

Assessing the Burden of Anemia in Non-Communicable Diseases at a Tertiary Care Center: A Cross-Sectional Study

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Abstract:

Background: Anemia is a prevalent global health issue, significantly affecting patients with non-communicable diseases (NCDs) like Type 2 Diabetes Mellitus (Type 2 DM), Hypertension (HTN), and Coronary Artery Disease (CAD). This study assessed the burden of anemia in patients with Type 2 DM, HTN, and CAD, and to identify its prevalence, types, and association with these chronic diseases.

Methods: A cross-sectional study was carried out, involving 250 patients diagnosed with Type 2 DM, HTN, and CAD. Patients were categorized as anemic based on WHO criteria: males with Hb < 13 gm% and females with Hb < 12 gm%. Data were collected through a structured questionnaire. Laboratory investigations included Hb, serum creatinine, MCV, MCHC, and reticulocyte count. Statistical analysis was accomplished using chi-square tests and logistic regression to examine associations between anemia and NCDs.

Results: Anemia was prevalent in 80% of the study population, with normocytic anemia being the most common type (45%). Significant correlations were found between anemia and Type 2 DM (p=0.036), HTN (p=0.032), and CAD (p=0.013). Anemic patients had significantly lower Hb levels and MCHC, and higher serum creatinine and reticulocyte counts compared to non-anemic patients.

Conclusion: The study highlights a high prevalence of anemia among patients with NCDs, indicating a critical need for routine screening and integrated management of anemia in this population. Addressing anemia could improve clinical outcomes and enhance the quality of life for individuals with chronic diseases.

Recommendations: Healthcare providers should implement regular anemia screening for patients with NCDs and adopt integrated care approaches that address both chronic diseases and anemia. Further research is needed to explore the underlying mechanisms linking anemia and NCDs and to develop targeted interventions.

Keywords: Anemia, Non-Communicable Diseases, Type 2 Diabetes Mellitus, Hypertension, Coronary Artery Disease..

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Introduction

Anaemia is a major health issue that has a considerable impact on a large number of people globally, impacting roughly 1.62 billion individuals. It is particularly prevalent among patients with non-communicable diseases (NCDs) such as Type 2 Diabetes Mellitus (Type 2 DM), Hypertension (HTN), and Coronary Artery Disease (CAD) [1]. Anaemia is a condition marked by a reduction in the quantity of red blood cells or the concentration of haemoglobin. This results in a diminished supply of oxygen to tissues and organs, which in turn has a negative impact on general health and quality of life. Anaemia poses a significant challenge in low- and middle-income countries with inadequate healthcare resources and increasing prevalence of chronic diseases.

The interplay between anemia and NCDs is complex and multifaceted. In patients with Type 2 DM, chronic hyperglycemia leads to increased oxidative stress and inflammation, which in turn can impair erythropoiesis and lead to anemia [2]. Moreover, diabetic nephropathy, a common complication of diabetes, further exacerbates anemia by reducing the kidney's ability to produce erythropoietin, a hormone crucial for red blood cell production. Similarly, hypertension, often coexisting with diabetes, contributes to anemia through mechanisms such as chronic kidney disease and the use of antihypertensive medications that may interfere with erythropoiesis [3].

CAD is another NCD closely linked with anemia. Patients with CAD often experience chronic inflammation and oxidative stress, which can suppress bone marrow function and reduce red blood cell production. Additionally, anemia in CAD patients is associated with worse clinical outcomes, including higher rates of hospitalization and mortality, highlighting the critical need for early detection and management [4].

Although the connection between anaemia and non-communicable diseases (NCDs) is well-established, the extent and consequences of anaemia in patients with these long-term disorders have not been thoroughly investigated in many contexts, including tertiary care centres in low- and middle-income countries. It is essential to address this deficiency because promptly identifying and treating anaemia can greatly enhance patient outcomes, decrease healthcare expenses, and improve quality of life.

The study aimed to assess the burden of anemia in patients with non-communicable diseases (NCDs).

Methodology

Study Design

A cross-sectional observational study design.

Study Setting

The study took place at Jawahar Lal Nehru Medical College & Hospital, Bhagalpur, Bihar from October 2023 to March 2024.

Participants

A total of 250 patients were involved in the study. Out of these, 200 patients were selected and categorized as anemic based on the WHO criteria: Males with Hb < 13 gm% and Females with Hb < 12 gm%.

Inclusion Criteria

- Patients aged >30 years.
- All cases of with Type 2 DM, HTN, and CAD were comprised in the study..

Exclusion Criteria

- Pregnant women of all ages.
- Patients with acute blood loss.
- on steroid therapy, anti-coagulants, or thrombolytic therapy.
- with chronic kidney disease, chronic liver disease, chronic alcoholic liver disease, and bleeding disorders.

- with acute coronary syndrome, malignancy, hematological disorders, infections, or a history of recent major surgery.

Sample size

To calculate the sample size for this study, the following formula was used for estimating a proportion in a population:

$$n = \frac{Z^2 \times p \times (1-p)}{E^2}$$

Where:

- n = sample size
- Z = Z-score corresponding to the desired level of confidence
- p = estimated proportion in the population
- E = margin of error

Bias

Efforts were made to minimize selection bias by including consecutive patients who met the inclusion criteria. Information bias was reduced by using a standardized data collection procedure and trained personnel.

Variables

Variables included age, gender, occupation, marital status, educational level, duration and onset of NCDs, family history, smoking and alcohol habits, Body Mass Index (BMI), blood pressure, Hb levels, and morphological classification of anemia.

Data Collection

The data was gathered through a meticulously designed questionnaire, which was made available in both English and Hindi to facilitate effective communication. The gathered information encompassed demographic data, pertinent medical history, family history, and lifestyle choices such as smoking and alcohol intake. The BMI was computed using the conventional procedure, which involves dividing the weight in

kilogrammes by the square of the height in metres. The measurement of blood pressure was conducted using a manual sphygmomanometer.

Procedure

Patients were categorized as anemic based on the WHO criteria. Anemia was further classified morphologically as:

- Microcytic (MCV < 80 fL)
- Normocytic (MCV 80-100 fL)
- Macrocytic (MCV > 100 fL)

Patients underwent laboratory and imaging investigations, including serum creatinine, Hb, GBP, MCHC, MCV, reticulocyte count, and ECG.

Statistical Analysis

Information was inputted into a database and examined using statistical tools. Demographic and clinical characteristics were summarised using descriptive statistics. Mean \pm standard deviation was used to represent continuous variables, while frequencies and percentages were used to represent categorical variables. The relationship between anaemia and non-communicable diseases (NCDs) was evaluated by chi-square testing and logistic regression analysis, with a significance level of $p < 0.05$.

Ethical considerations

The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

Result

The study included a total of 250 patients with non-communicable diseases (NCDs), out of which 200 were found to be anemic based on the WHO criteria. Table 1 provides a concise overview of the demographic and clinical attributes of the participants in the trial.

Table 1: Demographic and Clinical Features

Characteristic	Anemic (n=200)	Non-Anemic (n=50)	Total (= 250)
Mean Age (years)	55.3 ± 12.4	54.1 ± 11.8	55.0 ± 12.3
Gender			
Male	120	30	150
Female	80	20	100
Mean BMI	26.7 ± 4.5	25.9 ± 4.2	26.5 ± 4.5
Smokers (%)	65 (32.5%)	12 (24.0%)	77 (30.8%)
Alcohol Consumers (%)	58 (29.0%)	10 (20.0%)	68 (27.2%)
Duration of NCD (years)	7.8 ± 5.6	7.3 ± 5.1	7.7 ± 5.5

Table 2 shows the prevalence of anemia among the study population, broken down by gender and age groups. Anemia was found in 80% of the patients.

Table 2: Prevalence of Anemia by Gender and Age Group

Age Group (years)	Male (n= 120)	Female (n= 80)	Total (n= 200)
30-39	15 (12.5%)	10 (12.5%)	25 (12.5%)
40-49	30 (25.0%)	20 (25.0%)	50 (25.0%)
50-59	40 (33.3%)	25 (31.3%)	65 (32.5%)
60-69	25 (20.8%)	15 (18.8%)	40 (20.0%)
70+	10 (8.3%)	10 (12.5%)	20 (10.0%)

Anemia was classified morphologically among the anemic patients, as shown in Table 3. Normocytic anemia was the most common type.

Table 3: Morphological Classification of Anemia

Type of Anemia	Frequency (n=200)	Percentage (%)
Microcytic (MCV < 80 fL)	80	40.0
Normocytic (MCV 80-100)	90	45.0
Macrocytic (MCV > 100 fL)	30	15.0

Table 4 presents the association between anemia and various NCDs. Significant associations were found between anemia and Type 2 DM, hypertension, and CAD.

Table 4: Association between Anemia and NCDs

NCD	Anemic	Non-Anemic	Chi-square (χ^2)	p-value
Type 2 DM	130 (65.0%)	25 (50.0%)	4.38	0.036*
Hypertension	150 (75.0%)	30 (60.0%)	4.59	0.032*
CAD	120 (60.0%)	20 (40.0%)	6.13	0.013*

*Significant at $p < 0.05$

Table 5 displays the average values of different laboratory parameters for patients with anaemia and those without anaemia. Notable disparities were noted between the two groups.

Table 5: Laboratory Parameters of Anemic and Non-Anemic Patients

Parameter	Anemic	Non-Anemic	p-value
Hemoglobin (gm%)	10.8 ± 1.2	14.2 ± 0.8	< 0.001*
Serum Creatinine (mg/dL)	1.1 ± 0.3	1.0 ± 0.2	0.042*
MCV (fL)	85.4 ± 12.1	90.2 ± 9.8	0.018*
MCHC (%)	32.5 ± 2.4	34.2 ± 2.1	<0.001*
Reticulocyte Count (%)	1.5 ± 0.6	1.1 ± 0.4	0.033*

*Significant at $p < 0.05$

Discussion

The study examined the burden of anemia among patients with non-communicable diseases. Out of 250 patients diagnosed with Type 2 DM, HTN, and CAD, 200 were found to be anemic based on the WHO criteria. The incidence of anemia was equally high in both males and females (80%). The study highlights a significant burden of anemia among patients with NCDs, which necessitates attention and management in clinical practice.

The demographic analysis revealed that the average age was 55 years, with a slightly higher prevalence of anemia in older age groups. The majority of the anemic patients fell within the 50-59 age group (32.5%). The study also found that lifestyle factors such as smoking and alcohol consumption were prevalent among anemic patients (32.5% and 29.0%, respectively). This suggests that lifestyle modifications could be an essential part of managing anemia in this population.

The morphological classification of anemia showed that normocytic anemia was the most common type (45%), followed by microcytic (40%) and macrocytic anemia (15%). This distribution indicates that the underlying causes of anemia in patients with NCDs may vary, and a comprehensive diagnostic approach is necessary to identify and treat the specific type of anemia effectively.

Statistical analysis demonstrated significant associations between anemia and the three NCDs studied. Anemia was significantly related with Type 2 DM ($p=0.036$), HTN ($p=0.032$), and CAD ($p=0.013$). These associations highlight the interplay between chronic diseases and anemia, suggesting that patients with NCDs are at a higher risk of developing anemia. This calls for routine screening for anemia in patients with NCDs to ensure timely diagnosis and treatment.

Laboratory investigations showed significant differences between anemic and

non-anemic patients in terms of hemoglobin levels, serum creatinine, MCV, MCHC, and reticulocyte count. Anemic patients had lower hemoglobin levels and MCHC, and higher serum creatinine and reticulocyte counts compared to non-anemic patients. These findings indicate that anemia in patients with NCDs is associated with impaired renal function and altered red blood cell indices, which could be indicative of the chronic nature of these diseases and their impact on overall health.

Overall, the study underscores the high prevalence and significant burden of anemia among patients with NCDs. The findings highlight the need for integrated management approaches that include routine screening and treatment of anemia as part of the overall care for patients with chronic diseases. Addressing anemia in this population could improve clinical outcomes and enhance the quality of life for these patients.

A study found that the incidence of anemia among diabetes mellitus (DM) patients was significantly high, with 42.9% of DM patients affected. The study highlighted the association between anemia and poor glycemic control, underscoring the need for regular hematological assessments in DM management [6]. Research revealed that anemia remains a significant complication in individuals with inflammatory bowel disease (IBD). The prevalence of moderate to severe anemia was higher in Crohn's disease (CD) patients (15.4%) compared to ulcerative colitis (UC) patients (8.5%). Anemia was associated with disease activity and severity, and the study emphasized the need for targeted management of anemia in IBD patients [7].

A study reported that anemia affects 29.9% of HIV-positive adults on highly active antiretroviral therapy (HAART). Factors significantly associated with anemia included female sex, tuberculosis co-infection, advanced WHO clinical stage, and low body mass index (BMI). The study called for early preventive interventions

and regular monitoring to manage anemia in this population [8]. In a study conducted in Southern Nigeria, the burden of anemia was assessed among children with chronic illnesses. Sickle cell anemia and HIV were the most common conditions associated with anemia. The study highlighted significant physical, emotional, and financial burdens on caregivers, stressing the need for comprehensive support systems [9].

An investigation into pre-operative anemia in arthroplasty patients revealed a prevalence of 15%. Anemic patients had significantly higher risks of transfusions, complications, and prolonged hospital stays. The study recommended preoperative optimization of anemia to improve surgical outcomes [10]. A cross-sectional study examined anemia in hospitalized children, finding a high prevalence, particularly among those aged 6 to 59 months. The study called for better nutritional interventions and iron supplementation programs to combat pediatric anemia [11].

Conclusion

This study reveals a high incidence of anemia among patients with NCDs such as Type 2 DM, HTN, and CAD at a tertiary care center. Significant associations were found between anemia and these NCDs, highlighting the need for routine screening and comprehensive management of anemia in this patient population. Addressing anemia in patients with NCDs could lead to improved health outcomes and enhanced quality of life, emphasizing the importance of integrating anemia management into the standard care protocols for chronic diseases.

Limitations: The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

Recommendation: Healthcare providers should implement regular anemia screening

for patients with NCDs and adopt integrated care approaches that address both chronic diseases and anemia. Further research is needed to explore the underlying mechanisms linking anemia and NCDs and to develop targeted interventions.

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List of abbreviations:

NCDs: Non-Communicable Diseases
 Type 2 DM: Type 2 Diabetes Mellitus
 HTN: Hypertension
 CAD: Coronary Artery Disease
 Hb: Hemoglobin
 WHO: World Health Organization
 MCV: Mean Corpuscular Volume
 MCHC: Mean Corpuscular Hemoglobin Concentration
 BMI: Body Mass Index
 ECG: Electrocardiogram
 CD: Crohn's Disease
 UC: Ulcerative Colitis
 HAART: Highly Active Antiretroviral Therapy
 HIV: Human Immunodeficiency Virus
 IBD: Inflammatory Bowel Disease
 ACD: Anemia of Chronic Disease
 SCD: Sickle Cell Disease
 HbA1c: Glycated Hemoglobin
 PT: Prothrombin Time
 aPTT: Activated Partial Thromboplastin Time

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