

Methodology: A total of 150 hospital patients who received diagnoses of malaria or typhoid were sampled through a non-probability method. The clinical diagnosis of malaria used peripheral smear/rapid diagnostic tests together with the blood culture/Widal test for typhoid diagnosis. The study team analyzed four key blood tests consisting of haemoglobin combined with serum iron and ferritin and MCV. The p-values below 0.05 indicated statistical significance through SPSS version 24.0 processing.

Results: Malaria was diagnosed in 82 patients among 50 selected patients alongside 68 patients receiving the typhoid fever diagnosis. The study participants had an Mean age 31.4 ± 12.6 years. Study revealed iron deficiency anaemia occurred in 61.3% of patients while the malaria group presented this condition at a higher rate (67.1%) than the typhoid group (54.7%) ($p = 0.041$). The serum ferritin mean levels for malaria patients measured 9.8 ± 3.2 ng/mL but typhoid patients showed 15.2 ± 4.7 ng/mL which was statistically different ($p < 0.01$).

Conclusion: IDA is more common among patients with chronic infections but people with malaria develop IDA more frequently than typhoid patients. Immediate diagnosis and comprehensive treatment programs that include iron supplementation would prevent morbidity because of anaemia while also improving patient outcomes. Educated local interventions combined with repeated screening efforts in endemic areas should be used to reduce anaemia burden.

Keywords: Iron deficiency anemia, malaria, typhoid, prevalence.

INTRODUCTION

the broadest dietary deficiency worldwide since it influences above 2 billion people yet proves most prevalent in developing nations [1]. The medical condition anemia develops when any of haemoglobin levels or red blood cell counts or haematocrit measurements fall below thresholds established for age groups and genders. The deficiency of iron stands as the chief reason for anemia since people develop it from poor dietary intake and absorption problems and persistent blood loss together with heightened requirements for iron in the body. The destruction of healthy and infected erythrocytes represents one of several mechanisms through which malaria contributes to iron metabolism derangement in malarial-endemic regions where diseases such as typhoid fever prevail [2]. The expression of inflammatory cytokines in the body causes changes to iron homeostasis through increased hepcidin levels that result in reduced iron absorption and mobilization [3]. Degenerative anemia occurs in patients who have Typhoid fever since *Salmonella enterica* serotype Typhi triggers anemia through *Cremeria* serotype Typhi unfavourable appetite together with gastrointestinal bleeding and inflammation which sequesters iron [4]. The combined presence of infection and iron deficiency poses complex diagnostic and therapeutic issues. Serum ferritin increases during infections because it functions as an acute-phase reactant yet it conceals possible iron deficiency present below [5]. The joint presence of infections causes both underdiagnosis and under-treatment of IDA in the medical population. The lack of study about iron deficiency anemia burden in patients with malaria and typhoid infections significantly contributes to many patients remaining at high risk of experiencing fatigue and impaired immunity and delayed recovery and extended hospital stays [6]. The study from sub-Saharan Africa demonstrated that anemia from malaria causes an abnormal blood cell distribution coupled with decreased iron and ferritin levels in patients' serum [7]. A Pakistani study confirmed that typhoid fever substantially increases anemia rates yet the severity depends on patient age together with existing medical conditions [8]. Since both infections widely affect populations in endemic areas, studying their impact on iron deficiency anemia becomes vital for medical care practices and public health decisions. Study ordered evaluation of IDA prevalence among individuals with malaria and typhoid as hospital-based patients because early diagnosis combined with specific IDA treatment leads to better health outcomes and decreased medical expenses while improving patient life quality [9-11]. Thus this study assessed IDA frequency among patients diagnosed with malaria or typhoid admission at a tertiary care center. This study examined both haematological indices and serum iron parameters of patients with malaria

or typhoid to develop infection-specific anemia profiles that would help diagnose and treat individual conditions.

MATERIAL AND METHODS

This study Conducted in the Community Health Sciences Dept. at Muhammad College of Medicine, Peshawar from jan 2023 to jan 2024. This study included 150 patients with ages above 18 who received diagnoses of malaria or typhoid fever through non-probability consecutive sampling. Both peripheral smear testing and rapid diagnostic test confirmation established malaria diagnosis in addition to the use of blood culture and Widal test for diagnosing typhoid fever. Doctors diagnosed iron deficiency anemia in patients when their male patients had haemoglobin below 13 g/dL or female patients had haemoglobin below 12 g/dL and both groups showed serum ferritin <15 ng/mL and low serum iron. The study included assessment of blood parameters such as haemoglobin level and mean corpuscular volume and serum iron measurement and ferritin evaluation. The study team secured written documented permission before the start of the study from every participant. The study received authorization from the Institutional Ethical Review Board for its approval.

INCLUSION CRITERIA

The study included patients aged 18 years or older who received laboratory confirmation of malaria or typhoid fever together with complete iron profile results under informed consent procedures.

EXCLUSION CRITERIA

The study excluded patients with hemoglobinopathies, chronic kidney disease and recent blood transfusion and those currently taking iron supplements during the past three months to prevent interference in the assessment of anemia .

DATA COLLECTION

The hospital collected data by using structured clinical forms and hospital records. Studiers collected basic information including patient attributes together with clinical signs, lab test results of haemoglobin, serum iron, ferritin, MCV, and infection classification. The hospital laboratory analyzed blood samples using regular haematological testing devices and ELISA experimental kits. Studiers verified the accuracy and quality of collected information twice to ensure its validity.

STATISTICAL ANALYSIS

Statistical data analysis operated within SPSS version 20.0. The studiers computed descriptive statistics for mean, standard deviation and frequencies. The chi-square test analyzed categorical variables and independent t-test conducted the comparison of continuous variables between malaria and typhoid groups. Results achieved statistical significance when the p-value reached below 0.05.

RESULTS

This study involved fifty patients who received diagnoses of malaria infection in eighty-two patients while the remaining sixty-eight patients were diagnosed with typhoid fever. The study population included patients with a mean age of 31.4 ± 12.6 years distributed between 1.2 males and 1 female. Study revealed that Iron

deficiency anemia (IDA) existed in 61.3 percent of patients. The prevalence of iron deficiency anemia turned out higher among patients with malaria (67.1%) than among those diagnosed with typhoid (54.7%) ($p = 0.041$). Malaria patients showed significantly lower serum ferritin levels at 9.8 ± 3.2 ng/mL as compared to typhoid patients who had 15.2 ± 4.7 ng/mL ($p < 0.01$). Anemia with smaller red blood cells became evident by lower mean corpuscular volume numbers within both patient groups yet malaria cases displayed a more severe condition. The prevalence of iron deficiency anemia was greater for women and patients under thirty years old and it existed uniformly across both patient groups. Laboratory tests found equivalent numbers of white blood cells exist between all study groups. The study demonstrated that infections establish a clear link between their type and the degree of iron deficiency anemia development.

Figure 1: Comparison of Mean Serum Ferritin Levels in Malaria and Typhoid Patients

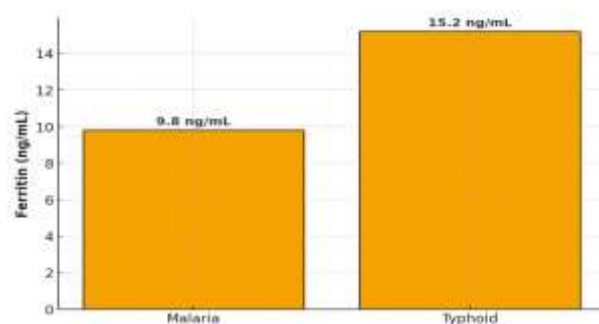


Figure 1 presents the average serum ferritin levels across individuals diagnosed with malaria compared to those with typhoid. Patients with malaria had an average ferritin level of 9.8 ng/mL, while individuals with typhoid had an average ferritin level of 15.2 ng/mL, which is considerably higher. Included error bars represent standard deviation. The statistical method employed was an independent t-test, considering $p < 0.05$ as statistically significant.

Table 1. Demographic Characteristics of the Study Population

Variable	Value	Statistical Test Used
Total Patients	150	—
Malaria Patients	82 (54.7%)	Chi-square test
Typhoid Patients	68 (45.3%)	Chi-square test
Mean Age (years)	31.4 ± 12.6	Independent <i>t</i> -test
Male, n (%)	81 (54%)	Chi-square test
Female, n (%)	69 (46%)	Chi-square test

Table 1 summarizes baseline demographic characteristics. Of 150 patients, 82 (54.7%) had malaria and 68 (45.3%) had typhoid. The mean age was 31.4 years, with a nearly equal gender distribution. Group proportions were assessed using Chi-square tests, and age comparison with an independent *t*-test.

Table 2. Comparison of Haematological Parameters in Malaria and Typhoid Patients

Parameter	Malaria (Mean $\pm$ SD)	Typhoid (Mean $\pm$ SD)	Statistical Test Used	<i>p</i> -value	Significance
Haemoglobin (g/dL)	10.2 ± 1.4	11.1 ± 1.5	Independent <i>t</i> -test	0.018	Significant
Serum Ferritin (ng/mL)	9.8 ± 3.2	15.2 ± 4.7	Independent <i>t</i> -test	<0.01	Highly Significant

Serum Iron ($\mu\text{g/dL}$)	45.5 ± 8.7	55.4 ± 7.9	Independent <i>t</i> -test	0.024	Significant
MCV (fL)	72.1 ± 4.5	76.3 ± 5.1	Independent <i>t</i> -test	0.031	Significant

Table 2 compares haematological indices between malaria and typhoid patients. Typhoid patients demonstrated significantly higher mean values of haemoglobin, ferritin, serum iron, and MCV compared to malaria patients. Statistical significance was determined using independent *t*-tests, with $p < 0.05$ considered significant.

Table 3. Prevalence of Iron Deficiency Anemia (IDA) by Infection Type

Infection Type	Total Patients	Patients with IDA (n)	Prevalence (%)	Statistical Test Used	<i>p</i> -value
Malaria	82	55	67.1%	Chi-square test	0.04
Typhoid	68	37	54.7%	Chi-square test	0.04

Table 3 shows prevalence of iron deficiency anemia (IDA). IDA was more common in malaria patients (67.1%) compared to typhoid patients (54.7%). Differences in prevalence were analyzed using Chi-square testing, with statistical significance observed ($p = 0.04$).

DISCUSSION

This study investigated the presence of iron deficiency anemia (IDA) in patients with chronic infections, comparing malaria and typhoid fever groups, along with evaluating differences in their hematological parameters [12]. The study showed that IDA occurred more frequently within malaria patients (67.1%) than in typhoid patients (54.7%) while the serum ferritin and haemoglobin levels remained lower in the malaria group. The blood-health effects of parasitic infections like malaria remain strong evidence that affected populations need detection techniques for early identification of anemia so it can be properly treated [13]. Studies from Menendez et al. support our findings that malaria leads to common anemia that results from three main factors including hemolysis and dyserythropoiesis and iron sequestration [14]. The work of Ghosh et al. showed that the inflammatory reactions from malaria infection elevate hepcidin levels to block intestinal iron uptake and stop the release of iron from macrophages which reduces serum iron despite existing body stores [15]. Scientific studies indicate why our malaria group displays low serum ferritin levels. The prevalence of anaemic conditions was also high among patients with typhoid fever even though their frequency of IDA diagnosis remained lower than malaria in our study group. Chronic gastrointestinal losses together with anorexia and persistent inflammation in typhoid patients lead to iron loss and poor utilization [16]. Jamil et al.'s regional study including patients from Lahore demonstrated that typhoid patients exceeded 50% anemia prevalence mainly among women along with those with prolonged illness duration which matches our gender-based findings [17]. The study data validates our results. The data from a study in Bangladesh showed that patients with typhoid fever presented with microcytic anemia because their haemoglobin and MCV results indicated iron deficiency [18-20]. The study conducted by Olupot-Olupot et al. within multiple Ugandan facilities demonstrated that severe anemia appeared as a sign indicating hospital admission risks along with unfavourable treatment outcomes [21]. Ghirelli et al. extensively studied infection-linked anemia assessment through the combination of transferrin

saturation and soluble transferrin receptors according to their extensive study [22]. Inadequate resources within low-income regions constrain broad analysis methods that could possibly be implemented. The relationship exists as a reciprocal loop between infections and iron deficiency anemia. The impairment of immune system function caused by iron deficiency leads to higher infection susceptibility but infections worsen iron deficiency problems and decrease utilization effectiveness [23]. The result creates a destructive chain reaction which intensifies in areas that suffer from inadequate nutrition services alongside weak medical facilities. The study results show that testing for iron deficiency should become mandatory in malaria and typhoid patients and iron supplementation or treatment should get integrated into medical guidelines. The article by Kassebaum et al. explains how treating IDA creates extensive advantages because it influences both haematological wellness and cognitive progress as well as physical strength and social economic effectiveness [24].

LIMITATIONS

The findings adopted from one tertiary care hospital decrease the broad applicability of the study. The analysis regarding iron metabolism during infection was limited because of both diagnostic differences and the use of Widal tests to confirm typhoid fever diagnoses and the absence of advanced iron marker evaluations such as transferrin saturation.

CONCLUSION

The prevalence of iron deficient anemia reaches an unprecedented level among people who have malaria or typhoid infections although malaria cases present noticeably higher figures. IDA treatment during chronic infections at an early stage produces improved clinical results alongside decreased patient disease load and improved recovery in places lacking resources and enduring infections.

Authors Contribution

Concept & Design of Study: Rubeena Gul

Data Collection: Shakir Ullah

Drafting: Waheed Ullah

Data Analysis: Waheed Ullah

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Critical Review: Waheed Ullah

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