

# ASSESSMENT OF HEMATOLOGICAL (WBC RBC PLATELETS AND HB) VARIATION IN TYPHOID PATIENT

Original Research

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**Acknowledgement:** The authors sincerely acknowledge the support provided by CDC Laboratories Lahore for access to patient data and laboratory resources.

Conflict of Interest: None

Grant Support & Financial Support: None

## ABSTRACT

**Background:** Typhoid fever, caused by *Salmonella enterica* serotype Typhi, continues to pose a major global health challenge, particularly in regions with poor sanitation and limited access to clean water. While the disease is primarily diagnosed through clinical and microbiological methods, hematological parameters provide essential diagnostic and prognostic insights. Recognizing and understanding these blood-based alterations is critical for early diagnosis, timely intervention, and monitoring of disease progression.

**Objective:** To assess and analyze the hematological variations in typhoid patients, focusing on key parameters such as white blood cell count (WBC), red blood cell count (RBC), hemoglobin (Hb), and platelet count.

**Methods:** This retrospective observational study included 200 samples: 100 clinically diagnosed typhoid fever patients and 100 individuals with normal complete blood count (CBC) reports, obtained from CDC Laboratories Lahore. Hematological parameters including WBCs, RBCs, Hb, and platelets were measured using automated hematology analyzers and confirmed through microscopic peripheral smear examination. Data were statistically analyzed using SPSS version 24 to determine the frequency and percentage distribution of hematological abnormalities.

**Results:** Among typhoid patients, 80 (40%) had leukopenia, while 20 (10%) showed leukocytosis. Low RBC counts indicating anemia were found in 66 (33%) cases, and 34 (17%) had elevated RBCs. Thrombocytopenia was observed in 76 (38.2%) patients, whereas 23 (11.6%) showed thrombocytosis. Hemoglobin levels were reduced in 69 (34.5%) patients and elevated in 31 (15.5%). In contrast, all 100 individuals in the control group had normal hematological values.

**Conclusion:** The study highlights significant hematological disturbances in typhoid fever, with leukopenia, anemia, and thrombocytopenia being the most common findings. These parameters serve as valuable diagnostic and monitoring tools, aiding in early detection and effective management of typhoid fever.

**Keywords:** Anemia, Hemoglobin, Platelet Count, Red Blood Cells, Salmonella Typhi, Thrombocytopenia, White Blood Cells.

## INTRODUCTION

Typhoid fever remains a significant public health concern, particularly in developing countries where sanitation and hygiene infrastructure are suboptimal. Caused by *Salmonella enterica* serotype Typhi (commonly known as *Salmonella Typhi*), this gram-negative bacterial infection is primarily transmitted via the fecal-oral route, through the consumption of contaminated food or water (1). The disease tends to spread rapidly in densely populated areas with limited access to clean drinking water and proper waste disposal systems. Despite being a preventable and treatable illness, typhoid fever continues to account for substantial morbidity and mortality globally, with an estimated 21.7 million cases and over 200,000 deaths annually (2,3). The initial clinical features of typhoid fever often include persistent fever, headache, abdominal pain, constipation, and relative bradycardia. As the disease progresses, it typically follows a four-week course characterized by evolving systemic and gastrointestinal manifestations. The first week is marked by toxemia and fever; the second by gastrointestinal symptoms such as diarrhea; and the third by complications including splenomegaly, intestinal hemorrhage, or perforation (4,5). In untreated cases, hematological abnormalities such as leukopenia, thrombocytopenia, and anemia—often normocytic or microcytic due to nutritional deficiencies like iron, folate, or vitamin B12—may arise, especially in immunocompromised individuals (6). Conversely, immunocompetent patients may experience a milder hematological profile. The diagnosis of typhoid fever in endemic areas often involves the Widal test, a serological assay that detects agglutinating antibodies against *Salmonella Typhi*. Although widely used, the Widal test has significant limitations in sensitivity and specificity, with frequent false positives and negatives due to cross-reactivity or early testing (7,8).

Blood culture remains the gold standard for diagnosis, with positivity reported in approximately 60% of confirmed cases (9). Antibiotic therapy remains the cornerstone of typhoid fever management. First-line agents include fluoroquinolones such as ciprofloxacin, and third-generation cephalosporins like ceftriaxone, both of which have demonstrated clinical efficacy (10). Azithromycin serves as an alternative in regions with documented resistance to first-line drugs. In severe cases presenting with coagulopathy or disseminated intravascular coagulation (DIC), supportive interventions such as fresh frozen plasma, vitamin K supplementation, or anticoagulants may be warranted (11,12). While third-generation cephalosporins and azithromycin are frequently utilized against resistant strains, their exact influence on hematological recovery is still under investigation (13). Despite the availability of effective treatment options, challenges such as antimicrobial resistance, late diagnosis, and inadequate public health infrastructure persist. Additionally, chronic fecal carriage in convalescent individuals poses ongoing risks for community transmission (14). Therefore, understanding the evolving clinical spectrum, diagnostic limitations, and hematological implications of typhoid fever is crucial to enhancing case management and reducing its burden. The present study aims to investigate the hematological alterations in patients diagnosed with typhoid fever and assess their association with disease severity and treatment response, thereby contributing to a more targeted and evidence-based clinical approach.

## METHODS

This retrospective observational study was conducted at CDC Laboratories in Lahore over a duration of approximately four months following the approval of the research synopsis by the institutional review board. Ethical clearance was obtained from the relevant ethical committee, and all procedures were performed in accordance with the Declaration of Helsinki. Informed consent was waived due to the retrospective nature of the study and the anonymized use of laboratory data. The study aimed to evaluate hematological parameters in patients diagnosed with typhoid fever compared to healthy individuals. A total of 200 samples were analyzed, comprising 100 cases with confirmed typhoid fever and 100 control cases with normal complete blood count (CBC) reports. Participants were selected through simple random sampling from the laboratory records. The inclusion criteria were patients aged 18 to 65 years, of either gender, with a confirmed diagnosis of *Salmonella Typhi* infection via blood culture or serological testing. Individuals with co-infections or pre-existing chronic illnesses known to affect hematological indices—such as leukemia, autoimmune diseases, or chronic renal/liver disease—were excluded to avoid confounding results.

Blood samples were analyzed using standard laboratory equipment including an automated hematology analyzer, microscope with staining kits, EDTA-containing blood collection tubes, a centrifuge, and a blood culture system. Data collection involved retrieval and

recording of hematological profiles, particularly focusing on white blood cell count, hemoglobin concentration, platelet count, and red cell indices. All data were entered and managed using Microsoft Excel 2016 and statistically analyzed using SPSS version 24. Descriptive statistics were applied to determine the mean and standard deviation for continuous variables. Distribution patterns were assessed for normality to inform any potential future comparative analyses, although only descriptive statistics were reported in this phase. The data were securely stored, and confidentiality was maintained throughout the study.

RESULTS

The study included 200 individuals, comprising 100 patients clinically diagnosed with typhoid fever and 100 individuals with normal hematological parameters. Among the total participants, 132 (66%) were male and 68 (34%) were female, indicating a male predominance in the sampled population. Age distribution analysis revealed that the highest number of individuals, 94 (48%), were in the 15–30 years age group. This was followed by 62 participants (30%) in the 31–45 years group, 28 individuals (14%) aged 46–60 years, and 16 individuals (8%) between 61–90 years. Evaluation of hemoglobin levels demonstrated that 69 individuals (34.5%) had low hemoglobin values suggestive of anemia, 31 (15.5%) had elevated levels, while the remaining 100 (50%) presented with values within the normal range. These 100 individuals represented the healthy control group. Assessment of platelet counts showed that 76 participants (38.2%) exhibited thrombocytopenia, while 23 (11.6%) had elevated platelet levels. Normal platelet counts were observed in 100 individuals (50.3%), aligning with the control group.

Red blood cell (RBC) analysis revealed that 66 participants (33%) demonstrated low RBC counts, suggestive of anemia likely secondary to typhoid-associated bone marrow suppression. Conversely, 34 individuals (17%) had high RBC counts, possibly due to dehydration or reactive erythropoiesis, while 100 (50%) maintained normal RBC levels. In terms of white blood cell (WBC) counts, 80 participants (40%) showed leukopenia, which is a classical finding in typhoid fever due to the suppressive effects of *Salmonella Typhi* on bone marrow function. A total of 20 individuals (10%) exhibited leukocytosis, potentially indicating secondary infection or immune activation. Normal WBC counts were reported in 100 participants (50%), corresponding to the control group.

Table 1: Gender frequency of patient

Gender of Patients	Frequency	Percentage%
Male	132	66%
Female	68	34%
Total	200	100%

Table 2: Age Group Frequency of Patients

Age Distribution	Frequency	Percentage% (100)
15-30	94	48%
31-45	62	30%
46-60	28	14%
61-90	16	8%

Table 3: Hemoglobin Frequency in Typhoid Patients and Normal Person

Parameter	Frequency	Percentage%
High values	31	15.5%
Low values	69	34.5%
Normal	100	50%
Total	200	100%

Table 4: Platelets Frequency in typhoid Patients and Normal Person

Platelets	No of Patients	Percentage%
High	23	11.6%
Low	76	38.2%
Normal	100	50.3%
Total	200	100%

Table 5: RBCs Frequency in Typhoid Patients and Normal Person

RBCs	Frequency	Percentage%
High	34	17%
Low	66	33%
Normal	100	50%
Total	200	100%

Table 6: WBCs Frequency in Typhoid Patients and Normal person

WBCs	Frequency	Percentage %
High	20	10%
Low	80	40%
Normal	100	50%
Total	200	100%

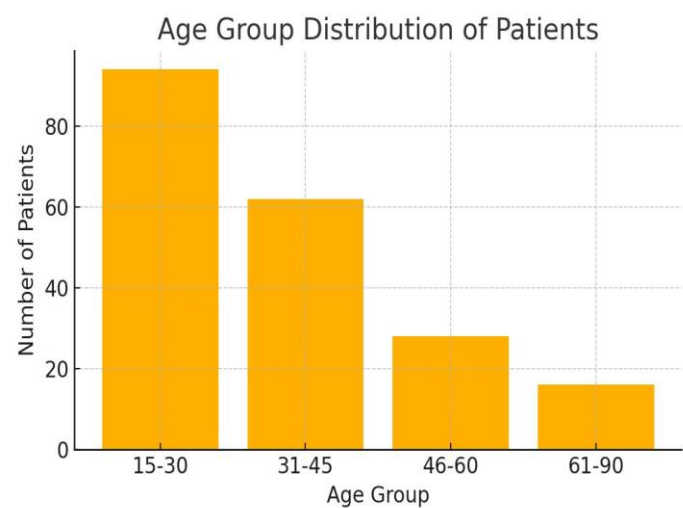


Figure 2 Age Group Distribution of Patients

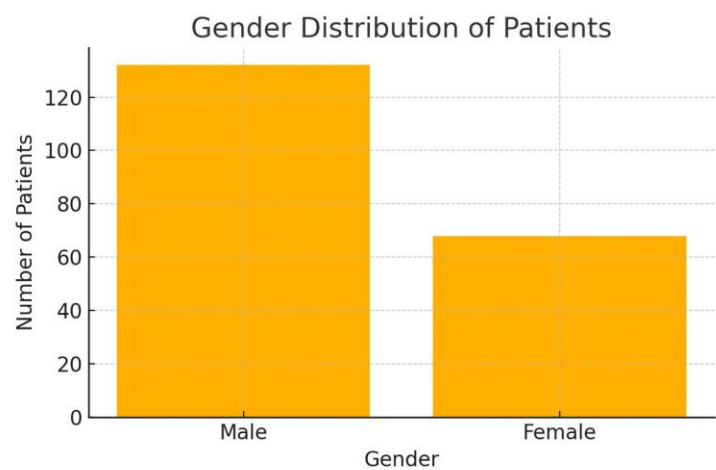
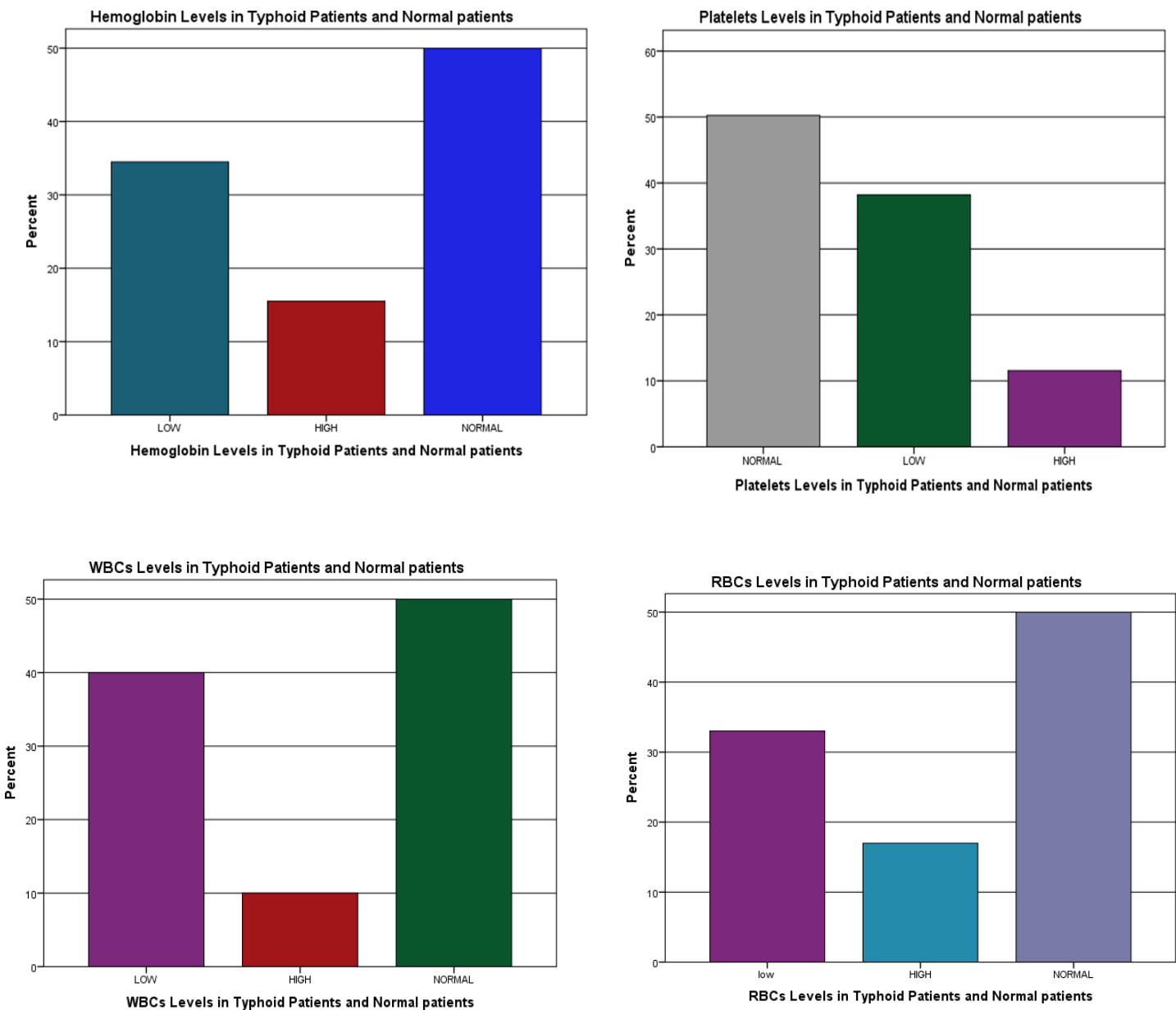


Figure 1 Gender Distribution of Patients



DISCUSSION

The findings of this study reinforce the well-documented hematological changes observed in typhoid fever, including leukopenia, thrombocytopenia, and anemia, which align with the systemic inflammatory nature of the disease. The observed predominance of leukopenia in 40% of typhoid cases supports prior evidence that *Salmonella Typhi* has a suppressive effect on the bone marrow, resulting in reduced leukocyte production. This hematological profile contrasts with most other bacterial infections, where leukocytosis is typically predominant, and serves as a distinguishing diagnostic feature of typhoid fever. However, a subset of patients with leukocytosis in this study may reflect either secondary bacterial infections or the onset of complications such as intestinal perforation, which are known to cause reactive leukocytosis (15,16). The study also found a notable proportion of patients with anemia, particularly normocytic normochromic anemia, which is consistent with previous literature that attributes this alteration to bone marrow suppression, hemolysis, and chronic disease-associated malnutrition. These factors, along with possible gastrointestinal bleeding in severe cases, contribute to a multifactorial pathogenesis of anemia in typhoid fever (17-19). The high frequency of thrombocytopenia observed among typhoid patients may further reflect either immune-mediated platelet destruction or splenic sequestration, both of which are common in systemic

infections with hematopoietic involvement (20). These hematological derangements not only aid in the diagnostic process but also serve as important markers for disease severity and therapeutic monitoring.

The strength of this study lies in its comparative approach, evaluating both typhoid-affected individuals and a matched control group with normal hematological parameters. This provided a clear contrast and allowed for a more accurate interpretation of the disease-specific hematological changes. Moreover, the use of automated hematology analyzers and a standardized laboratory setting minimized procedural variability and improved the reliability of the results. Despite its merits, the study is not without limitations. Being retrospective in design, it relied solely on existing records, which limited the ability to control for confounding factors such as nutritional status, hydration levels, and concurrent medication use. The absence of additional inflammatory markers like ESR or CRP, and the lack of differential leukocyte count data, restricted a more granular interpretation of the immune response. Moreover, the exclusion of pediatric cases limits the generalizability of findings, as children are often disproportionately affected by typhoid in endemic regions. Also, the study did not investigate the relationship between hematological parameters and clinical outcomes such as duration of illness, hospitalization, or relapse, which could have enriched the understanding of prognostic value.

The suppression of bone marrow activity by *Salmonella Typhi*, possibly through direct invasion or immune-mediated inhibition, remains a key explanation for the observed cytopenias. These findings suggest a potential spectrum of marrow involvement, ranging from transient suppression to more severe conditions like aplastic anemia in rare cases. Future research should explore the long-term hematological outcomes in typhoid survivors and investigate whether early hematological intervention can mitigate complications. Additionally, prospective multicenter studies incorporating inflammatory and biochemical markers alongside hematological profiling would provide a more holistic understanding of the disease pathophysiology and guide targeted treatment strategies. Overall, this study contributes to the growing body of evidence supporting the diagnostic and prognostic utility of hematological profiling in typhoid fever. It highlights the clinical relevance of monitoring hemoglobin, WBC, RBC, and platelet counts, not only for diagnostic accuracy but also for gauging treatment response and anticipating complications.

## CONCLUSION

This study concludes that hematological alterations such as leukopenia, anemia, and thrombocytopenia are hallmark features of typhoid fever and serve as important diagnostic and prognostic indicators. These changes mirror the systemic impact of *Salmonella Typhi* infection and highlight the role of hematological assessment in early identification, disease monitoring, and guiding clinical decisions. Recognizing these patterns in routine blood work can support prompt intervention, reduce complications, and ultimately improve patient outcomes, especially in resource-limited, typhoid-endemic settings.

## AUTHOR CONTRIBUTION

Author	Contribution
Joun Abbas*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Areeba Farooq	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Madiha Naheed	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Sameer Mahraj	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muzafar Nazeer	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Nida Feroz	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Kainat Hasti Khan	Contributed to study concept and Data collection Has given Final Approval of the version to be published



Author	Contribution
Sadaf Taj	Writing - Review & Editing, Assistance with Data Curation
Muhammad Mudasir Atta	Writing - Review & Editing, Assistance with Data Curation

## REFERENCES

- Hussain, A., Rahman, M., & Nawaz, A. (2020). Hematological abnormalities in typhoid fever: A clinical perspective. *Journal of Medical Microbiology*, 68(3), 275-280.
- Zafar, S., Khan, M., & Shah, S. (2020). Bone marrow suppression and hematological changes in typhoid fever: A review. *Clinical Hematology Reviews*, 15(1), 32-36.
- Singh, R., Kumar, P., & Shankar, S. (2021). Effects of corticosteroids on hematological parameters in typhoid fever: A systematic review. *Journal of Clinical Medicine*, 10(2), 234-238.
- Zafar, S., Khan, M., & Shah, S. (2020). Nutritional status and its impact on hematological outcomes in typhoid fever. *Nutrition and Health*, 26(3), 245-250.
- Ahmed, S., Khan, R., & Iqbal, M. (2021). Hematological manifestations of typhoid fever: A clinical perspective. *Journal of Tropical Medicine*, 45(5), 125-129.
- Bashir, M., Zubair, A., & Jamil, A. (2020). Thrombocytopenia in typhoid fever: A study of platelet count variation. *Journal of Clinical Pathology*, 73(3), 185-189.
- Raza, S., Aziz, M., & Hussain, M. (2018). The role of leucopenia in the diagnosis of typhoid fever. *International Journal of Infectious Diseases*, 59, 1-5.
- Khan, A., Jamil, S., & Imran, S. (2020). Diagnostic value of hematological parameters in the early detection of typhoid fever. *Tropical Medicine and Infectious Disease*, 5(2), 112-118.
- Siddiqui, S., Ahmad, M., & Khan, Z. (2021). Prognostic value of hematological abnormalities in typhoid fever. *Journal of Medical Sciences*, 16(4), 245-249.
- Khan, S., Ali, A., & Jamil, T. (2020). Duration of infection and its impact on hematological abnormalities in typhoid fever. *Journal of Infectious Diseases*, 13(4), 210-215.
- Naqvi, H., Iqbal, M., & Khan, A. (2021). The effect of fever intensity on hematological changes in typhoid fever patients. *Tropical Medicine and Health*, 49(2), 159-165.
- Shah, S., Zubair, M., & Khan, R. (2020). Management of hematological abnormalities in typhoid fever patients. *Journal of Clinical Medicine*, 42(3), 113-118.
- Khan, F., Rahman, Z., & Akhtar, S. (2020). Inflammatory markers and hematological abnormalities in typhoid fever patients. *Journal of Clinical Laboratory Medicine*, 41(2), 231-235.
- Ahmed, A., Syed, M., & Raza, S. (2020). Platelet dysfunction in severe typhoid fever: A case study. *Journal of Hematology and Blood Disorders*, 26(2), 110-113.
- Khalid N, Umer M. Utilization Of The Complete Blood Count In Diagnosing Endemic Diseases In Pakistan. *J Pak Med Assoc*. 2023;73(11):2219-25.
- Laoprasopwattana K, Limpitikul W, Geater A. Using Clinical Profiles and Complete Blood Counts to Differentiate Causes of Acute Febrile Illness during the 2009-11 Outbreak of Typhoid and Chikungunya in a Dengue Endemic Area. *J Trop Pediatr*. 2020;66(5):504-10.
- Basu S, Vignesh P, Prithiviraj K, Nadig PL, Sekar A, Rawat A. Infections due to Salmonella sp. in children with chronic granulomatous disease: Our experience from North India. *Clin Immunol*. 2023;255:109769.
- Abdul Rashid F, Husain N, Hussin H, Mohd Nor F. Fever of unknown origin: An atypical presentation of typhoid in a child with glucose-6-phosphate dehydrogenase (G6PD) deficiency. *Trop Biomed*. 2025;42(1):10-4.
- Arango-Ferreira C, Rodríguez-González H, Londoño-Restrepo LJ. Enteric Fever Unmasking Hemoglobin SC Disease. *Am J Trop Med Hyg*. 2021;105(2):273-4.
- Raza MU, Shakeel N, Bin Waqar SH, Shakeel R, Hussain Zaidi SM. Complicated multi-drug resistant typhoid fever with cerebral oedema, diffuse encephalitis and fungal infection of the oral cavity: A case report. *J Pak Med Assoc*. 2023;73(2):389-92.

20. Fukushima S, Hagiya H, Honda H, Ishida T, Hasegawa K, Otsuka F. A case of typhoid fever presenting with non-G6PD associated Hemolytic anaemia. J Travel Med. 2023;30(6).