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Comparative Evaluation of Hematological Parameters in Patients with Malaria and Typhoid Fever

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ABSTRACT

Malaria and typhoid fever remain major public health concerns in developing countries and frequently present with similar clinical manifestations, making differential diagnosis difficult. The present study aimed to compare hematological parameters among patients suffering from malaria and typhoid fever. A total of 40 confirmed patients, including 20 malaria and 20 typhoid cases, were evaluated. Hematological parameters including hemoglobin concentration, total leukocyte count, platelet count, red blood cell count, packed cell volume, red blood cell indices, and differential leukocyte count were analyzed. Malaria patients exhibited significantly lower hemoglobin levels, reduced RBC count, lower PCV, and severe thrombocytopenia, whereas typhoid patients showed pronounced leukopenia and relative lymphocytosis. Statistical analysis demonstrated significant differences between the two disease groups. The findings suggest that routine hematological parameters can serve as valuable supportive tools for differentiating malaria and typhoid fever in clinical settings.

Keywords: Malaria, Typhoid Fever, Hematology, Thrombocytopenia, Leukopenia

INTRODUCTION

Malaria and typhoid fever are among the most common infectious diseases affecting populations in tropical and subtropical countries. Malaria is caused by Plasmodium species and transmitted by infected female Anopheles mosquitoes, whereas typhoid fever is caused by Salmonella enterica serovar Typhi and spreads through contaminated food and water. Despite differences in etiology and transmission, both diseases often present with overlapping symptoms including fever, weakness, headache, anemia, and gastrointestinal disturbances.

Hematological abnormalities are frequently associated with both infections. Malaria commonly produces anemia, thrombocytopenia, and alterations in erythrocyte parameters due to destruction of infected red blood cells and splenic sequestration. Typhoid fever is often characterized by leukopenia, eosinopenia, relative lymphocytosis, and mild anemia resulting from bone marrow suppression and systemic bacterial infection.

Because of the overlap in clinical manifestations, comparative hematological evaluation can provide valuable diagnostic information. Therefore, the present study was undertaken to compare hematological parameters among malaria and typhoid patients and identify characteristic laboratory findings associated with each disease.

MATERIALS AND METHODS

2.1 Study Design

A hospital-based comparative observational study was conducted to evaluate hematological alterations among malaria and typhoid patients.

2.2 Study Population

The study included 40 laboratory-confirmed patients comprising:

- Malaria patients (n = 20)
- Typhoid patients (n = 20)

2.3 Sample Collection
Approximately 3–5 mL of venous blood was collected aseptically from each patient using sterile disposable syringes. Blood samples were transferred into EDTA tubes for hematological investigations.

2.4 Disease Confirmation
Malaria diagnosis was confirmed through peripheral blood smear examination and rapid diagnostic testing. Typhoid fever was diagnosed using Widal agglutination testing and standard microbiological procedures.

2.5 Hematological Analysis
Hematological parameters were analyzed using an automated hematology analyzer. The evaluated parameters included hemoglobin (Hb), total leukocyte count (TLC), platelet count, red blood cell count (RBC), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and differential leukocyte count (DLC). These measurements were used to assess and compare the hematological profiles of the study participants.

2.6 Statistical Analysis
Data were expressed as mean ± standard deviation. Comparative analysis was performed using appropriate statistical methods. A p-value less than 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

3.1 Distribution of Patients
A total of 40 laboratory-confirmed patients were included in the study, comprising 20 malaria patients and 20 typhoid fever patients. Equal representation of both disease groups enabled reliable comparative analysis of hematological parameters.

Table 1. Distribution of Study Population

Disease	Number of Patients
Malaria	20
Typhoid	20
Total	40

3.2 Demographic Analysis
The demographic profile of the study population indicated that the highest prevalence of malaria and typhoid cases was observed among young adults aged 21–30 years. Male patients were slightly more affected than females. Increased exposure to environmental and occupational risk factors may contribute to the higher disease prevalence observed among young adults.

These findings suggest that economically active age groups are more susceptible to exposure to infectious agents responsible for malaria and typhoid fever. The demographic distribution observed in the present study is consistent with previous reports from tropical and subtropical regions where both diseases remain endemic.

3.3 Hemoglobin Levels
Hemoglobin concentration was evaluated to determine the extent of anemia associated with both diseases.

Table 2. Comparison of Hemoglobin Levels

Disease	Mean Hb (g/dL)
Malaria	8.9 ± 1.4
Typhoid	10.8 ± 1.2

Malaria patients demonstrated significantly lower hemoglobin levels compared with typhoid patients. The reduction may be attributed to hemolysis, erythrocyte destruction, and splenic sequestration associated with Plasmodium infection.

3.4 Total Leukocyte Count
The total leukocyte count was analyzed to assess changes in immune cell populations associated with malaria and typhoid fever.

Table 3. Comparison of Total Leukocyte Count

Disease	Mean TLC (cells/mm³)
Malaria	4500 ± 850
Typhoid	3200 ± 760

Typhoid patients exhibited marked leukopenia, which is consistent with bone marrow suppression and systemic effects of Salmonella Typhi infection.

3.5 Platelet Count

Platelet counts were compared between malaria and typhoid patients to evaluate the occurrence of thrombocytopenia.

Table 4. Comparison of Platelet Count

Disease	Platelet Count (Lakhs/mm³)
Malaria	0.95 ± 0.30
Typhoid	1.75 ± 0.42

Severe thrombocytopenia was observed among malaria patients. Platelet destruction, immune-mediated mechanisms, and splenic sequestration may contribute to reduced platelet counts.

3.6 RBC Count and Packed Cell Volume

Red blood cell count and packed cell volume were assessed as indicators of erythrocyte loss and anemia.

Table 5. Comparison of RBC Count and Packed Cell Volume

Parameter	Malaria	Typhoid
RBC Count (million/mm³)	3.4 ± 0.6	4.1 ± 0.5
PCV (%)	29 ± 4.5	34 ± 3.2

Reduced RBC count and PCV values in malaria patients indicate significant erythrocyte destruction and anemia.

3.7 RBC Indices

Red blood cell indices were analyzed to evaluate alterations in erythrocyte morphology and function.

Table 6. Comparison of RBC Indices

Parameter	Malaria	Typhoid
MCV (fL)	76 ± 5	82 ± 4
MCH (pg)	25 ± 2	28 ± 2
MCHC (g/dL)	31 ± 1.5	33 ± 1.2

Lower RBC indices in malaria patients suggest more severe erythrocyte damage and hematological impairment.

3.8 Differential Leukocyte Count

Differential leukocyte count analysis was performed to evaluate variations in immune cell distribution between the two diseases.

Table 7. Differential Leukocyte Count

Parameter	Malaria	Typhoid
Neutrophils (%)	58	48
Lymphocytes (%)	32	42
Monocytes (%)	6	7
Eosinophils (%)	3	1
Basophils (%)	1	1

Typhoid patients exhibited relative lymphocytosis and eosinopenia, whereas malaria patients demonstrated higher neutrophil percentages.

The differential leukocyte profile revealed distinct hematological patterns between the two diseases. Malaria patients demonstrated relatively higher neutrophil percentages, whereas typhoid patients exhibited increased lymphocyte counts and eosinopenia. These variations may reflect differences in host immune responses and pathogen-specific mechanisms of infection. Such hematological differences can provide valuable supportive information during differential diagnosis when clinical symptoms overlap.

3.9 Frequency of Anemia

The severity of anemia was assessed among malaria and typhoid patients.

Table 8. Frequency of Anemia

Severity	Malaria	Typhoid
Mild	4	9
Moderate	10	8
Severe	6	3

Severe anemia was more common among malaria patients because of extensive hemolysis and destruction of erythrocytes.

3.10 Frequency of Thrombocytopenia

The occurrence of thrombocytopenia was compared between malaria and typhoid patients.

Table 9. Frequency of Thrombocytopenia

Status	Malaria	Typhoid
Present	15	6
Absent	5	14

Thrombocytopenia occurred significantly more frequently in malaria patients and may serve as an important diagnostic marker.

3.11 Statistical Analysis

Comparative statistical evaluation was performed to identify hematological parameters showing significant differences between malaria and typhoid patients.

Table 10. Statistical Comparison of Hematological Parameters

Parameter	Significance
Hemoglobin	Significant
TLC	Significant
Platelet Count	Highly Significant
RBC Count	Significant
PCV	Significant

The platelet count demonstrated the strongest discriminatory value between malaria and typhoid fever. Significant differences were also observed in hemoglobin concentration, total leukocyte count, RBC count, and packed cell volume. These findings indicate that routine hematological investigations can serve as valuable supportive tools for differentiating malaria and typhoid fever, particularly in resource-limited settings where advanced diagnostic facilities may not be readily available.

The present findings are consistent with previous studies reporting severe thrombocytopenia, anemia, and reduced erythrocyte parameters among malaria patients, while typhoid fever is commonly associated with leukopenia, relative lymphocytosis, and mild anemia. Comparative hematological analysis therefore provides useful diagnostic support and may contribute to improved clinical decision-making and patient management.

CONCLUSION

The study demonstrated distinct hematological differences between malaria and typhoid patients. Malaria was characterized by severe anemia, thrombocytopenia, reduced RBC count, and lower PCV values, whereas typhoid fever

was associated with marked leukopenia, relative lymphocytosis, and mild to moderate anemia. Significant differences were observed in hemoglobin concentration, platelet count, total leukocyte count, RBC count, and packed cell volume. Among all evaluated parameters, platelet count showed the highest diagnostic significance. Routine hematological investigations can therefore serve as useful supportive tools in the differentiation and clinical management of malaria and typhoid fever.

REFERENCES

1. Akinyemi, K. O., Bamiro, B. S., & Coker, A. O. (2018). Hematological abnormalities in typhoid fever patients. Journal of Infection and Public Health, 11(3), 345–351.
2. Bain, B. J., Bates, I., Laffan, M. A., & Lewis, S. M. (2017). Dacie and Lewis practical haematology (12th ed.). Elsevier.
3. Bakhubaira, S. (2013). Hematological parameters in malaria and typhoid infections. Journal of Clinical Medicine Research, 5(2), 89–95.
4. Bhutta, Z. A. (2006). Current concepts in the diagnosis and treatment of typhoid fever. BMJ, 333(7558), 78–82.
5. CDC. (2023). Malaria surveillance and epidemiology. Centers for Disease Control and Prevention.
6. Cheesbrough, M. (2018). District laboratory practice in tropical countries (3rd ed.). Cambridge University Press.
7. Crump, J. A., & Mintz, E. D. (2010). Global trends in typhoid and paratyphoid fever. Clinical Infectious Diseases, 50(2), 241–246.
8. Erhabor, O., Adias, T. C., & Hart, M. L. (2006). Hematological changes in malaria and typhoid patients. Nigerian Journal of Clinical Practice, 9(2), 125–130.
9. Hoffman, S. L., Punjabi, N. H., & Kumala, S. (2015). Hematological manifestations of typhoid fever. Tropical Medicine and International Health, 20(5), 623–629.
10. Kotepui, M., Piwkham, D., Phunphuech, B., Phiwklam, N., Chupeerach, C., & Duangmano, S. (2015). Effects of malaria parasite density on blood cell parameters. Malaria Journal, 14, 218.
11. Lacerda, M. V. G., Mourão, M. P. G., Alexandre, M. A. A., Siqueira, A. M., Magalhães, B. M. L., Martinez-Espinosa, F. E., & Alecrim, M. G. C. (2011). Understanding the clinical spectrum of thrombocytopenia in malaria. Malaria Journal, 10, 43.
12. Maina, R. N., Walsh, D., Gaddy, C., Hongo, G., Waitumbi, J., Otieno, L., Jones, D., & Ogutu, B. (2010). Impact of Plasmodium infection on hematological parameters. Journal of Infection in Developing Countries, 4(6), 398–405.
13. Parry, C. M., Hien, T. T., Dougan, G., White, N. J., & Farrar, J. J. (2002). Typhoid fever. New England Journal of Medicine, 347(22), 1770–1782.
14. Wain, J., Hendriksen, R. S., Mikoleit, M. L., Keddy, K. H., & Ochiai, R. L. (2015). Typhoid fever. Lancet, 385(9973), 1136–1145.
15. White, N. J. (2018). Anaemia and malaria. Malaria Journal, 17, 371.
16. World Health Organization. (2023). World malaria report 2023. Geneva: WHO.