

ORIGINAL ARTICLE

Patterns of Anemia and Its Clinical Correlates among Patients Attending an Internal Medicine Service

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ABSTRACT

Background: Anemia is a common hematological disorder among patients receiving internal medicine care and may reflect nutritional deficiency, chronic disease, blood loss, or impaired erythropoiesis. Its morphological patterns and clinical correlates are important for appropriate diagnostic evaluation and management. **Aim of the study:** To assess the patterns of anemia and their clinical correlates among patients attending an internal medicine service. **Methods & Materials:** This hospital-based cross-sectional observational study included 300 adults attending the Internal Medicine Service of a tertiary-level hospital in Bangladesh. Sociodemographic, clinical, and hematological data were collected through structured questionnaires, clinical records, and laboratory reports. Anemia was classified according to severity and morphological pattern using predefined criteria. Associations were assessed using chi-square/Fisher's exact tests and independent-samples t-test, with $p < 0.05$ considered statistically significant. **Result:** Anemia was present in 59.67% of participants, with moderate anemia being the most common severity category (27.33%). Microcytic hypochromic anemia was the predominant morphological pattern (42.46%), followed by normocytic normochromic anemia (37.43%). Anemia was significantly associated with older age ($p < 0.001$), female sex ($p = 0.014$), and rural residence ($p = 0.034$), whereas smoking showed no significant association ($p = 0.063$). Significant clinical associations were observed with chronic kidney disease, gastrointestinal bleeding, diabetes mellitus, chronic liver disease, and heart failure. Anemic participants had significantly lower hemoglobin, RBC count, and MCV, higher RDW, and longer hospital stay than non-anemic participants (all $p < 0.001$). **Conclusion:** Anemia was highly prevalent among internal medicine patients, with moderate and microcytic hypochromic patterns predominating. Routine hematological assessment with targeted evaluation of nutritional deficiency, blood loss, renal dysfunction, and chronic disease may facilitate timely diagnosis and appropriate management.

Keywords: Anemia; Hematological patterns; Internal medicine; Chronic disease; Hospitalization

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INTRODUCTION

Anemia is a condition characterized by a hemoglobin concentration below the level required to meet the body's physiological needs, resulting in reduced oxygen-carrying capacity of the blood. According to World Health Organization criteria, anemia in adults is defined using sex-specific hemoglobin thresholds, with <13 g/dL in men and <12 g/dL in non-pregnant women [1]. Globally, anemia affects approximately 24.3% of the population across all ages [2]. In Bangladesh, anemia affects approximately 93.8% of patients admitted to Medicine and Gynecology departments of a district hospital, indicating a substantial burden among hospital-attending patients [3]. Anemia develops when red blood cell production is inadequate, blood loss is excessive, or red blood cell destruction is increased [4]. Iron deficiency is the leading nutritional cause and accounts for a substantial proportion of anemia globally [2,5]. Other important causes include deficiencies of vitamin B12 and folate, chronic inflammation, chronic kidney disease, infections, malignancy, hemoglobinopathies, and hemolytic disorders [4,6]. In chronic inflammatory states, cytokine-mediated hepcidin elevation

reduces iron availability for erythropoiesis, while impaired erythropoietin activity and shortened red cell survival further contribute to anemia [6,7]. Clinical classification by red-cell indices and peripheral blood morphology can help distinguish microcytic, normocytic, and macrocytic patterns and guide etiological evaluation [1,4]. These patterns provide useful clues to the underlying cause and help clinicians select appropriate laboratory investigations for further evaluation [4,5]. The clinical impact of anemia varies with its severity, duration, and underlying cause. Common manifestations include fatigue, weakness, dizziness, headache, reduced exercise tolerance, and shortness of breath [8]. More severe anemia can compromise tissue oxygenation and place additional stress on the cardiovascular system, particularly in patients with chronic cardiac or respiratory disorders [8,9]. Anemia associated with chronic diseases can aggravate the symptoms and functional limitations of the underlying condition [6]. Among hospitalized medical patients, anemia has also been associated with longer hospital stays and a greater burden of comorbid illness. Its clinical consequences can therefore extend beyond hematological abnormalities and affect overall

functional status and healthcare needs [9]. A major advantage of recognizing the morphological and etiological patterns of anemia is that it facilitates targeted investigations and appropriate treatment, rather than relying on nonspecific supplementation [4,5]. However, overlapping causes such as iron deficiency and chronic inflammation can complicate diagnosis and require combined clinical and laboratory assessment [6,7]. For internal medicine services, identifying the pattern of anemia and its clinical correlates is important because patients frequently present with multiple chronic conditions that can influence hemoglobin levels and modify treatment needs. A clear understanding of these relationships can support earlier diagnosis, rational investigation, appropriate referral, and better management of the underlying disease [6,9]. Despite the substantial burden of anemia reported in Bangladesh, limited data are available on its overall patterns and clinical correlates among patients attending internal medicine services [3,10]. Therefore, the present study aimed to assess the patterns of anemia and their clinical correlates among patients attending an internal medicine service.

METHODS & MATERIALS

This hospital-based cross-sectional observational study was conducted among patients attending Department of Internal Medicine, Shaheed Monsur Ali Medical College Hospital, Dhaka, Bangladesh, during the study period from January 2019 to December 2019. A total of 300 eligible patients were enrolled consecutively according to predefined inclusion and exclusion criteria.

Inclusion Criteria

- Patients aged ≥ 18 years attending the Internal Medicine Service.
- Patients with a complete blood count performed during the study period.
- Patients with adequate demographic, clinical, and laboratory information relevant to the study.
- Patients who provided written informed consent to participate.

Exclusion Criteria

- Patients aged < 18 years.
- Pregnant women.
- Patients with substantially incomplete clinical or hematological records.
- Patients unwilling to provide informed consent.

Ethical Considerations

The study protocol was reviewed and approved by the appropriate institutional ethics committee before

commencement. Written informed consent was obtained from all participants. Participation was voluntary, and participants were informed of their right to withdraw at any stage without affecting their medical care. Personal identifiers were excluded from the analytical dataset, and confidentiality of all collected information was maintained throughout the study.

Data Collection

Data were collected using a structured interviewer-administered questionnaire and supplemented by clinical records and laboratory reports. Sociodemographic variables included age, sex, and residence, while baseline characteristics included body mass index (BMI) and smoking status. Clinical information included chronic kidney disease, diabetes mellitus, chronic liver disease, heart failure, and a history of gastrointestinal bleeding. Hematological parameters included hemoglobin, red blood cell count, mean corpuscular volume (MCV), and red cell distribution width (RDW). Length of hospital stay was recorded in days.

Assessment of Anemia

Anemia was identified according to predefined hemoglobin thresholds appropriate for adult patients. Participants were categorized as having no anemia or anemia, with anemia further classified as mild, moderate, or severe according to the applied clinical severity criteria. Among anemic patients, morphological patterns were categorized as microcytic hypochromic, normocytic normochromic, macrocytic, or dimorphic based on hematological indices and available peripheral blood findings.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean $\pm$ standard deviation, whereas categorical variables were summarized as frequencies and percentages. Associations between anemia status and categorical variables were assessed using the chi-square test or Fisher's exact test where appropriate. Continuous variables were compared using the independent-samples t-test. A two-sided p-value < 0.05 was considered statistically significant.

RESULTS

The mean age was 51.7 ± 16.8 years. The largest age group was 40–59 years (33.67%), followed by 60–74 years (27.33%), 18–39 years (25.33%), and ≥ 75 years (13.67%). Males constituted 58.00% of the study population, while females accounted for 42.00%. Urban and rural residents represented 52.67% and 47.33%, respectively. The mean BMI was 24.1 ± 4.0 kg/m², and 29.00% were current smokers (Table 1).

Table I: Sociodemographic and baseline characteristics of patients (n=300)

Variables	Frequency (n)	Percentage (%)
Age (years)		
Mean $\pm$ SD		51.7 $\pm$ 16.8
18–39	76	25.33
40–59	101	33.67
60–74	82	27.33
≥ 75	41	13.67
Gender		
Male	174	58.00
Female	126	42.00
Residence		
Urban	158	52.67
Rural	142	47.33
BMI (kg/m ²)		
Mean $\pm$ SD		24.1 $\pm$ 4.0
Smoking status		
Current smoker	87	29.00
Non-smoker	213	71.00

Overall, 59.67% of participants had anemia, while 40.33% had no anemia. Regarding severity, 27.33% had moderate anemia, followed by mild anemia (24.33%) and severe anemia (8.00%) (*Table II*).

Table II: Distribution of patients according to anemia status and severity (n=300)

Variables	Frequency (n)	Percentage (%)
No anemia	121	40.33
Mild anemia	73	24.33
Moderate anemia	82	27.33
Severe anemia	24	8.00

Among anemic participants, the predominant hematological morphology was microcytic hypochromic anemia (42.46%), followed by normocytic normochromic (37.43%), macrocytic (11.73%), and dimorphic (8.38%) patterns (*Tables III*).

Table III: Morphological patterns of anemia among anemic patients (n=179)

Variables	Frequency (n)	Percentage (%)
Microcytic hypochromic	76	42.46
Normocytic normochromic	67	37.43
Macrocytic	21	11.73
Dimorphic	15	8.38

Anemia was significantly associated with age, gender, and residence. Its proportion increased progressively with age, from 39.47% among participants aged 18–39 years to 75.61% among those aged ≥ 75 years ($\chi^2=24.61$, $p<0.001$). Females had a higher proportion of anemia than males (69.05% vs. 52.87%; $\chi^2=6.01$, $p=0.014$). Similarly, anemia was more

prevalent among rural than urban residents (66.20% vs. 53.80%; $\chi^2=4.48$, $p=0.034$). In contrast, smoking status was not significantly associated with anemia (67.82% and 56.34%; $\chi^2=3.46$, $p=0.063$) (*Table IV*).

Table IV: Association between anemia status and sociodemographic characteristics (n=300)

Variables	Anemia (n=179)		No anemia (n=121)		χ^2	p-value
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)		
Age group (years)						
18–39	30	39.47	46	60.53	24.61	<0.001
40–59	54	53.47	47	46.53		
60–74	64	78.05	18	21.95		
≥75	31	75.61	10	24.39		
Gender						
Male	92	52.87	82	47.13	6.01	0.014
Female	87	69.05	39	30.95		
Residence						
Urban	85	53.80	73	46.20	4.48	0.034
Rural	94	66.20	48	33.80		
Smoking						
Current smoker	59	67.82	28	32.18	3.46	0.063
Non-smoker	120	56.34	93	43.66		

Several clinical conditions demonstrated significant associations with anemia. Participants with chronic kidney disease showed a markedly higher proportion of anemia (80.77%; $\chi^2=14.82$, $p<0.001$). Similarly, anemia was prominent among those with a history of gastrointestinal

bleeding (81.58%; $\chi^2=10.36$, $p=0.001$). Significant associations were also observed with diabetes mellitus (68.00%; $\chi^2=6.27$, $p=0.012$), chronic liver disease (76.32%; $\chi^2=5.93$, $p=0.015$), and heart failure (71.15%; $\chi^2=4.71$, $p=0.030$) (Table V).

Table V: Clinical correlates associated with anemia among hospitalized patients (n=300)

Variables	Anemia (n=179)		No anemia (n=121)		χ^2	p-value
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)		
Chronic kidney disease						
Yes	42	80.77	10	19.23	14.82	<0.001
No	137	55.23	111	44.77		
Diabetes mellitus						
Yes	68	68.00	32	32.00	6.27	0.012
No	111	55.50	89	44.50		
Chronic liver disease						
Yes	29	76.32	9	23.68	5.93	0.015
No	150	57.25	112	42.75		
Heart failure						
Yes	37	71.15	15	28.85	4.71	0.03
No	142	57.26	106	42.74		
History of gastrointestinal bleeding						
Yes	31	81.58	7	18.42	10.36	0.001
No	148	56.49	114	43.51		

Compared with participants without anemia, those with anemia were older (55.8 ± 16.1 and 45.6 ± 16.2 years; $p<0.001$) and had lower BMI (23.7 ± 4.1 and 24.7 ± 3.8 kg/m²; $p=0.028$). Hemoglobin (9.3 ± 1.5 and 12.7 ± 1.0 g/dL), RBC count (3.41 ± 0.56 and $4.43 \pm 0.48 \times 10^6/\mu\text{L}$), and MCV ($77.1 \pm$

11.9 and 83.8 ± 9.8 fL) were significantly lower, whereas RDW was higher (16.7 ± 3.4 and $14.5 \pm 2.2\%$; $p<0.001$). Hospital stay was also longer among anemic participants (7.4 ± 3.8 and 5.6 ± 2.7 days; $p<0.001$) (Table VI).

Table VI: Clinical and hematological characteristics according to anemia status (n=300)

Variables	Anemia (n=179) Mean $\pm$ SD	No anemia (n=121) Mean $\pm$ SD	p-value
Age (years)	55.8 ± 16.1	45.6 ± 16.2	<0.001
BMI (kg/m ²)	23.7 ± 4.1	24.7 ± 3.8	0.028
Hemoglobin (g/dL)	9.3 ± 1.5	12.7 ± 1.0	<0.001
RBC count ($\times 10^6/\mu\text{L}$)	3.41 ± 0.56	4.43 ± 0.48	<0.001
MCV (fL)	77.1 ± 11.9	83.8 ± 9.8	<0.001
RDW (%)	16.7 ± 3.4	14.5 ± 2.2	<0.001
Length of hospital stay (days)	7.4 ± 3.8	5.6 ± 2.7	<0.001

DISCUSSION

Anemia is a common hematological disorder characterized by reduced hemoglobin concentration and impaired oxygen-carrying capacity. In internal medicine practice, it is clinically

important because it frequently accompanies chronic systemic diseases and may indicate greater disease burden and poorer outcomes. The study population was predominantly middle-aged and older adults, with the largest proportion aged 40–59

years, followed by those aged 60–74 years. Males constituted a majority, while urban and rural residents were similarly represented. This demographic profile is broadly consistent with patients managed in internal medicine services, where anemia frequently occurs with advancing age and multimorbidity. Zaninetti et al. reported a high prevalence of anemia among internal medicine inpatients and identified increasing age as an important associated factor [11]. Similarly, Gaskell et al. demonstrated that anemia becomes progressively more prevalent with advancing age, particularly among older adults [12]. This pattern may reflect age-related changes in hematopoiesis, chronic inflammation, nutritional deficiency, renal impairment, and multimorbidity. Anemia was present in 59.67% of participants, with moderate anemia being the most frequent category, followed by mild anemia, while severe anemia was less common. This prevalence is comparable with findings from hospitalized internal medicine populations. Zaninetti et al. reported anemia in 58.4% of internal medicine inpatients [11], while Migone De Amicis et al. also found a high frequency of anemia among hospitalized older adults, with mild-to-moderate forms predominating [13]. The substantial burden highlights anemia as a frequent clinical abnormality. Moderate anemia may indicate important pathology requiring evaluation for treatable causes. Chronic disease, nutritional inadequacy, inflammation, renal dysfunction, and blood loss may collectively explain this burden in hospitalized patients. Microcytic hypochromic anemia was the predominant morphological pattern, followed by normocytic normochromic anemia, whereas macrocytic and dimorphic patterns were less frequent. The predominance of microcytosis suggests an important contribution of iron-restricted erythropoiesis, although microcytosis may also result from other disorders of hemoglobin synthesis [14]. This differs from some studies of older hospitalized populations in which normocytic anemia was more common, reflecting chronic inflammation, renal dysfunction, and systemic disease [13,15]. Differences in age, nutritional status, comorbidity, and healthcare setting may explain this variation. The coexistence of microcytic and normocytic patterns also demonstrates the heterogeneous nature of anemia in internal medicine patients. Morphological classification is therefore useful as an initial guide but should be complemented by assessment of iron status, renal function, inflammation, and nutritional parameters. A significant age-related gradient was observed, with anemia prevalence increasing from 39.47% among younger adults to 78.05% among those aged 60–74 years and remaining high among those aged ≥75 years ($p<0.001$). This finding is consistent with previous research demonstrating a strong relationship between advancing age and anemia [11,12]. Females had a significantly higher prevalence than males (69.05% vs. 52.87%; $p=0.014$), consistent with the recognized contribution of iron deficiency and blood loss to anemia among women [16]. Rural residents also had a higher prevalence than urban residents (66.20% vs. 53.80%; $p=0.034$). Although determinants were not directly assessed, differences in diet, socioeconomic circumstances, healthcare access, and recognition of chronic disease may contribute. Smoking was not significantly associated with anemia ($p=0.063$). These findings suggest that age, sex, and residence may help identify groups with greater anemia burden, alongside clinical and nutritional factors. Several clinically important conditions were significantly associated with anemia. The highest prevalence occurred among participants with gastrointestinal bleeding and chronic kidney disease, while anemia was also frequent among those with chronic

liver disease, heart failure, and diabetes mellitus. The strongest associations were observed for chronic kidney disease and gastrointestinal bleeding. Gastrointestinal bleeding can cause iron depletion through overt or occult blood loss, whereas chronic kidney disease contributes to anemia through inadequate erythropoietin production, impaired iron availability, inflammation, and reduced erythropoietic response [17,18]. Anemia is also common in heart failure through interacting mechanisms involving iron deficiency, renal dysfunction, inflammation, and chronic disease burden [19]. Zaninetti et al. similarly identified chronic renal failure and chronic liver disease as important conditions associated with anemia among internal medicine inpatients [11]. These findings emphasize evaluation of anemia within the broader clinical context. However, the associations should not be interpreted as causal because the study design does not establish temporality. Comparison of anemic and non-anemic participants demonstrated clinically meaningful differences. Patients with anemia were older and had a slightly lower BMI. As expected, hemoglobin, RBC count, and MCV were significantly lower among anemic participants, whereas RDW was higher, indicating greater variation in red-cell size and supporting heterogeneous erythropoietic abnormalities [14]. This profile is compatible with multifactorial anemia, in which nutritional deficiency, inflammation, renal dysfunction, and blood loss may coexist. Importantly, mean hospital stay was significantly longer among anemic patients than among those without anemia (7.4 ± 3.8 vs. 5.6 ± 2.7 days; $p<0.001$). This finding is consistent with evidence linking anemia with prolonged hospitalization among internal medicine patients [11,20]. Krishnasivam et al. similarly reported an association between anemia and increased length of hospital stay [20]. The longer hospitalization may reflect greater disease complexity and comorbidity among anemic patients. Thus, anemia may serve as a marker of disease burden and healthcare utilization. Nevertheless, hospitalization duration is influenced by multiple factors, so the observed association should not be interpreted as evidence that anemia independently causes prolonged hospitalization.

LIMITATIONS

This study had several limitations. The single-center, hospital-based design and relatively small sample size may limit the generalizability of findings to other populations and healthcare settings. Potential determinants of anemia, including iron status, vitamin B12, folate, dietary intake, inflammatory markers, and socioeconomic factors, were not comprehensively assessed. Furthermore, the cross-sectional design precluded evaluation of temporal or causal relationships between anemia, associated comorbidities, and hospitalization duration.

CONCLUSION & RECOMMENDATIONS

Anemia was prevalent among patients attending the internal medicine service, with moderate and microcytic hypochromic patterns predominating. Older age, female sex, rural residence, chronic kidney disease, gastrointestinal bleeding, diabetes mellitus, chronic liver disease, and heart failure were significantly associated with anemia. Anemia was associated with altered hematological parameters and prolonged hospital stay. Routine screening and morphological assessment should be integrated into internal medicine practice, followed by targeted evaluation for nutritional deficiencies, blood loss, renal dysfunction, and chronic disease. Multicenter longitudinal studies with nutritional, biochemical, and clinical assessments are recommended to

clarify etiological determinants and their effects on patient outcomes.

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CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

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