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Correlation Between Hemoglobin Levels and Functional Status in Heart Failure Patients

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Abstract

Background: Anemia is a frequent comorbidity in chronic heart failure (HF) and is associated with increased morbidity, rehospitalizations, and mortality. Low hemoglobin levels impair oxygen delivery, exacerbate myocardial dysfunction, and worsen exercise tolerance, leading to poor functional status.

Objectives:

1. To determine the prevalence of anemia among patients with chronic HF.
2. To evaluate the correlation between hemoglobin levels and functional status using the New York Heart Association (NYHA) classification.
3. To assess the impact of anemia on hospitalizations and disease severity.

Methods: A cross-sectional study was conducted in the Department of Medicine between **July 2023 and June 2024**. A total of 120 consecutive patients with clinically and echocardiographically confirmed chronic HF were enrolled. Hemoglobin levels were measured and anemia defined as <13 g/dL in men and <12 g/dL in women (WHO criteria). Functional status was classified according to NYHA grades I–IV. Correlation analysis between hemoglobin and NYHA class was performed using Pearson's coefficient.

Results: Anemia was present in 48.3% (58/120) of HF patients. The mean hemoglobin level was significantly lower in anemic patients (11.2 ± 1.9 g/dL) than in non-anemic patients (13.9 ± 1.4 g/dL, $p < 0.01$). Advanced functional limitation (NYHA III–IV) was more frequent in the anemic group (69% vs. 32% in non-anemic). Hemoglobin levels showed a moderate negative correlation with NYHA class ($r = -0.42$, $p < 0.01$). Hospitalizations in the past year were significantly higher in anemic patients (42% vs. 18%).

Conclusion: Anemia is common in heart failure patients and strongly correlates with worse functional status and higher hospitalization rates. Regular screening and management of anemia should be integrated into HF care to improve outcomes.

Keywords: Heart Failure, Hemoglobin, Anemia, NYHA, Functional Status

1. Introduction

Heart failure (HF) is a global health burden, with rising prevalence due to aging populations, improved survival after myocardial infarction, and lifestyle changes. In India, the prevalence of HF is increasing rapidly, contributing significantly to morbidity and mortality.

Anemia is one of the most important comorbidities in HF, reported in 30–50% of patients. Causes include iron deficiency, renal dysfunction, chronic inflammation, and hemodilution. Low hemoglobin levels decrease oxygen delivery to tissues, worsen exercise capacity, and impair quality of life.

The New York Heart Association (NYHA) functional classification is a validated measure of symptom severity and functional status in HF. Studies worldwide have shown that anemia is associated with worse NYHA class, frequent hospitalizations, and poorer survival. However, there is limited data from tertiary care centers in North India.

This study was therefore conducted **July 2023 – June 2024** to assess the prevalence of anemia in HF patients and its correlation with functional status.

Methods

Study Design:
Cross-sectional observational study.

Study Setting:
Department of Medicine– a tertiary care teaching hospital catering to rural and semi-urban populations.

Study Period:
July 2023 – June 2024.

Sample Size and Sampling:
120 consecutive patients with chronic HF attending outpatient or admitted to medicine wards were included. Consecutive sampling was used.

Inclusion Criteria:

- Age ≥18 years
- Clinically and echocardiographically confirmed diagnosis of chronic heart failure (HFrEF or HFpEF)
- Informed written consent obtained

Exclusion Criteria:

- Acute blood loss, recent transfusion
- Known hematological disorders (aplastic anemia, hemoglobinopathies)

- End-stage renal disease on dialysis
- Malignancy

Data Collection:

- Demographic details: age, sex, residence
- Clinical: duration of HF, comorbidities
- Laboratory: hemoglobin (g/dL), renal function, echocardiographic left ventricular ejection fraction (LVEF)
- Functional status: NYHA class I–IV
- Hospitalizations: ≥1 HF-related admission in past 12 months

Definitions:

- Anemia: Hb <13 g/dL (men), <12 g/dL (women) (WHO criteria)
- Functional class: NYHA I–IV

Statistical Analysis:
Data were entered in Microsoft Excel and analyzed using SPSS v25. Continuous variables were expressed as mean ± SD and compared with Student's t-test. Categorical variables were analyzed with Chi-square. Pearson correlation coefficient was used to assess correlation between Hb and NYHA class. A p-value <0.05 was considered significant.

Ethical Considerations:
The study protocol was approved by the Institutional Ethics Committee, UPUMS, Saifai. Written informed consent was obtained from all participants. Data confidentiality was maintained.

Results

Table 1. Baseline Characteristics (n = 120)

Characteristic	Value
Mean age (years) ± SD	58.6 ± 11.2
Male : Female ratio	74 (62%) : 46 (38%)
Residence (Rural/Urban)	70 (58%) / 50 (42%)
Mean Hb (g/dL)	12.6 ± 2.1
Mean LVEF (%)	38.4 ± 7.9

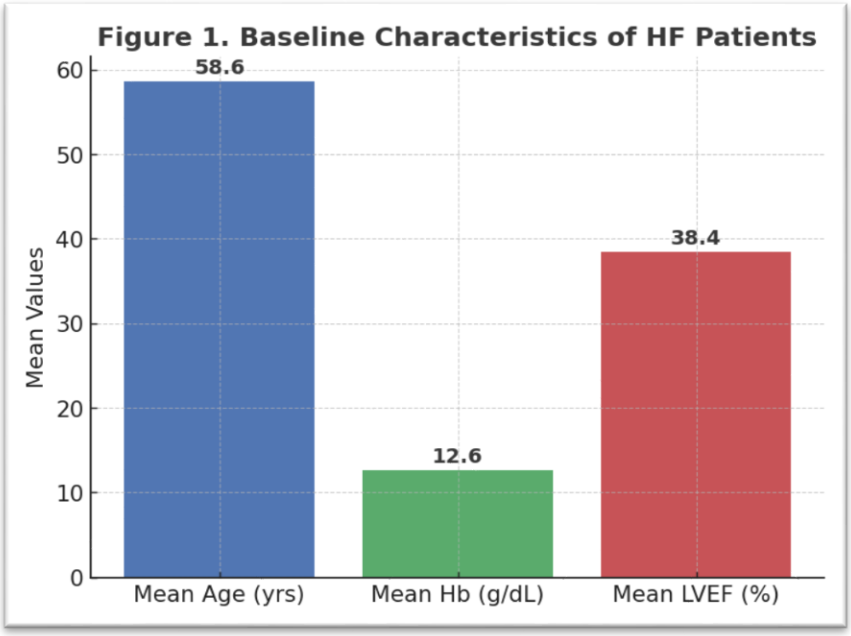


Table 2. Prevalence of Anemia in HF Patients

Group	Patients (%)
Non-anemic	62 (51.7%)
Anemic	58 (48.3%)

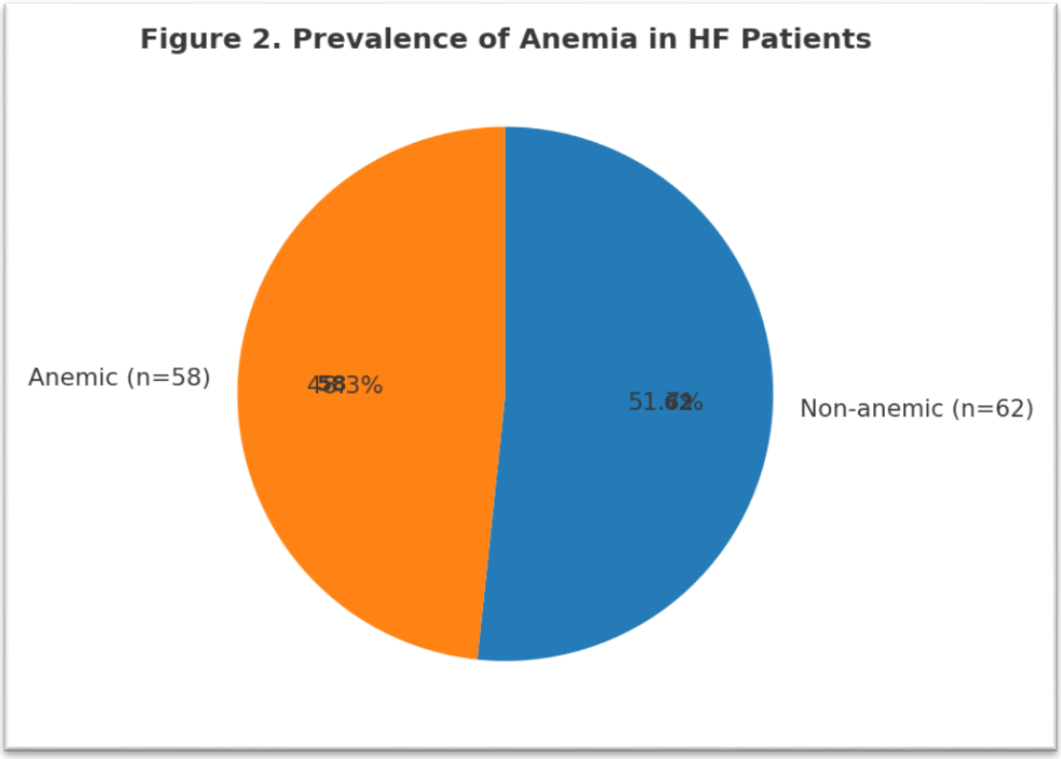


Table 3. Hemoglobin Levels vs NYHA Class

NYHA Class	Mean Hb (g/dL)	Patients with Anemia (%)
I (n=22)	13.9 ± 1.2	14%
II (n=40)	12.8 ± 1.5	38%
III (n=38)	11.3 ± 1.7	63%
IV (n=20)	10.2 ± 1.6	80%

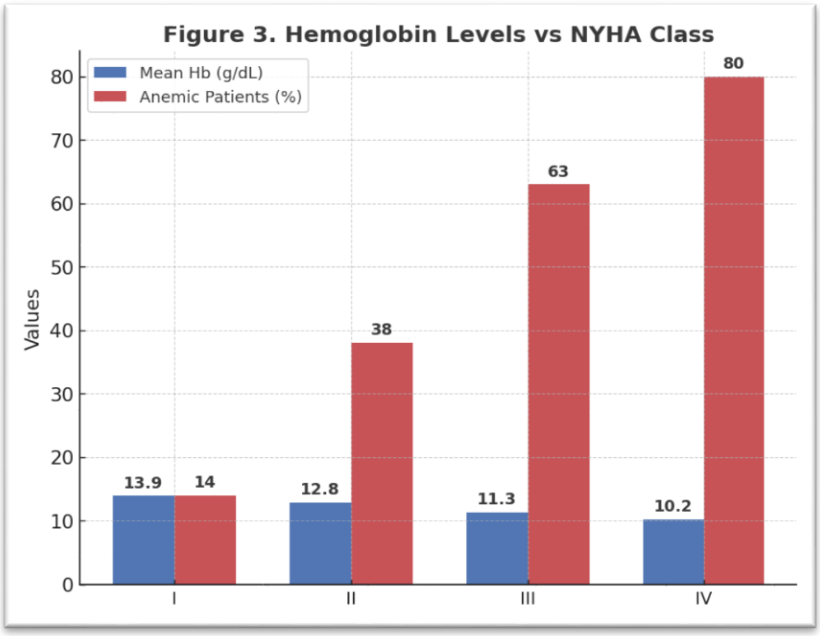
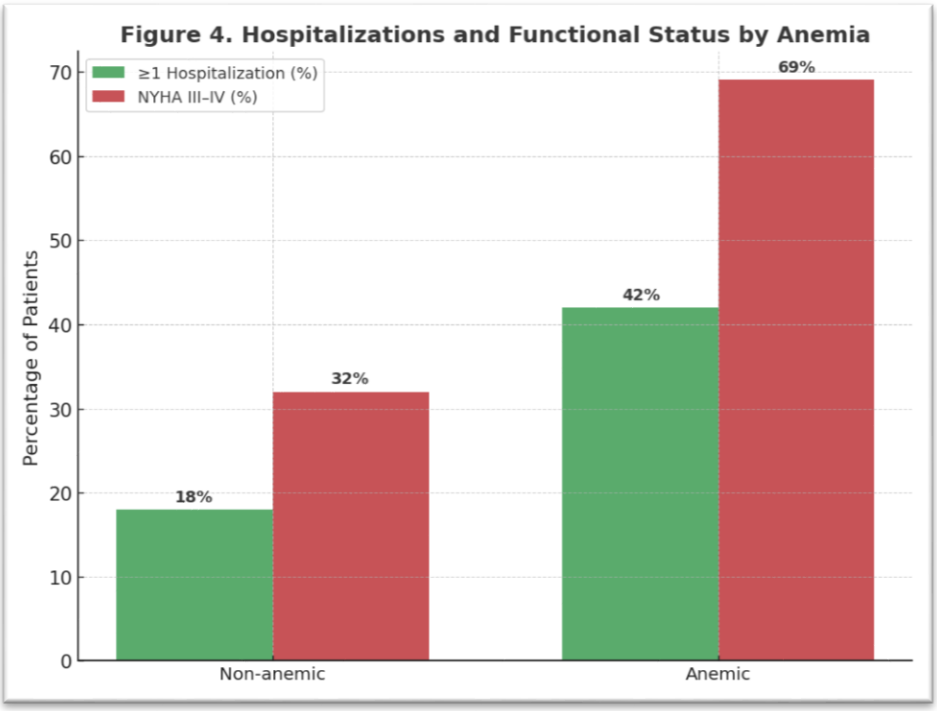


Table 4. Hospitalizations and Functional Status

Variable	Non-anemic (n=62)	Anemic (n=58)
≥1 hospitalization last year	11 (18%)	24 (42%)
NYHA III–IV (%)	32%	69%



Discussion

This study found that nearly half (48.3%) of HF patients at UPUMS, Saifai were anemic. The prevalence is similar to global estimates and Indian studies reporting 30–50%.

Hemoglobin levels correlated inversely with NYHA functional class ($r = –0.42$, $p < 0.01$). Patients with lower Hb had more advanced symptoms (NYHA III–IV). This finding is consistent with Tang et al. and Ezekowitz et al., who demonstrated anemia as an independent predictor of worse exercise tolerance and mortality in HF.

Hospitalizations were significantly higher in anemic patients, supporting the hypothesis that anemia contributes to decompensation and recurrent admissions.

Possible mechanisms:

- Reduced oxygen delivery to myocardium and skeletal muscles
- Activation of neurohormonal pathways (RAAS, sympathetic system)
- Increased cardiac workload and worsening LV dysfunction

Clinical Implications:

- Anemia should be routinely screened in HF patients.
- Treatment options include iron supplementation (oral/IV), erythropoietin analogues, and optimization of HF therapy.

Limitations:

- Single-center, cross-sectional design.
- Did not evaluate iron studies or vitamin B12/folate status.
- Prospective longitudinal studies needed to assess outcomes after anemia correction.

Conclusion

Anemia is highly prevalent in patients with chronic HF and strongly correlates with poor functional status (NYHA III–IV) and increased hospitalizations. Screening and early management of anemia should be integrated into HF care protocols to improve patient outcomes.

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