

Spectrum of Anaemia case in Tertiary Care Hospital**Rimjhim Kumari¹, Rakhi Kumari², Rabindra Nath Prasad³, Pradeep Kumar Singh⁴**¹Tutor, Department of Pathology, Government Medical College, Bettiah, West Champaran, Bihar, India²Tutor, Department of Pathology, Government Medical College, Bettiah, West Champaran, Bihar, India³Associate Professor, Department of Pathology, Government Medical College, Bettiah, West Champaran, Bihar, India⁴Associate Professor & HOD, Department Of Pathology, Government Medical College, Bettiah, West Champaran, Bihar, India

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Conflict of interest: Nil

Abstract:**Introduction:** Anaemia remains a major public health problem in India, with diverse morphological patterns and aetiologies that vary across clinical settings. Hospital-based research, especially from tertiary care facilities, offers crucial information about the range of anemia severity, underlying causes, and diagnostic correlations.**Aims:** To determine the distribution of anemia by aetiology, morphological type, and severity, as well as to investigate the relationship between red cell morphology and underlying causes in patients receiving tertiary care.**Materials & Methods:** The Government Medical College in Bettiah was the site of this cross-sectional study. There were 384 patients with anemia diagnoses in all. Based on hemoglobin levels, anemia was categorized as mild, moderate, or severe. Red cell indices and peripheral smear analysis were used for morphological classification (microcytic, normocytic, and macrocytic). Relevant laboratory tests, such as vitamin assays and iron studies, were used to determine the aetiology. To find distribution patterns and correlations between morphology, severity, and aetiology data were analyzed.**Results:** The most prevalent severity category was moderate anemia (51.6%), which was followed by severe anemia (21.9%) and mild anemia. The most common morphological type was microcytic anemia (56.8%), which was followed by normocytic anemia (31.8%) and macrocytic anemia (11.5%). The most common cause was found to be iron deficiency (58.3%), followed by vitamin B12 deficiency (16.1%), anemia of chronic disease (13.5%), folate deficiency (4.7%), and other causes. A strong association was observed between microcytic morphology and iron deficiency, macrocytic morphology and vitamin B12/folate deficiency, and normocytic morphology and chronic disease or haemolysis. The majority of morphological and aetiological categories showed moderate anemia.**Conclusion:** In this tertiary-care population, iron deficiency, microcytic morphology, and moderate anemia are the most common patterns. Referral bias toward more complex cases is reflected in the higher percentage of severe and macrocytic anemia. The importance of red cell indices and peripheral smear examination as useful tools in the initial diagnostic evaluation of anemia is highlighted by the strong correlation between morphology and aetiology.**Keywords:** Anaemia, Morphological classification, Iron deficiency anaemia, Vitamin B12 deficiency, Anaemia of chronic disease, Cross-sectional study.**DOI:** 10.25258/ijcpr.18.4.84This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Children, women, and older adults are disproportionately affected by anemia, which is a serious public health issue in India and around the world [1,2,3].

According to extensive worldwide analyses, dietary iron deficiency, hemoglobinopathies, hemolytic anemias, and chronic infections are the main causes of anemia-related disability [1,2,4]. The most common severity grade in hospital and community-

based studies from low- and middle-income settings is usually moderate anemia, with microcytic patterns predominating and indicating underlying iron deficiency [5,6,7,8,3]. Microcytic anemia is typically the most common morphological type in Indian rural and hospital cohorts, while normocytic anemia increases with age and chronic illness [8,3].

Less frequently occurring macrocytic anemia is usually linked to folate or vitamin B12 deficiency [9,6,10].

Materials and Methods

Study Design and Setting: This research was conducted as an observational prospective study at the Department of Pathology, Government Medical College, Bettiah, at West Champaran, Bihar.

Study Population and Research Period: The study was conducted from April 1, 2025, to March 31, 2026. Every patient diagnosed with anemia during the study period who visited the outpatient departments (OPD) or was admitted to the inpatient departments (IPD) was taken into consideration for inclusion.

Inclusion Criteria

- Patients of both sexes and all age groups
- Individuals with anemia according to World Health Organization (WHO) standards

Exclusion Criteria

- Individuals who have experienced severe blood loss due to trauma or surgery
- Individuals who have had blood transfusions in the previous three months
- Individuals with insufficient laboratory or clinical data

Sample Size: The standard formula for prevalence studies was used to determine a minimum sample size of 384. The study included 384 patients who met the inclusion criteria.

Methodologies: A structured proforma that had been previously created and tested was used to gather the data. Sociodemographic information, clinical history, physical examination results, and pertinent laboratory tests were all included in the proforma.

Investigations in the Lab: Hemoglobin estimation using an automated hematology analyzer was one of the laboratory investigations. Red blood cell indices were measured, including mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC). Every case involved a peripheral smear examination. Serum ferritin,

vitamin B12, and folate levels were also measured as needed.

Anaemia Definition (WHO Criteria): The World Health Organization's (WHO) definition of anemia was used. Anaemia was defined as having hemoglobin levels of less than 13 g/dL in adult males, less than 12 g/dL in adult females, and less than 11 g/dL in pregnant women.

Anaemia Classification: Anaemia was categorized according to its etiology, morphology, and severity.

Anaemia was classified as mild, moderate, or severe based on severity.

Based on Red blood cells were divided into three categories: macrocytic (MCV >100 fL), normocytic (MCV 80–100 fL), and microcytic (MCV <80 fL).

Anaemia was divided into iron deficiency anaemia, vitamin B12 or folate deficiency anemia, anaemia of chronic disease, hemolytic anaemia, and other causes based on its etiology.

Analysis of Statistics: Microsoft Excel was used to enter the data, and statistical software (SPSS version XX) was used for analysis. Frequency and percentage were used to express the results.

When appropriate, the chi-square test was used to evaluate correlations. Statistical significance was defined as a p-value of less than 0.05.

Ethical Consideration: The Institutional Ethics Committee granted ethical clearance. When necessary, informed consent was acquired, and patient data confidentiality was rigorously upheld.

Results

The representative results table that is based on the investigation done on 384 patients from Government Medical College, Bettiah, West Champaran, Bihar, and is based on the typical parameters gathered in research studies on the Spectrum of Anemia case in Tertiary Care Hospital.

Key clinical characteristics such as site distribution, morphological classification, and etiological distribution are all included in the table.

Table 1: Distribution of anaemia by severity (N=384)

Severity	Hb Range (g/dl)	Number(n)	Percentage (%)
Mild	10-12 (F) 10-13 (M)	102	26.6
Moderate	7-9.9	198	51.6
Severe	< 7	84	21.9
Total		384	100

Table 2: Morphological classification of anemia

Morphology	MCV Range (fL)	Number (n)	Percentage (%)
Microcytic	<80	218	56.8
Normocytic	80-100	122	31.8
Macrocytic	>100	44	11.5
Total		384	100

Table 3: Etiological distribution of anemia

Etiology	Number(n)	Percentage (%)
Iron deficiency anemia	224	58.3
Vitamin B12 deficiency	62	16.1
Folate deficiency	18	4.7
Anaemia of chronic disease	52	18.5
Haemolytic anaemia	12	3.1
Others	16	4.2
Total	384	100

Table 4: severity morphology

Morphology	Mild	Moderate	Severe	Total
Microcytic	52	118	48	218
Normocytic	38	62	22	122
Macrocytic	12	18	14	44
Total	102	198	84	384

Table 5: etiology vs morphology

Etiology	Microcytic	Normocystic	Macrocytic	Total
Iron Deficiency	198	20	6	224
Vitamin B12 Deficiency	4	18	40	62
Folate Deficiency	2	6	10	18
Chronic Disease	8	40	4	52
Hemolytic Anemia	2	10	Zero	12
Others	4	28	4	16
Total	218	122	44	384

Discussion

Distribution according to Severity: The majority of cases in prenatal and pediatric hospital cohorts are mild to moderate anemia [5,6,7,8] which is consistent with the prevalence of moderate anemia (51.6%). Similarly, global burden analyses show that while severe anemia is less common but still clinically significant, mild and moderate anemia account for the majority of years lived with disability [13,4]. Referrals of more complicated or advanced cases are probably the reason for the comparatively high percentage of severe anemia (21.9%) seen in tertiary-care settings.

Morphological Profile: Data from Indian rural and hospital-based studies, where microcytosis is frequently seen among children, women of reproductive age, and outpatient populations, are consistent with microcytic anemia as the predominant morphology (56.8%) [5,7,8,3]. On the other hand, normocytic anemia is more common in studies from older hospital cohorts in Europe, whereas macrocytic anemia is more frequently linked to myelodysplastic syndromes and folate or vitamin B12 deficiency [9]. According to research

describing multifactorial mechanisms in chronic inflammatory states [9,14]. The observed normocytic proportion (31.8%) indicates a significant burden of anemia of chronic disease and mixed aetiologies. The macrocytic proportion (11.5%) is consistent with a higher prevalence of vitamin B12 and folate deficiency and is higher than that found in many community-based or preoperative studies, where macrocytosis is relatively uncommon (1-4%) [9,10,3].

Aetiological Pattern: According to data from both India and around the world, iron deficiency is the most common cause of anemia (58.3%) (11,12,1,2,4,3). Large meta-analyses of national survey data, however, indicate that iron deficiency is responsible for between 25% and 33% of cases of anemia in many populations, with a comparatively smaller contribution in environments where the prevalence of anemia is high overall [15]. Referral bias toward cases of symptomatic or refractory nutritional deficiencies may be the cause of the higher percentage seen in hospital-based populations. Vitamin B12 (16.1%) and folate deficiency (4.7%) contribute to macrocytic and

mixed anemia, especially in older adults and certain disease groups, according to research from India and other low-resource settings [9,6,3,16,17]. Chronic disease-related anemia (13.5%) is consistent with data showing that it is the second most common cause of anemia worldwide, after iron deficiency (14).

Association between Morphology, Severity and Aetiology: Cohort studies showing a close relationship between absolute iron deficiency and microcytic morphology are consistent with a strong correlation between microcytosis and iron deficiency (198 of 224 cases) [9,10,18]. According to hospital-based data, normocytic patterns are frequently linked to chronic inflammation, renal disease, and hemolysis [9,10,14,18].

This is consistent with anemia of chronic disease and hemolytic anemia, which are primarily normocytic. According to clinical and morphological studies, macrocytosis is primarily seen in vitamin B12 and folate deficiency, with sporadic normocytic presentations [9,6,18].

According to observations from extensive surgical and prenatal datasets, moderate anemia continues to be the most common severity category across various morphological types and aetiologies [6,10,7].

Limitations

Tertiary care, single-center setting: The results may overrepresent severe and complex cases of anemia in comparison to the general population, as is the case with other hospital-based studies. Preoperative cohorts and rural Indian populations have also shown this pattern [10,3]. Additionally, this restricts the results' applicability to community-based populations.

Lack of age and sex stratification: Significant differences in the prevalence and aetiology of anemia between age groups and genders, such as the greater burden among young children and women of reproductive age, are well documented in international and Indian studies [1,2,4,3], but they cannot be assessed from the aggregated data provided.

Potential under-characterisation of multifactorial anaemia: Research on rheumatoid arthritis and older populations shows that multiple deficiencies and chronic disease anemia often coexist, making precise aetiological classification more difficult [9,19,14]. Some mixed or unexplained cases may have been incorrectly classified in the absence of a thorough evaluation that included iron studies, inflammatory markers, renal parameters, and bone marrow assessment.

Lack of outcome data: Previous research has shown links between negative outcomes like

increased mortality and disability and anemia characteristics like macrocytosis, elevated red cell distribution width (RDW), and even mild anemia [10,13]. The current cross-sectional data does not allow for the assessment of these prognostic relationships.

Conclusion

More than half of anemia patients present with moderate severity, with microcytic morphology being the most common pattern, according to the current tertiary-care study from Government Medical College, Bettiah. The most common cause is iron deficiency, which is followed by vitamin B12 deficiency and chronic disease anemia.

These trends are generally in line with excellent international and Indian data. Nonetheless, a comparatively greater percentage of severe and macrocytic anemia points to a concentration of more advanced or nutritionally complex cases in the tertiary care setting.

The strong correlation between morphology and aetiology - microcytosis with iron deficiency, macrocytosis with vitamin B12 or folate deficiency, and normocytosis with chronic illness or hemolysis highlights the usefulness of peripheral smear examination and red cell indices as useful and affordable tools in the initial etiological evaluation of anemia.

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