



Original Research Article

ANEMIA IN ADULT MALE PATIENTS: A COMPREHENSIVE STUDY OF CLINICAL FEATURES, LABORATORY PARAMETERS, AND ETIOLOGICAL PATTERNS

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ABSTRACT

Background: Anemia in adult males is an important yet often underdiagnosed clinical condition that may indicate underlying nutritional deficiencies, chronic diseases, or occult blood loss. Unlike women and children, anemia in males is less frequently screened, leading to delayed diagnosis and increased morbidity. Understanding the clinical presentation, laboratory characteristics, and etiological patterns of anemia in adult males is essential for timely diagnosis and targeted management. **Aim:** To evaluate the clinical presentation and laboratory profile of anemia in adult male patients and to identify common etiological and morphological patterns.

Materials and Methods: This hospital-based observational cross-sectional study was conducted in the Department of General Medicine at a tertiary care hospital in Ahmedabad over a period of two years (January 2023 to January 2025). A total of 108 adult male patients aged ≥ 18 years with hemoglobin levels < 13 g/dL were included. Comprehensive laboratory tests, including complete blood counts, peripheral smears, iron studies, vitamin B12 and folate levels, inflammatory indicators, and pertinent imaging, were carried out in addition to a thorough clinical examination, socioeconomic assessment, and lifestyle evaluation. Anaemia was categorised according to its aetiology, morphology, and severity. Descriptive and inferential statistical techniques were used, and a p-value of less than 0.05 was deemed significant.

Results: The mean age of patients was 54.8 ± 17.36 years, with the highest prevalence in the 51–70-year age group. Moderate anemia (52.78%) was most common, followed by severe anemia (41.67%). Nutritional anemia was the predominant etiology (75%), with iron deficiency being the most frequent cause (49.07%). Normocytic normochromic and microcytic hypochromic anemia were the most common morphological patterns (38% each). Significant associations were observed between anemia severity and socioeconomic status, inflammatory markers, gastrointestinal blood loss, and addiction history.

Conclusion: Anemia in adult males is predominantly nutritional and multifactorial, commonly presenting at moderate to severe stages. Early detection, etiological evaluation, and addressing nutritional, inflammatory, and lifestyle factors are essential to reduce disease burden.

Keywords: Anemia; Adult males; Iron deficiency anemia; Morphological classification; Etiological profile; Nutritional anemia.

INTRODUCTION

Anemia is a major global public health problem with significant implications for morbidity, mortality, and quality of life. It is characterized by a reduced oxygen-carrying capacity of blood, most commonly due to a decrease in hemoglobin concentration or red blood cell mass.^[1] Growing data indicates that anaemia among adult males is still underdiagnosed, underreported, and improperly treated, despite the fact that anaemia has historically been thought to primarily afflict women and children, especially in poorer nations like India. Increased hospitalisation rates, less productivity at work, and deteriorating outcomes for those with underlying chronic diseases are all consequences of this neglect. Among the major etiological causes are infections, chronic illnesses, dietary inadequacies, and iron deficiency, which is the most prevalent cause globally.^[2]

Few research particularly address anaemia in the adult male population, despite the large number of studies concentrating on anaemia in children and women of reproductive age. A thorough assessment of anaemia in adult males is crucial in the Indian setting, where healthcare access, dietary knowledge, and socioeconomic inequities continue to exist. According to national surveys, anaemia in Indian males is often underdiagnosed, which results in a delayed diagnosis and inadequate treatment. Adult males who suffer from anaemia have reduced functional ability, are more vulnerable to metabolic and cardiovascular problems, and have a substantial population-level illness burden.^[3] For an accurate diagnosis and focused treatment, a thorough grasp of the clinical characteristics, laboratory measurements, and etiological patterns of anaemia is therefore essential.^[2]

Anemia is functionally defined as an insufficient red blood cell mass to meet tissue oxygen demands. According to the World Health Organization (WHO), anemia in adult males is defined as a hemoglobin concentration below 13 g/dL at sea level. Erythropoiesis is a tightly regulated process involving the differentiation of erythroid progenitor cells in the bone marrow, ultimately producing mature red blood cells. Erythropoietin (EPO), primarily synthesized by peritubular cells of the kidney, plays a central role in regulating red cell production in response to tissue oxygenation.^[1] Under hypoxic conditions, hypoxia-inducible factor-1 α (HIF-1 α) stimulates EPO gene expression, resulting in increased erythropoiesis.^[2]

Since haemoglobin offers a more precise indicator of oxygen-carrying ability than haematocrit, haemoglobin concentration is the primary metric used to assess anaemia. Adult boys typically have haemoglobin levels between 13.5 and 17.5 g/dL. Diagnostic accuracy is enhanced by comparison with prior haemoglobin levels, particularly in chronic diseases.^[4] Anaemia results from a disturbance of the balance between production and

destruction, which is reflected in red cell mass.^[2] When haemoglobin drops below around 10–12 g/dL, EPO levels rise exponentially in response to anaemia, prompting marrow erythroid precursors to enhance red cell synthesis as long as sufficient nutrients such iron, vitamin B12, and folate are available.^[4]

Approximately 25% of people worldwide suffer from anaemia, with developing nations accounting for 89% of cases. According to WHO standards, anaemia affects around 12.7% of males globally, while prevalence is higher among women.^[5] Despite being under-represented in international health databases, anaemia in males is linked to decreased productivity, an increased risk of diabetes, cardiovascular disease, and chronic renal disease. Only the National Family Health Survey (NFHS-3) provided national-level data on male anaemia in India. Anaemia is becoming more common among adult males and teenage boys, according to later surveys like NFHS-4 and NFHS-5.^[6]

According to NFHS-5 statistics, anaemia affects around 25% of males in India between the ages of 15 and 49. It is more common in rural regions, among those with less education, and among people from lower socioeconomic classes.^[7] There are several states with exceptionally high incidence rates among men, such as Ladakh, Jammu and Kashmir, and West Bengal. These results demonstrate that anaemia is a serious but little-known public health issue among adult males in India.

Male adult anaemia has a complex aetiology. Important contributions include bone marrow abnormalities, cancer, gastrointestinal blood loss, chronic renal disease, liver disease, and ageing. Older males have also been linked to hormonal issues, such as reduced testosterone levels.^[7] Alcohol use, diabetes, hypertension, low body mass index, and nutritional inadequacies all increase the risk. Sociodemographic factors, such as occupation, income, education, and living in a rural area, are important because they affect food consumption, access to healthcare, and infection exposure.^[8]

Clinically, anaemia may not show any symptoms until haemoglobin levels considerably decline. Fatigue, pallor, palpitations, dizziness, dyspnoea during effort, and decreased exercise tolerance are among the symptoms that are present. Severe anaemia can cause neurological symptoms, systemic problems, and cardiovascular strain, especially in those who already have cardiopulmonary illness.^[9] Accurate categorisation and etiological diagnosis depend on laboratory assessment, which includes complete blood count, peripheral blood smear, reticulocyte count, iron tests, and bone marrow examination when necessary.^[10]

Given the rising prevalence of anemia among adult males and the paucity of focused studies in this population, the present study aims to comprehensively evaluate the clinical features, laboratory parameters, and etiological patterns of

anemia in adult male patients. Understanding these aspects in relation to demographic factors, comorbidities, and addiction patterns is crucial for early diagnosis, appropriate management, and formulation of effective public health strategies.

Aims and Objectives

Aim

To evaluate the clinical and laboratory profile of anemia in adult male patients and identify common etiological patterns.

Objectives

1. To assess the severity of anemia across different age groups.
2. To study the clinical features and laboratory parameters of anemia.
3. To classify anemia based on morphological and etiological types.
4. To identify common causes of anemia in adult males.
5. To correlate anemia type and severity with clinical, socioeconomic, and lifestyle factors.

MATERIALS AND METHODS

Study Design: This was a hospital-based observational, cross-sectional study conducted to evaluate the clinical and laboratory profile of anemia in adult male patients.

Study Location: The study was conducted in the Department of General Medicine at a tertiary care hospital, Ahmedabad.

Study Period: The study was carried out over a period of two years, from January 2023 to January 2025.

Sample Size: A total of 108 adult male patients diagnosed with anemia were included in the study.

Study Population: Adult male patients admitted to or attending the Department of General Medicine during the study period and fulfilling the inclusion criteria were enrolled after obtaining informed consent.

Inclusion Criteria

1. Male patients
2. Age more than 18 years
3. Hemoglobin levels less than 13 g/dL, as per the latest World Health Organization (WHO) criteria for anemia in adult males

Exclusion Criteria

1. Patients who had received a blood transfusion within the preceding **four weeks**
2. Patients who refused to participate in the study

Data Collection

Detailed clinical history was obtained from all patients, including presenting symptoms, duration of illness, dietary habits, socioeconomic status, occupational profile, and addiction history such as smoking, alcohol consumption, tobacco use, or other substance use. A thorough physical examination was performed, focusing on general examination and systemic findings relevant to anemia.

Laboratory investigations included complete blood count, red cell indices, peripheral blood smear examination, reticulocyte count, and relevant biochemical tests such as serum iron, total iron-binding capacity, serum ferritin, and vitamin B12 levels, wherever indicated. Based on clinical and laboratory findings, anemia was classified according to morphological and etiological patterns.

Statistical Analysis

All collected data were compiled using **Microsoft Excel** and analyzed using **Stastity**, an online statistical analysis platform that utilizes standard statistical algorithms comparable to those used in **SPSS** and **GraphPad Prism**.

Descriptive statistics were used to summarize the data.

- Continuous variables (such as age, hemoglobin, mean corpuscular volume [MCV], mean corpuscular hemoglobin [MCH], serum iron, and vitamin B12 levels) were expressed as mean \pm standard deviation (SD).
- Categorical variables (such as severity of anemia, type of anemia, and presence of comorbidities) were expressed as frequencies and percentages.

Inferential statistical methods included:

- Independent samples t-test to compare mean values between two groups
- Chi-square test or Fisher's exact test, where appropriate, to assess associations between categorical variables
- Pearson's correlation coefficient to evaluate the strength of association between two continuous variables

A p-value < 0.05 was considered statistically significant for all analyses.

RESULTS

Total 108 patients were enrolled in the study as per the selection criteria. Mean \pm SD age in years for the study patients was 54.8 ± 17.36 years. Majority of the patients i.e. 48 (44.44 %) belong to 51- 70 years age group, followed by 30 (27.78%) belonging to 31-50 years age group. [Table & figure 1]

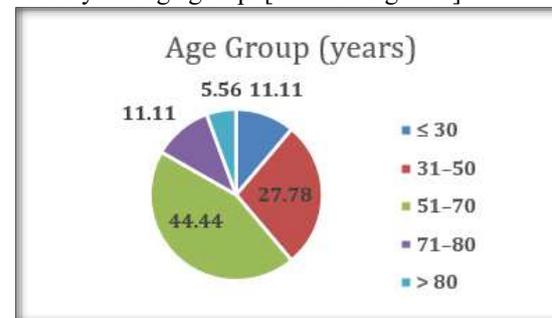


Figure 1: Age group distribution in the study patients (%) (n=108)

Table 2 depicts the distribution of anemia severity among the 108 study participants based on their hemoglobin levels. The majority of patients were

found to have moderate anemia, with hemoglobin levels ranging from 7–9.9 g/dL, accounting for 57 patients (52.78%). This was followed by a substantial proportion of patients with severe anemia (hemoglobin <7 g/dL), observed in 45 patients (41.67%), indicating a high burden of clinically significant anemia in the study population. In contrast, mild anemia (hemoglobin 10–12.9 g/dL) was relatively uncommon, affecting only 6 patients (5.56%). Overall, the table highlights that more than nine-tenths of the study participants presented with moderate to severe anemia, underscoring the need for early detection and appropriate management strategies.

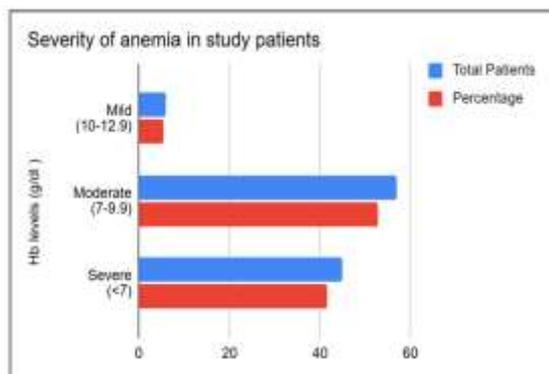


Figure 2: Severity of anemia in the study patients

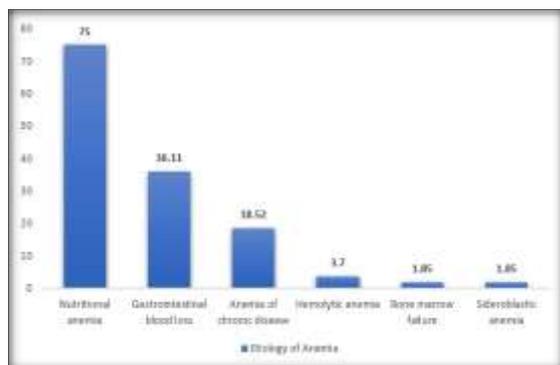


Figure 3: Etiological Classification of Anemia in Study Patients

Anemia was classified based on etiology as shown in Table 3. Nutritional anemia was the most common cause, seen in 76 (70%) patients, followed by gastrointestinal blood loss in 39 (35%) and anemia of chronic disease in 20 (19%). Less common causes included hemolysis, bone marrow failure, and sideroblastic anemia. Of the four patients with hemolytic anemia, two had extrinsic causes (malaria) and two had intrinsic causes—G6PD deficiency and autoimmune hemolytic anemia, the latter with a positive Coombs test. Among the two patients with bone marrow disorders, one had aplastic anemia and the other

myelodysplastic syndrome. Bone marrow biopsy was performed in six patients.

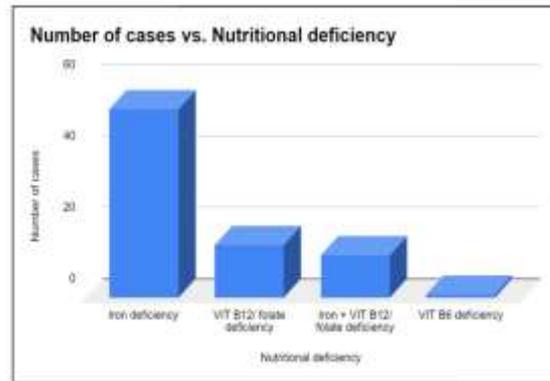


Figure 4: Types of nutritional deficiencies in the study patients (%) (n=108)

Amongst the patients suffering from nutritional anemia, 53 (49.07, n=108) patients suffered from iron deficiency, 15 (13.89%) patients suffered from vitamin B12/ folic acid deficiency, 12 (11.11%) patients suffered from combine iron+ vitamin B12 & folic acid deficiency, and one patient suffered from vitamin B6 deficiency. Vitamin B6 deficiency can cause sideroblastic anemia by impairing heme synthesis due to its role as a cofactor for ALA synthase (which is first and rate limiting enzyme in heme synthesis). [Table 4 & figure 4]

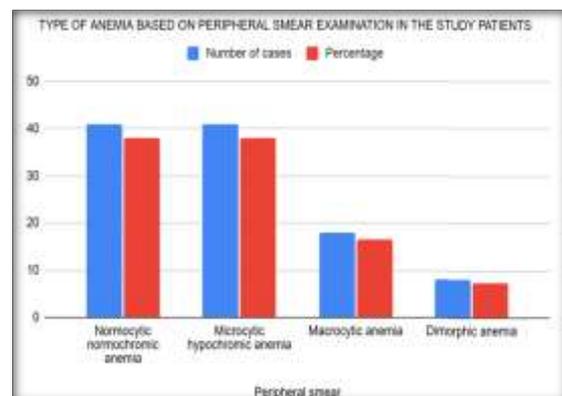


Figure 5: Type of anemia based on peripheral smear examination in the study patients (n=108)

Peripheral smear examination revealed that microcytic hypochromic and normocytic normochromic anemia were the most common morphological patterns, each observed in 41 patients (38%). Macrocytic anemia was seen in 18 patients (17%), while dimorphic anemia was noted in 8 patients (7%). The predominance of microcytic and normocytic patterns likely reflects the high prevalence of nutritional deficiencies and chronic disease-related anemia in the study population. [Table 5 and Figure 5]

Table 1: Age Group Distribution of Study Patients (n = 108)

Age Group (years)	Number of Patients	Percentage (%)
≤ 30	12	11.11
31–50	30	27.78
51–70	48	44.44
71–80	12	11.11
> 80	6	5.56
Total	108	100

Table 2: Severity of Anemia Among Study Patients (n = 108)

Severity of Anemia	Hemoglobin Level (g/dL)	Number of Patients	Percentage (%)
Mild	10–12.9	6	5.56
Moderate	7–9.9	57	52.78
Severe	< 7	45	41.67
Total	—	108	100

Table 3: Etiological Classification of Anemia in Study Patients (n = 108)

Etiology of Anemia	Number of Patients	Percentage (%)
Nutritional anemia	81	75.00
Gastrointestinal blood loss	39	36.11
Anemia of chronic disease	20	18.52
Hemolytic anemia	4	3.70
Bone marrow failure	2	1.85
Sideroblastic anemia	2	1.85

Table 4: Types of Nutritional Deficiencies Among Study Patients (n = 108)

Type of Nutritional Deficiency	Number of Patients	Percentage (%)
Iron deficiency	53	49.07
Vitamin B12 / Folate deficiency	15	13.89
Combined iron + Vitamin B12/Folate deficiency	12	11.11
Vitamin B6 deficiency	1	0.93

Table 5: Type of anemia based on peripheral smear examination in the study patients (n=108)

Peripheral smear	Number of cases	Percentage
Normocytic normochromic anemia	41	38
Microcytic hypochromic anemia	41	38
Macrocytic anemia	18	16.6
Dimorphic anemia	8	7.4

Table 6: Association Between Clinical Variables and Anemia Classifications (Chi-Square Test)

Variable Compared	Chi-square (χ^2 , df)	p-value	Significance	Interpretation
Comorbidities / Past History vs. Morphological Classification of anemia	$\chi^2(114) = 132.59$	0.113	Not Significant	No significant association; likely due to heterogeneous comorbidity distribution.
Stool for Occult Blood vs. Etiological Classification Of anemia	$\chi^2(10) = 64.3$	< 0.001	Significant	Strong association; GI blood loss is a key factor, especially in iron deficiency.

A Chi-square test was used to assess the relationship between clinical variables and anemia classifications. [Table 6]

- There was no statistically significant association between comorbidities/past history and the morphological classification of anemia ($\chi^2(114) = 132.59$, $p = 0.113$). However, the effect size (Cramér's $V = 0.64$) indicated a moderate, non-significant relationship, potentially due to the heterogeneous

distribution of comorbidities among anemia types.

- In contrast, a significant association was found between stool for occult blood and the etiological classification of anemia ($\chi^2(10) = 64.3$, $p < 0.001$, Cramér's $V = 0.77$), suggesting that gastrointestinal blood loss is a major contributor, particularly in iron deficiency anemia.

Table 7: Clinical Signs Observed in Male Anemic Patients (n=108)

Clinical signs	Number of cases	Percentage of cases
Pallor	105	97.22
Brittle nail or nail changes	64	59.26
Hair loss	61	56.48
Edema	28	25.93
Knuckle pigmentation	23	21.3
Icterus	21	19.44
Lymphadenopathy	14	12.96
Bald tongue	11	10.19
Blue sclera	3	2.78
Cyanosis	2	1.85

Pallor was the most prevalent clinical sign (97.22%), followed by nail and hair changes (59.26% and 56.48% respectively), edema (25.93%), and knuckle pigmentation (21.3%). Other signs like icterus, bald tongue, and lymphadenopathy were seen less frequently. These findings highlight the systemic effects of anemia—particularly iron deficiency and nutritional causes—which manifest through skin, mucosal, and hematologic changes in male patients. [Table 7]

DISCUSSION

Anemia in adult males is an under-recognized yet clinically significant condition, often reflecting underlying nutritional deficiencies, chronic diseases, or occult blood loss. The current study highlights the complex character of anaemia and its correlation with socioeconomic, dietary, and inflammatory variables by offering a thorough assessment of the clinical, haematological, morphological, and etiological patterns of anaemia among adult male patients. The average age of the patients in this research was 54.8 ± 17.36 years, and the age group of 51–70 years had the highest frequency (44.44%). This result is in line with research by Jain A et al., which also found that older males had a larger anaemia load.^[11] Growing older is frequently linked to diminished haematopoietic reserve, chronic comorbidities, and dietary deficiencies, all of which raise the incidence of anaemia. The age-related susceptibility found in this study was further supported by Didzun O et al.'s comparable demonstration of an increased incidence of anaemia with increasing age.^[12] The most prevalent group in terms of severity was moderate anaemia (52.78%), which was followed by severe anaemia (41.67%). These results closely resemble those of Kaur N et al., who found that 45.61% of patients had severe anaemia.^[13] The very low percentage of mild anaemia (5.56%) indicates a lack of early diagnosis and delayed healthcare-seeking behaviour, particularly in males who frequently ignore minor symptoms until anaemia becomes severe.

Iron deficiency was the most prevalent nutritional shortfall (49.07%), with nutritional anaemia emerging as the most common cause (75%). This result is in line with international and Indian research that has identified iron deficiency as a

major cause of anaemia, such as NHANES III and studies by Suprapti E et al. and Saxena V et al.^[14,7] The percentage of iron deficiency anaemia in the current research, however, was significantly greater than that found in Western populations, highlighting regional dietary deficiencies, financial limitations, and a higher incidence of chronic blood loss.

36.11% of patients had gastrointestinal blood loss; haemorrhoids were the most frequent cause, followed by upper gastrointestinal bleeding. This conclusion is consistent with research by Stein J et al., who found that iron deficiency anaemia is significantly influenced by chronic GI blood loss.^[15] On the other hand, research by Cotter J et al. revealed a greater frequency of upper GI or malignancy-related lesions.^[16] The current study's preponderance of haemorrhoids may be a result of regional variations in referral procedures and illness trends.

Morphologically, microcytic hypochromic anaemia and normocytic normochromic anaemia were equally common (38% each). While many studies continue to identify microcytic anaemia as the most prevalent pattern, Krishnamurthy S et al. have observed similar distributions.^[17] Because most patients had increased CRP and ESR values, the study's equal incidence of normocytic anaemia probably reflects the significant burden of anaemia associated with chronic illness.

16.6% of patients had macrocytic anaemia, which was mostly linked to severe anaemia. This result is in line with the findings of Suprapti E et al. and Mann S et al., who also documented macrocytic anaemia in a lesser but clinically relevant percentage of patients,^[14,18] and the presence of vitamin B12 and folate insufficiency in 13.89% of patients. The diagnosis of megaloblastic anaemia in this subgroup is further supported by the presence of hypersegmented neutrophils and macroovalocytes. The majority of moderate and severe cases were found in the lower middle and upper lower classes, indicating a robust correlation between socioeconomic level and anaemia severity. Jain A et al. have identified similar socioeconomic gradients, highlighting the significance of poverty, inadequate nutrition, and restricted access to healthcare in the development of anaemia.^[11] A large percentage of underweight patients (26.85%) indicate chronic nutritional deprivation, notwithstanding the lack of a statistically significant correlation between BMI

and haemoglobin levels. The majority of patients had high levels of inflammatory markers including CRP and ESR, which supports the significance of chronic inflammation in the pathophysiology of anaemia, especially anaemia of chronic illness. Gastrointestinal blood loss is a major cause of anaemia in adult males, as evidenced by the strong correlation between stool occult blood positive and etiological categorisation.

High rates of alcohol intake (34.26%) and tobacco use (72.22%) were seen in addiction patterns; these results are consistent with research by Suprapti E et al. and Saxena V et al.^[14-7] Alcohol and tobacco are believed to worsen the severity of anaemia by increasing gastrointestinal blood loss, promoting chronic inflammation, and impairing nutritional absorption. Overall, the results of this study show that adult male anaemia is mostly nutritional and complex, with major contributions from inflammation, chronic blood loss, socioeconomic disadvantage, and lifestyle variables. To lessen the burden of anaemia in this group, early identification, focused etiological assessment, and all-encompassing therapeutic techniques targeting dietary, inflammatory, and socioeconomic factors are crucial.

CONCLUSION

This study offers a thorough assessment of anaemia in adult male patients, emphasising its great clinical and laboratory variability as well as its complex aetiology. The majority of patients presented with moderate to severe anaemia, indicating delayed healthcare-seeking behaviour, and anaemia was most common in middle-aged and older males. The most frequent cause was found to be nutritional anaemia, especially iron deficiency, which was followed by anaemia from chronic illness and gastrointestinal blood loss. The most common morphological forms were normocytic normochromic and microcytic hypochromic anaemia, which reflected the combined effects of occult blood loss, chronic inflammation, and nutritional inadequacies.

The study shows significant correlations between the degree of anaemia and inflammatory markers, food patterns, addiction history, and socioeconomic position. A significant percentage of patients have elevated CRP and ESR readings, which highlight the part chronic inflammation plays in the pathophysiology of anaemia. Evaluation of the digestive system was crucial since many patients experienced occult or overt blood loss, with haemorrhoids being the most common cause. Furthermore, lifestyle issues including alcohol and tobacco use were quite common and probably contributed to the development of the illness and nutritional deficits. Overall, the results highlight that anaemia in adult males is frequently avoidable and curable with early identification, focused etiological

assessment, and all-encompassing care that takes into account socioeconomic, inflammatory, and dietary factors.

Limitations of the study

There are several restrictions on this study. The results may not be entirely applicable to a larger community because the study was conducted at a single hospital. Establishing causal links between risk factors and anaemia is limited by the cross-sectional approach. While sufficient for descriptive analysis, the sample size was insufficient for in-depth subgroup comparisons. Due to logistical and budgetary limitations, several specialised examinations were also not consistently available for every patient. There was no longitudinal follow-up to evaluate therapy response and results, which may have given more information on the course of the illness and the efficacy of treatments.

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