

CLINICO-HEMATOLOGICAL AND ETIOLOGICAL PROFILE OF PANCYTOPENIA PATIENTS IN A TERTIARY CARE CENTRE

K. Prabha¹, J. Jayalakshmi², S. Kathiravan³

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Corresponding Author:
Dr. K. Prabha,
 Email: prabha06kmp@gmail.com

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¹⁻²Assistant Professor, Department of General Medicine, Government Medical College, Omandur Government Estate, Chennai, India.

³Assistant Professor, Department of General Medicine, ESIC Medical College and PGIMS, KK Nagar, Chennai, India.

ABSTRACT

Background: Pancytopenia, a simultaneous reduction of all three blood cell lineages, is a critical hematological condition with diverse etiologies that vary geographically. In the Indian context, nutritional deficiencies are frequently implicated, though comprehensive data from tertiary care centers are essential for shaping local diagnostic and management protocols. **Aims and Objectives:** This study aimed to determine the etiological spectrum of pancytopenia and to correlate the clinical presentation and hematological parameters with the underlying causes. **Materials and Methods:** A cross-sectional study was conducted on 50 consecutive patients with pancytopenia. All participants underwent detailed clinical evaluation and laboratory investigations, including complete blood count, peripheral smear examination, and specialized tests like serum Vitamin B12 assay and bone marrow studies where indicated. Data were analyzed using descriptive statistics and one-way ANOVA. **Result:** The study cohort had a mean age of 46.46 ± 14.66 years with a male predominance (66%). The most common presenting symptoms were fatigue (36%), fever (32%), and breathlessness (32%). Vitamin B12 deficiency was the leading etiology, found in 16 patients (32%), followed by hepatic/splenic causes (22%) and infections (14%). A significant gender-based distribution was observed, with Vitamin B12 deficiency showing a strong male preponderance (81.3% of cases), while Systemic Lupus Erythematosus was exclusively diagnosed in females (23.5% of all female patients). Haematologically, Vitamin B12 deficiency was characterized by the most severe anemia (Haemoglobin: 4.8 ± 1.1 g/dL, $p < 0.001$) and marked macrocytosis (MCV: 106.1 ± 7.9 fL, $p < 0.001$). Platelet counts also varied significantly ($p = 0.048$), being highest in B12 deficiency and lowest in autoimmune disorders. **Conclusion:** Vitamin B12 deficiency is the predominant cause of pancytopenia in this region. The combination of clinical features and basic hematological indices, particularly hemoglobin and MCV, provides a highly effective initial approach to differentiating the underlying causes, emphasizing the continued public health importance of addressing nutritional deficiencies.

INTRODUCTION

Pancytopenia refers to the simultaneous reduction in red blood cells, white blood cells, and platelets below normal reference ranges. It is not a disease by itself but a manifestation of multiple underlying disorders involving the bone marrow, reticuloendothelial system, or peripheral destruction of blood cells. In India, the etiology varies widely due to differences in nutrition, endemic infections, and healthcare accessibility. The most common causes include megaloblastic anemia, aplastic anemia, hypersplenism, infections, hematological malignancies, and drug-induced marrow

suppression.^[1,2] Early identification of the cause through clinical presentation and hematological parameters is crucial for timely management and prognosis improvement.^[3,4] Several Indian studies have shown that nutritional deficiencies, especially Vitamin B12 deficiency, account for a major proportion of pancytopenia cases. A study from Ahmedabad reported megaloblastic anemia in 45% of cases, followed by infections and hypersplenism.^[1] Similarly, research from Uttarakhand found megaloblastic anemia in 25% and aplastic anemia and leukaemia in 19% each.^[2] In Chhattisgarh, megaloblastic anemia contributed to 50.7% of pancytopenia cases, followed by hypersplenism,

malaria, leukemia, and aplastic anemia.^[3] These findings suggest that, despite regional variations, reversible nutritional deficiencies remain a leading cause in India.^[5]

The clinical presentation in pancytopenia commonly includes fatigue, pallor, fever, bleeding tendencies, and organomegaly. The pattern and severity of these features vary according to the underlying etiology and can often guide diagnosis when combined with haematological indices such as haemoglobin (Hb), total leukocyte count (TLC), platelet count, and mean corpuscular volume (MCV).^[6] In particular, macrocytosis and severe anemia are characteristic of megaloblastic causes, whereas normocytic or mildly microcytic indices may indicate infections, autoimmune diseases, or hepatic disorders.^[7] The present study was undertaken to determine the etiological spectrum and haematological characteristics of pancytopenia, and to correlate them with clinical presentation in a tertiary care centre.

Aim and Objectives

- To determine the various etiologies of pancytopenia and haematological parameters associated with it
- To know various patterns of clinical Presentation and correlate haematological parameters in differentiating the causes of pancytopenia.

MATERIALS AND METHODS

A hospital based cross-sectional study conducted in the Department of General Medicine, Government Omandurar Medical College & Hospital, Chennai. The study duration was six months January 2025 to June 2025. The study participants were selected based on the following inclusion criteria.

Inclusion Criteria

- 1) Age ≥ 18 years
- 2) Patients presenting with hematological parameters:
 - a. Hemoglobin ≤ 10 g/dl
 - b. WBC ≤ 4000 cells/cumm
 - c. Platelets ≤ 1.50 lakh cells/cumm

Exclusion Criteria

- 1) Age < 18 years
- 2) Patients who had blood transfusion in last 3 months
- 3) Patients who did not give consent

The study was approved by the institutional ethical committee, and informed consent was obtained.

Sample Size

A total of 50 patients meeting the inclusion criteria were enrolled consecutively during the study period. The sample size was determined based on previous Indian studies that reported the prevalence of megaloblastic anemia as the leading cause of pancytopenia.^[3,4]

Pancytopenia was defined as hemoglobin concentration less than 10 g/dL, total leukocyte counts below 4,000 cells/ μ L, and platelet count less than 100,000 cells/ μ L, as described in earlier Indian studies^[1,2] Patients who had received a blood

transfusion within the previous four weeks, those undergoing cytotoxic chemotherapy or radiotherapy, and cases with incomplete clinical or laboratory data were excluded from the study. Detailed clinical histories were obtained using a predesigned proforma, including demographic details such as age, sex, dietary habits, and socioeconomic status. Presenting complaints like fever, fatigue, breathlessness, bleeding manifestations, and weight loss were recorded, along with systemic examination findings such as pallor, hepatosplenomegaly, or lymphadenopathy. Any history of drug intake, exposure to toxins, or recent infections was carefully noted.^[3]

Venous blood samples (3–5 mL) were collected under aseptic precautions using EDTA and plain vacutainers. Complete blood counts were performed on an automated hematology analyzer (for example, Sysmex XN-1000). The parameters analyzed included hemoglobin, total and differential leukocyte counts, red cell indices (MCV, MCH, MCHC), and platelet count. Peripheral blood smears were prepared, stained with Leishman stain, and examined under light microscopy to assess red cell morphology, anisopoikilocytosis, macrocytosis, hypersegmented neutrophils, blast cells, and platelet adequacy. Reticulocyte counts were performed using supravital staining (new methylene blue) to evaluate bone marrow response.

Where clinically indicated, serum vitamin B12 and folate levels were measured by chemiluminescent immunoassay (CLIA) to identify megaloblastic anemia. Liver and renal function tests were performed to assess metabolic and hepatic causes.^[6] Screening for infections such as malaria, dengue, HIV, hepatitis B, and hepatitis C was carried out when appropriate. In cases where the underlying cause could not be determined by peripheral investigations, bone marrow aspiration and biopsy were performed under aseptic conditions. Smears were stained with Leishman and reticulin stains and examined for cellularity, maturation patterns, megaloblastic changes, dysplasia, fibrosis, or infiltration by abnormal or malignant cells. Based on clinical findings and laboratory results, each patient was categorized into etiological groups including nutritional deficiency (vitamin B12 or folate deficiency), infections, drug-induced causes, hepatic and splenic disorders, autoimmune disorders, hematological malignancies, bone marrow failure syndromes, and miscellaneous causes.

All data were entered into Microsoft Excel and analyzed using SPSS software version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used for demographic and clinical variables, with continuous data expressed as mean $\pm$ standard deviation (SD) and categorical variables as frequencies and percentages. Comparisons of hematological parameters among different etiological groups were performed using one-way ANOVA for continuous variables and Chi-square test for categorical variables. A p-value of less than 0.05

was considered statistically significant. Confidentiality of patient data was maintained throughout the research process, and all participants provided written informed consent prior to inclusion.

RESULTS

The mean age of the study participants was 46.46 ± 14.66 years and majority of the were in the age category more than 50 years which is 22 (44.0%) participants. Out of 50 most of them were males which is 33 (66.0%) and 17 (34.0%) were females. The clinical presentation revealed that constitutional symptoms were the most common complaints at

diagnosis. Fatigue, weakness, or tiredness was the single most frequent symptom, affecting 18 (36.0%) patients. This was closely followed by fever and breathlessness, each present in 16 (32.0%) cases. Gastrointestinal symptoms, such as vomiting, abdominal pain, or distension, were also notable, reported by 13 individuals (26.0%). Less common presentations included edema in 7 patients (14.0%), while weight loss and cough were each seen in 5 (10.0%) patients. A smaller subset of patients presented with dermatological findings or neurological changes, including skin manifestations in 4 (8.0%) cases and altered sensorium in 3 (6.0%) patients.

Table 1: Basic characteristics of the study population

	Number of Patients	Percentage
Gender		
Male	33	66.0%
Female	17	34.0%
Age category		
≤ 20 years	2	4.0%
21 to 30 years	7	14.0%
31 to 40 years	9	18.0%
41 to 50 years	10	20.0%
> 50 years	22	44.0%
Mean Age ± SD Years	46.46 ± 14.66	
Symptom		
Fatigue/Weakness/Tiredness	18	36.0%
Fever	16	32.0%
Breathlessness/Dyspnea	16	32.0%
Gastrointestinal Symptoms	13	26.0%
Edema	7	14.0%
Weight Loss	5	10.0%
Cough	5	10.0%
Skin Manifestations	4	8.0%
Altered Sensorium	3	6.0%
Total	50	100%

Table 2: Etiological profile details among study participants

Etiological Category	Specific Diagnosis	Number	Percentage
Nutritional Deficiencies	Vitamin B12 Deficiency	16	32.0%
Hepatic & Splenic	DCLD/Portal Hypertension/Hypersplenism	9	18.0%
	Chronic Liver Disease	2	4.0%
Autoimmune Disorders	Systemic Lupus Erythematosus (SLE)	4	8.0%
	Antiphospholipid Antibody Syndrome	1	2.0%
Infections	Tuberculosis	2	4.0%
	Sepsis/Pyelonephritis/ Urosepsis	2	4.0%
	Enteric Fever, Dengue/Malaria	3	6.0%
Drug & Toxin Induced	Methotrexate Toxicity	3	6.0%
	Other Drug-Induced	2	4.0%
Hematological Malignancies	AML, Hodgkin Lymphoma, MDS	3	6.0%
Bone Marrow Failure	Aplastic Anemia	2	4.0%
Other	Autoimmune Hemolytic Anemia	1	2.0%
Total		50	100.0%

Nutritional deficiencies like Vitamin B12 deficiency was the single most common specific diagnosis, identified as the cause in 16 patients (32.0%). Hepatic and splenic-related etiologies, primarily DCLD and portal hypertension-induced hypersplenism, constituted the second largest group, accounting for 11 patients (22.0%) when combining its subcategories of 9 (18.0%) and 2 (4.0%) patients, respectively. Infections were the third major category, responsible for 7 cases (14.0%), which included tuberculosis and sepsis or pyelonephritis in

2 patients (4.0%) each, and other infections like enteric fever in 3 patients (6.0%). Autoimmune disorders, led by Systemic Lupus Erythematosus in 4 patients (8.0%), were implicated in 6 cases (12.0%) in total. Drug-induced pancytopenia was observed in 5 patients (10.0%), with methotrexate toxicity being the most frequent offender in 3 (6.0%) of these cases. Less common causes included hematological malignancies and bone marrow failure syndromes, each category contributing to 3 (6.0%) and 2 (4.0%) cases, respectively.

Table 3: Gender-wise etiological distribution among study participants

Etiology	Male	Female	Total Cases
Vitamin B12 Deficiency	13 (81.3%)	3 (17.6%)	16
DCLD/Portal Hypertension	7 (77.8%)	2 (11.8%)	9
SLE	0 (0%)	4 (23.5%)	4
Infections	6 (85.7%)	1 (5.9%)	7
Drug Induced	3 (60%)	2 (11.8%)	5
Total	33 (66.0%)	17 (34.0%)	50

Among the 33 male patients, Vitamin B12 deficiency was the most prevalent cause, affecting 13 individuals, which constitutes 81.3% of all B12 deficiency cases and 39.4% of the total male cohort. Hepatic causes, specifically DCLD and portal hypertension, were also more common in men, accounting for 7 cases or 77.8% of that diagnostic

group. Furthermore, infections showed a strong male predominance, implicated in 6 out of 7 cases (85.7%). In stark contrast, Systemic Lupus Erythematosus (SLE) was exclusively diagnosed in the female population, accounting for all 4 cases and representing 23.5% of all female patients.

Table 4: Haematological Parameters for Major Etiologies

Etiology	Mean Hb (g/dL) ± SD	Mean WBC (cells/μL) ± SD	Mean Platelet (x10³/μL) ± SD	Mean MCV (fL) ± SD
All Patients	6.1 ± 1.8	2792 ± 886	58,460 ± 30,791	90.9 ± 15.8
B12 Deficiency	4.8 ± 1.1	2281 ± 917	91,063 ± 31,240	106.1 ± 7.9
Hepatic/Splenic	7.1 ± 1.8	2883 ± 698	65,667 ± 21,907	87.3 ± 12.5
Infections	7.1 ± 1.5	2829 ± 1028	77,714 ± 38,207	79.1 ± 12.4
Autoimmune	5.8 ± 1.6	3083 ± 1048	53,000 ± 25,100	80.3 ± 10.4
Drug Induced	7.6 ± 1.0	2800 ± 528	58,000 ± 21,354	101.2 ± 5.4
Malignancies	6.2 ± 0.3	2250 ± 212	80,000 ± 56,569	96.5 ± 10.6
P value	<0.001	0.489	0.048	<0.001

The severity of anemia varied markedly, with Vitamin B12 deficient patients presenting with the most profound anemia, reflected in a mean hemoglobin of 4.8 ± 1.1 g/dL, a finding that was highly statistically significant ($p < 0.001$) when compared to other groups. In contrast, patients with drug-induced causes or hepatic/splenic etiologies had notably milder anemia, with mean hemoglobin levels of 7.6 ± 1.0 g/dL and 7.1 ± 1.8 g/dL, respectively. The Mean Corpuscular Volume (MCV) emerged as another highly significant differentiator ($p < 0.001$), clearly segregating the etiologies into macrocytic and normocytic categories. Vitamin B12 deficiency and drug-induced causes were distinctly macrocytic, with mean MCVs of 106.1 ± 7.9 fL and 101.2 ± 5.4 fL, whereas infections, autoimmune disorders, and hepatic causes were normocytic, with mean MCVs below 90 fL. For platelet counts, the overall difference was also statistically significant ($p = 0.048$), with autoimmune disorders showing the most severe thrombocytopenia ($53,000 \pm 25,100/\mu\text{L}$), while B12 deficiency was associated with a relatively preserved count ($91,063 \pm 31,240/\mu\text{L}$). Conversely, the total WBC count did not show any statistically significant variation across the different causes ($p = 0.489$), indicating that leukopenia is a universal feature of pancytopenia and does not help in distinguishing its underlying etiology.

DISCUSSION

In the present study, nutritional deficiencies mainly Vitamin B12 deficiency were identified as the most common cause of pancytopenia (32%), followed by hepatic and splenic causes (22%), infections (14%),

autoimmune disorders (12%), and drug-induced etiologies (10%). Less frequent causes included hematological malignancies and bone marrow failure. These findings are consistent with previous Indian studies that have established megaloblastic anemia as the predominant etiology of pancytopenia.^[1,5] A study from Ahmedabad reported megaloblastic anemia as the leading cause (45%), followed by infections and hypersplenism.^[1] Similarly, a study from the north Himalayan region found megaloblastic anemia in 25% of cases and bone marrow failure syndromes in 19%.^[2] The Bhilai study of 132 cases also reported megaloblastic anemia (50.7%) as the most frequent cause, followed by hypersplenism, malaria, leukemia, and aplastic anemia.^[3] Other studies from various Indian centers have shown a similar etiological pattern, though the proportion of nutritional versus non-nutritional causes varies depending on dietary habits, endemic infections, and access to healthcare.^[4,7]

Clinically, fatigue and weakness (36%), fever (32%), and breathlessness (32%) were the most common presenting complaints in this cohort. These findings align with earlier Indian studies where generalized weakness and pallor were nearly universal features of pancytopenia, particularly in megaloblastic and aplastic etiologies.^[5,8] Fever was more commonly associated with infectious and autoimmune causes, while gastrointestinal symptoms and edema were frequent in hepatic and splenic causes. The male predominance observed in this study (66%) also parallels other Indian reports where male-to-female ratios ranged from 1.5:1 to 2:1.^[4,5,11] The hematological parameters in this study showed statistically significant variation in mean hemoglobin

($p < 0.001$) and MCV ($p < 0.001$) across etiologies, while WBC count did not differ significantly ($p = 0.489$). Patients with Vitamin B12 deficiency exhibited the most severe anemia (mean Hb 4.8 ± 1.1 g/dL) and the highest MCV (106.1 ± 7.9 fL), which are characteristic findings of megaloblastic anemia (1,5). Drug-induced cases also showed macrocytosis (MCV 101.2 ± 5.4 fL), whereas hepatic, infectious, and autoimmune causes presented with normocytic indices. Autoimmune etiologies showed the most severe thrombocytopenia (mean platelet count $53,000 \pm 25,100/\mu\text{L}$), possibly reflecting immune-mediated platelet destruction, whereas B12 deficiency was associated with relatively preserved platelet counts ($91,063 \pm 31,240/\mu\text{L}$). These results are consistent with those reported by Varma and Dash.^[9] and Tilak and Jain^[12] who observed macrocytosis and relatively higher platelet counts in megaloblastic anemia, contrasting with severe thrombocytopenia in bone marrow failure and autoimmune diseases.

Leukopenia did not show significant variation across etiologies, suggesting that it is a common feature of pancytopenia irrespective of its cause.^[6,8] Similar findings were observed in studies from Lucknow and Delhi, where total leukocyte counts were uniformly reduced across different diagnostic categories.^[4,7] This indicates that WBC count alone has limited discriminatory value in differentiating causes of pancytopenia. Taken together, these observations reinforce that basic hematological indices—particularly hemoglobin, MCV, and platelet count along with clinical features can provide valuable diagnostic guidance even before bone marrow examination.^[11] Severe anemia with macrocytosis and relatively preserved platelets in a middle-aged male points toward Vitamin B12 deficiency, while normocytic indices with organomegaly and systemic symptoms suggest hepatic or infectious etiologies. The strength of the study is detailed quantification of hematological parameters by etiologic category, allowing statistical comparisons. Limitations include sample size (50), possible referral bias, and lack of bone marrow biopsy in all patients (if that applies) to confirm certain diagnoses. Future studies with larger sample sizes, inclusion of additional biomarkers (e.g. LDH, reticulocyte index), and longitudinal follow-up (response to therapy) would strengthen causal inferences. Also, regional surveys to capture nutritional and infectious prevalence will help explain geographic variation in etiologic patterns. In conclusion, Vitamin B12 deficiency remains the leading cause of pancytopenia in the Indian context, highlighting the ongoing burden of nutritional

anemia despite improved awareness and supplementation programs. Early recognition of macrocytic anemia, dietary assessment, and timely intervention can prevent severe hematological complications. Regional studies across India continue to emphasize the need for improved nutritional surveillance, early diagnosis, and appropriate management strategies to reduce pancytopenia-related morbidity and mortality.

CONCLUSION

Vitamin B12 deficiency is the predominant cause of pancytopenia in this region. The combination of clinical features and basic hematological indices, particularly hemoglobin and MCV, provides a highly effective initial approach to differentiating the underlying causes, emphasizing the continued public health importance of addressing nutritional deficiencies.

REFERENCES

1. Tilak V, Jain R. Pancytopenia—A clinico-haematologic analysis of 77 cases. *Indian J Pathol Microbiol.* 1999;42(4):399–404.
2. Kaur H, Bal M, Chopra R, Singh R. Clinico-haematological profile of pancytopenia: A study from north Himalayan region of India. *J Clin Diagn Res.* 2019;13(5):OC04-OC08.
3. Manzoor F, Gupta PK, Kumar R, Singh M. Pancytopenia—A clinicopathological analysis of 132 cases. *Int J Med Res Rev.* 2016;4(8):814–20.
4. Gupta V, Tripathi S, Tilak V, Jain R. A study of etiological profile of pancytopenia. *Indian J Hematol Blood Transfus.* 2008;24(3):115–120.
5. Khunger JM, Arculselvi S, Sharma U, Ranga S, Talib VH. Pancytopenia—a clinico-haematological study of 200 cases. *Indian J Pathol Microbiol.* 2002;45(3):375–379.
6. Khodke K, Marwah S, Buxi G, Vadav RB, Chaturvedi NK. Bone marrow examination in cases of pancytopenia. *J Indian Acad Clin Med.* 2001;2(1):55–59.
7. Kumar DB, Reddy CM, Sudha S. Clinical and hematological profile of pancytopenia. *Int J Contemp Med Res.* 2018;5(5):E1–E5.
8. Jha A, Sayami G, Adhikari RC, Panta AD, Jha R. Bone marrow examination in cases of pancytopenia. *J Nepal Med Assoc.* 2008;47(169):12–17.
9. Varma N, Dash S. Reappraisal of underlying pathology in adult pancytopenia. *Indian J Pathol Microbiol.* 1992;35(2):150–157.
10. Mehta S, Das M, Mehta S, Jain R. Etiological study of pancytopenia in adults: A tertiary care experience. *Int J Adv Med.* 2020;7(4):771–775.
11. Goyal P, Shukla R, Singh S, Verma R. Clinico-hematological evaluation of pancytopenia: An institutional experience. *Med J DY Patil Vidyapeeth.* 2021;14(3):303–308.
12. Kumar R, Kalra SP, Kumar H, Anand AC, Madan H. Pancytopenia—a six-year study. *J Assoc Physicians India.* 2001;49:1078–108.