



Original Research Article

A STUDY OF ANEMIA PATTERNS IN MEDICAL INPATIENTS

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ABSTRACT

Background: Anemia is a frequently encountered clinical problem among hospitalized patients and is associated with increased morbidity, prolonged hospital stay, and adverse outcomes. Despite its high burden, anemia often remains underdiagnosed and inadequately evaluated in inpatient settings, especially in developing countries. **Objectives:** To assess the clinical profile, severity, morphological patterns, and etiological factors of anemia among adult medical inpatients and to study the association of anemia severity with dietary patterns and comorbidities.

Materials and Methods: This hospital-based cross-sectional observational study was conducted in the Department of General Medicine at a tertiary care teaching hospital over a period of six months (July to December 2023). A total of 216 adult medical inpatients with anemia, defined according to World Health Organization (WHO) criteria, were included. Data were collected using a pre-designed structured proforma, which included demographic details, clinical features, dietary habits, comorbidities, and laboratory parameters. Hematological evaluation comprised hemoglobin estimation, complete blood count, red cell indices, and peripheral blood smear examination. Anemia was morphologically classified, and further investigations were performed where clinically indicated.

Results: Most patients were middle-aged or elderly, with a male predominance. Moderate anemia was the most common severity observed. Microcytic hypochromic anemia was the predominant morphological type, and iron deficiency anemia was the leading etiology, followed by anemia of chronic disease. A statistically significant association was noted between dietary pattern and morphological type of anemia, as well as between severity of anemia and the presence of comorbidities, particularly chronic kidney disease and chronic infections.

Conclusion: Anemia among hospitalized medical patients is highly prevalent and multifactorial. Routine screening, early etiological evaluation, and appropriate management of anemia in inpatients are essential to improve clinical outcomes and reduce disease burden.

Keywords: Anemia, Morphological classification, Iron deficiency anemia, Comorbidities.

INTRODUCTION

Anemia is one of the most common hematological abnormalities encountered in clinical practice and remains a significant public health problem worldwide. It is particularly prevalent among hospitalized medical patients, where it often reflects

underlying chronic diseases, nutritional deficiencies, inflammatory states, or acute illness. The presence of anemia in medical inpatients is associated with increased morbidity, prolonged hospital stay, higher healthcare costs, and poorer clinical outcomes.^[1]

In the inpatient setting, anemia is frequently multifactorial. Conditions such as chronic kidney disease, chronic liver disease, infections,

malignancies, and inflammatory disorders commonly contribute to its development. Additionally, nutritional deficiencies—especially iron, vitamin B12, and folate deficiencies—continue to be highly prevalent in developing countries. Acute blood loss, hemolysis, and bone marrow suppression further add to the complexity of anemia observed in hospitalized patients. Despite its high prevalence, anemia is often underdiagnosed, inadequately evaluated, or treated as a secondary finding rather than a clinical entity requiring systematic assessment.

Understanding the patterns of anemia, including morphological types and underlying etiologies, is crucial for accurate diagnosis and targeted management. Classification of anemia based on red cell indices and peripheral smear findings provides valuable clues to its cause and guides further investigations. In medical inpatients, identifying these patterns can help clinicians address reversible causes, optimize treatment strategies, and potentially improve patient outcomes.^[2,3]

Although several studies have evaluated anemia in community and outpatient settings, data focusing specifically on anemia patterns among medical inpatients remain limited, particularly in the Indian context. Given the diverse disease burden and nutritional challenges in this population, studying anemia patterns in hospitalized patients is of significant clinical relevance.

The present study was undertaken to analyze the prevalence and patterns of anemia among medical inpatients and to assess their distribution based on morphological characteristics and associated clinical conditions. This study aims to contribute to a better understanding of anemia in hospitalized medical patients and to emphasize the importance of systematic evaluation of anemia in routine inpatient care.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based cross-sectional observational study conducted in the Department of General Medicine at a tertiary care teaching hospital. The study was carried out over a period of 6 months, from July 2023 to December 2023.

Study Population

The study included adult medical inpatients admitted to the general medicine wards during the study period.

Inclusion Criteria

Patients aged ≥ 18 years

Medical inpatients diagnosed with anemia, defined according to World Health Organization (WHO) criteria

Patients who provided informed consent

Exclusion Criteria

Patients admitted to surgical, obstetric, or pediatric wards

Patients with a history of recent blood transfusion (within the last 3 months)

Patients with acute major hemorrhage or trauma

Pregnant women

Sample Size

Formula: $n = Z^2 \times p \times q / d^2$

Where:

- **n** = required sample size
- **Z** = standard normal deviate at 95% confidence level = **1.96**
- **p** = estimated prevalence of anemia
- **q** = $100 - p$
- **d** = allowable error (absolute precision)

Since exact local prevalence may not be available, we usually take:

- $p = 64\%$ (Bahadur Singh et al)^[2]
- $q = 36\%$
- $d = 10\%$ of $p = 5\%$
- Confidence level = 95%

Calculation

$$n = (1.96)^2 \times 0.64 \times 0.36 / 0.064^2 = 216$$

Considering possible non-response or incomplete data, the sample size was rounded off to: **216 patients**

Data Collection

After obtaining informed consent, detailed data were collected using a **pre-designed and structured proforma**. Information included demographic details, clinical history, presenting complaints, comorbidities, dietary history, and relevant drug history.

Laboratory Evaluation

All patients underwent a complete hematological evaluation, which included:

- Hemoglobin estimation
- Complete blood count (CBC)
- Red cell indices (MCV, MCH, MCHC)
- Peripheral blood smear examination

Based on red cell indices and peripheral smear findings, anemia was morphologically classified into:

- Microcytic hypochromic anemia
- Normocytic normochromic anemia
- Macrocytic anemia
- Dimorphic anemia

Further investigations were performed where clinically indicated, including:

- Serum iron studies
- Serum vitamin B12 and folate levels
- Renal function tests
- Liver function tests
- Relevant imaging or additional tests as required

Data Analysis

The collected data were entered into Microsoft Excel and analyzed using statistical software SPSS 19.0. Categorical variables were expressed as frequencies and percentages, while continuous variables were expressed as mean \pm standard deviation. Appropriate statistical tests were applied where necessary, and a p value of < 0.05 was considered statistically significant.

Ethical Considerations: The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to

enrollment. Confidentiality of patient data was strictly maintained throughout the study.

RESULTS

Table 1: Age and Gender Distribution of Study Participants (n = 216)

Age group (years)	Male n (%)	Female n (%)	Total n (%)
18–30	18 (8.3)	14 (6.5)	32 (14.8)
31–40	26 (12.0)	22 (10.2)	48 (22.2)
41–50	32 (14.8)	28 (13.0)	60 (27.8)
51–60	30 (13.9)	20 (9.3)	50 (23.1)
>60	16 (7.4)	10 (4.6)	26 (12.0)
Total	122 (56.5)	94 (43.5)	216 (100)

The majority of the study participants belonged to the 41–50 years age group, followed by the 51–60 years group. Males constituted a higher proportion of the

study population compared to females, with a male predominance observed across most age groups.

Table 2: Severity of Anemia Based on WHO Criteria (n = 216)

Severity of anemia	Number of patients	Percentage (%)
Mild	48	22.2
Moderate	116	53.7
Severe	52	24.1
Total	216	100

Most patients had moderate anemia (53.7%), followed by severe anemia (24.1%), while mild anemia accounted for the smallest proportion. This

indicates that a large number of inpatients presented with clinically significant anemia.

Table 3: Morphological Classification of Anemia (n = 216)

Morphological type	Number of patients	Percentage (%)
Microcytic hypochromic	98	45.4
Normocytic normochromic	62	28.7
Macrocytic	32	14.8
Dimorphic	24	11.1
Total	216	100

Microcytic hypochromic anemia was the most common morphological type, followed by normocytic normochromic anemia. Macrocytic and dimorphic anemia constituted a smaller but significant proportion of cases.

Table 4: Distribution of Etiological Factors of Anemia (n = 216)

Etiology	Number of patients	Percentage (%)
Iron deficiency anemia	94	43.5
Anemia of chronic disease	58	26.9
Vitamin B12 deficiency	28	13.0
Folate deficiency	14	6.5
Chronic kidney disease	12	5.6
Multifactorial	10	4.6
Total	216	100

Iron deficiency anemia was the most common etiology, followed by anemia of chronic disease. Nutritional deficiencies such as vitamin B12 and

folate deficiency were also observed, while a smaller proportion of patients had multifactorial causes.

Table 5: Common Comorbidities Among Study Participants (n = 216)

Comorbidity	Number of patients	Percentage (%)
Diabetes mellitus	72	33.3
Hypertension	68	31.5
Chronic kidney disease	42	19.4
Chronic liver disease	36	16.7
Chronic infections	28	13.0
Malignancy	18	8.3

A high proportion of patients had associated comorbidities, with diabetes mellitus and hypertension being the most common. Chronic

kidney disease, chronic liver disease, chronic infections, and malignancy were also frequently observed.

Table 6: Mean Hemoglobin Levels According to Severity of Anemia (n = 216)

Severity of anemia	Number of patients	Mean Hb (g/dL) ± SD
Mild	48	10.8 ± 0.6
Moderate	116	8.4 ± 0.7
Severe	52	6.2 ± 0.8
Total	216	8.4 ± 1.6

Mean hemoglobin levels showed a progressive decline from mild to severe anemia, confirming the validity of anemia severity classification based on WHO criteria.

Table 7: Distribution of Red Cell Indices Among Study Participants (n = 216)

Parameter	Mean ± SD	Reference range
Hemoglobin (g/dL)	8.4 ± 1.6	12–16
MCV (fL)	74.6 ± 12.8	80–96
MCH (pg)	23.4 ± 4.6	27–33
MCHC (g/dL)	30.1 ± 2.8	32–36
RDW (%)	16.8 ± 3.2	11.5–14.5

The mean hemoglobin and red cell indices indicated predominantly microcytic and hypochromic patterns, supported by low MCV and MCH values, with increased RDW suggesting mixed or nutritional etiologies.

Table 8: Association Between Dietary Pattern and Morphological Type of Anemia (n = 216)

Morphological type	Vegetarian n (%)	Mixed diet n (%)	Total
Microcytic hypochromic	62 (63.3)	36 (36.7)	98
Normocytic normochromic	24 (38.7)	38 (61.3)	62
Macrocytic	20 (62.5)	12 (37.5)	32
Dimorphic	14 (58.3)	10 (41.7)	24
Total	120 (55.6)	96 (44.4)	216

Chi-square value = 9.12, p value = 0.028: Statistically significant association

Vegetarian diet was more commonly associated with microcytic hypochromic and macrocytic anemia, whereas patients on a mixed diet showed a higher proportion of normocytic normochromic anemia. The association was statistically significant.

Table 9: Association Between Severity of Anemia and Presence of Comorbidities (n = 216)

Severity of anemia	With comorbidities n (%)	Without comorbidities n (%)	Total
Mild	26 (54.2)	22 (45.8)	48
Moderate	84 (72.4)	32 (27.6)	116
Severe	46 (88.5)	6 (11.5)	52
Total	156 (72.2)	60 (27.8)	216

Chi-square value = 16.87, p value < 0.001 Highly statistically significant

The presence of comorbidities increased with the severity of anemia, with severe anemia being most common among patients with associated chronic illnesses. This association was highly statistically significant.

Table 10: Association Between Severity of Anemia and Major Comorbid Conditions (Chi-square Analysis)

Comorbidity	Mild n (%)	Moderate n (%)	Severe n (%)	χ^2 value	p value
Diabetes mellitus (n=72)	12 (16.7)	40 (55.6)	20 (27.7)	6.42	0.040
Chronic kidney disease (n=42)	4 (9.5)	20 (47.6)	18 (42.9)	12.18	0.002
Chronic liver disease (n=36)	6 (16.7)	18 (50.0)	12 (33.3)	3.98	0.137
Chronic infection (n=28)	2 (7.1)	14 (50.0)	12 (42.9)	8.06	0.018

A statistically significant association was observed between dietary pattern and morphological type of anemia ($\chi^2 = 9.12, p = 0.028$).

Severity of anemia showed a strong association with the presence of comorbidities, with severe anemia being more common among patients with chronic illnesses ($p < 0.001$).

Chronic kidney disease and chronic infections demonstrated a significant association with severe anemia.

DISCUSSION

Age and Gender Distribution

In the present study, anemia was more common among middle-aged and elderly inpatients, with a male predominance. Similar findings were reported by Bahadur Singh et al,^[2] who observed a higher prevalence of anemia among hospitalized males, which was attributed to increased burden of chronic diseases and higher hospitalization rates in men.

Comparable age trends were also reported in hospital-based studies by Ranjan Gupta et al,^[4] where anemia prevalence increased with advancing age.

Severity of Anemia

The majority of patients in the present study had moderate anemia, followed by severe anemia. This pattern is consistent with findings reported by S. Bhasin et al,^[5] who noted that moderate anemia is the most frequent presentation among medical inpatients, often going undiagnosed until hospital admission. Severe anemia was more common among patients with multiple comorbidities, a finding also reported by K. Patel et al.^[6]

Morphological Pattern of Anemia

Microcytic hypochromic anemia was the predominant morphological type in this study. Similar observations were made by A. Kassebaum et al,^[7] who reported iron deficiency as the leading cause of anemia in both community and hospital settings. Normocytic normochromic anemia was the second most common type, reflecting anemia of chronic disease, which aligns with findings from R. Weiss et al.^[8]

Etiological Factors

Iron deficiency anemia was the most common etiology identified, followed by anemia of chronic disease. This distribution is consistent with hospital-based studies by S. Pasricha et al,^[3] who highlighted nutritional deficiencies and chronic inflammation as leading contributors to anemia in hospitalized adults. Vitamin B12 and folate deficiencies were observed mainly in patients with macrocytic and dimorphic anemia, similar to findings reported by J. O'Leary et al.^[9]

Comorbidities and Anemia

A high proportion of anemic patients in the present study had associated comorbidities such as diabetes mellitus, hypertension, chronic kidney disease, and chronic liver disease. Similar results were documented by M. Babitt et al,^[10] who reported a strong association between anemia severity and chronic kidney disease among inpatients.

Hemoglobin Levels and Red Cell Indices

Mean hemoglobin levels showed a progressive decline with increasing severity of anemia. Red cell indices revealed predominantly microcytic and hypochromic patterns with increased RDW. These findings are in agreement with studies by T. Ganz et al,^[11] emphasizing the role of iron deficiency and mixed nutritional etiologies in hospitalized patients.

Dietary Pattern and Morphological Type

A statistically significant association was observed between dietary pattern and morphological type of anemia, with microcytic and macrocytic anemia being more common among vegetarians. Similar associations were reported by Kumari M. et al,^[12] who demonstrated higher rates of iron and vitamin B12 deficiency among vegetarian populations.

Severity of Anemia and Comorbidities

The present study demonstrated a strong association between severity of anemia and presence of comorbidities, particularly chronic kidney disease

and chronic infections. Comparable findings were reported by Portoles J et al et al,^[13] who noted that severe anemia is frequently associated with chronic inflammatory and renal disorders. The findings of the present study are largely consistent with recent hospital-based literature, confirming that anemia among inpatients is multifactorial, commonly moderate to severe, and strongly influenced by nutritional deficiencies and chronic diseases.

CONCLUSION

The present hospital-based cross-sectional study highlights that anemia is highly prevalent among adult medical inpatients, with a majority of patients presenting with moderate to severe anemia. The condition was more commonly observed among middle-aged and elderly patients, with a male predominance, reflecting the higher burden of chronic illnesses in this population. Microcytic hypochromic anemia was the most frequently observed morphological type, and iron deficiency anemia emerged as the leading etiology, followed by anemia of chronic disease. Nutritional deficiencies, particularly vitamin B12 and folate deficiency, also contributed significantly, especially in patients with macrocytic and dimorphic anemia.

A strong association was noted between severity of anemia and the presence of comorbidities, particularly chronic kidney disease, diabetes mellitus, and chronic infections, indicating that anemia often reflects underlying systemic illness in hospitalized patients. Dietary pattern showed a statistically significant association with the morphological type of anemia, emphasizing the role of nutritional factors. Overall, the findings underscore that anemia among hospitalized patients is multifactorial, under-recognized, and clinically significant. Early identification, systematic evaluation of etiology, and timely management of anemia—along with optimal control of underlying comorbidities—are essential to improve patient outcomes, reduce morbidity, and shorten hospital stay.

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