ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 02 | February - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

"HAEMATOLOGICAL PATTERNS AND PREDICTORS OF SEVERITY OF ANAEMIA IN GERIATRIC PATIENTS: A CROSS-SECTIONAL STUDY"

Pathology

Dr. Pallavi Shivaji Rathod Senior Resident, Department of Pathology, Government Medical College, Jalna.

Dr. Hupesh D. Jadhav Consultant physician, Vighnharta Multi-speciality Hospital, Jalna.

Dr. Aditya Rathod* Junior Resident, Department of Orthopaedics, IGMC Nagpur. *Corresponding Author

ABSTRACT

Background: Anaemia is a common yet underdiagnosed condition in the geriatric population and is associated with increased morbidity, functional impairment, and mortality. In elderly patients, anaemia is often multifactorial, resulting from nutritional deficiencies, chronic inflammatory states, and age-related physiological changes**. The present study aimed to evaluate the haematological patterns of anaemia in geriatric patients and to identify predictors of severe anaemia. Materials & Methods:** This hospital-based cross-sectional study was conducted at a tertiary medical care centre over 18 months and included 200 geriatric patients aged ≥60 years with anaemia defined according to WHO criteria. Clinical and laboratory data including complete blood count, red cell indices, peripheral smear findings, ESR, CRP, serum ferritin, and vitamin B12 levels were analysed. Statistical analysis was performed using SPSS version 26. Categorical variables were analysed using the chi-square test, while continuous variables were compared using one-way ANOVA. Pearson correlation, binary logistic regression, and ROC curve analyses were used to identify predictors of severe anaemia. A p-value <0.05 was considered statistically significant. **Results:** Normocytic normochromic anaemia was the most common morphological pattern, followed by microcytic hypochromic and macrocytic anaemia. Macrocytic anaemia showed a significant association with vitamin B12 deficiency. Red cell distribution width (RDW), ESR, and CRP levels were significantly higher in patients with moderate and severe anaemia. Haemoglobin levels showed a negative correlation with RDW and inflammatory markers. Logistic regression analysis identified elevated RDW, raised CRP levels, and vitamin B12 deficiency as independent predictors of severe anaemia. ROC analysis demonstrated good diagnostic accuracy of RDW in predicting severe anaemia. **Conclusion:** Anaemia in geriatric patients is predominantly multifactorial, with normocytic normochromic anaemia being the most common pattern. RDW and CRP are useful predictors of anaemia severity and may aid in early identification and targeted management.

KEYWORDS

Anaemia; Geriatric patients; Red cell distribution width; C-reactive protein; Vitamin B1

INTRODUCTION

Anaemia is a common haematological disorder in the geriatric population and represents an important public health concern. With increasing life expectancy, the burden of anaemia among older adults has assumed greater clinical significance. Anaemia in the elderly is associated with adverse outcomes such as reduced physical performance, cognitive impairment, increased risk of falls, prolonged hospitalization, cardiovascular morbidity, and higher mortality, and should not be considered a normal consequence of ageing [1,2]. However, it often remains underdiagnosed or inadequately evaluated in routine clinical practice.

The aetiology of anaemia in geriatric patients is complex and multifactorial. Nutritional deficiencies, particularly iron, vitamin B12, and folate deficiency, remain important causes, especially in developing countries. In addition, chronic inflammatory conditions, chronic kidney disease, malignancies, and bone marrow disorders contribute significantly to anaemia in this age group [3,4]. A substantial proportion of elderly patients are diagnosed with anaemia of chronic disease or unexplained anaemia of ageing, further complicating evaluation and management [5].

Morphological classification of anaemia using red cell indices and peripheral blood smear examination serves as a useful initial diagnostic approach. While microcytic and macrocytic anaemia often reflect nutritional deficiencies, normocytic normochromic anaemia-most frequently observed in the elderly-is commonly associated with chronic disease and inflammation [6]. However, morphology alone may not adequately predict severity or clinical outcomes.

Recent evidence suggests that red cell distribution width (RDW) and inflammatory markers such as C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) may serve as useful predictors of anaemia severity. Elevated RDW has been associated with ineffective erythropoiesis and adverse outcomes, including increased mortality, while inflammatory markers reflect the underlying chronic inflammatory milieu [7,8]. Despite their availability, these parameters are not routinely incorporated into severity assessment.

In view of limited data from Indian tertiary care settings, the present study was undertaken to evaluate the haematological patterns of anaemia in geriatric patients and to identify predictors of anaemia severity using red cell indices, biochemical parameters, and inflammatory markers.

MATERIALS AND METHODS

This hospital-based cross-sectional observational study was conducted at a department of pathology, government medical college, Jalna, Maharashtra state, India, during period March 2025 to November 2025. Geriatric patients aged 60 years and above diagnosed with anaemia were enrolled consecutively. Anaemia was defined according to World Health Organization criteria as haemoglobin <13 g/dL in males and <12 g/dL in females. Patients with acute blood loss, recent blood transfusion within the preceding three months, haematological malignancies, known congenital anaemias, or those receiving chemotherapy were excluded from the study. Written informed consent was obtained from all participants prior to enrolment.

The sample size was calculated using the formula $n = Z^2pq/d^2$, where Z = 1.96 corresponding to a 95% confidence interval, p was assumed as 50% due to variable prevalence reported in literature, q = 1 − p, and d was taken as 7% absolute precision. The calculated minimum sample size was 196, which was rounded off to 200 patients. Demographic and clinical details were recorded using a structured proforma.

Laboratory evaluation included complete blood count with red cell indices, namely mean corpuscular volume, mean corpuscular haemoglobin, and red cell distribution width. Peripheral blood smear examination was performed in all patients. Additional investigations included erythrocyte sedimentation rate, C-reactive protein, serum ferritin, and serum vitamin B12 levels. Based on red cell indices and peripheral smear findings, anaemia was morphologically classified as microcytic hypochromic, normocytic normochromic, or macrocytic. Severity of anaemia was graded as mild, moderate, or severe according to WHO criteria.

Data were entered in Microsoft Excel and analysed using SPSS version 26. Categorical variables were expressed as frequencies and percentages and compared using the chi-square test. Continuous variables were expressed as mean ± standard deviation and compared

across anaemia severity groups using one-way analysis of variance. Pearson correlation coefficient was used to assess the relationship between haemoglobin levels and laboratory parameters such as red cell distribution width and inflammatory markers. Binary logistic regression analysis was performed to identify independent predictors of severe anaemia. Receiver operating characteristic curve analysis was used to evaluate the diagnostic accuracy of red cell distribution width and C-reactive protein in predicting severe anaemia. A p-value less than 0.05 was considered statistically significant.

RESULTS

Table 1. Demographic Profile Of The Study Population (n = 200)

Age group (years)	Male	Female	Total n (%)
60–69	50	30	80 (40.0)
70–79	45	25	70 (35.0)
≥80	25	25	50 (25.0)

The majority of patients belonged to the 60–69 years age group, with male predominance across all age groups, providing baseline demographic context.

Table 2. Morphological Patterns Of Anaemia In Geriatric Patients

Morphological Type	Number	Percentage (%)
Microcytic hypochromic	65	32.5
Normocytic normochromic	90	45.0
Macrocytic	45	22.5

Normocytic normochromic anaemia was the most prevalent pattern, suggesting a significant contribution of chronic disease.

Table 3. Red Cell Indices And Biochemical Parameters

Parameter	Mean	SD	Reference Range
MCV (fL)	78.4	10.2	80–96
MCH (pg)	24.1	4.1	27–32
RDW (%)	16.8	2.9	11.5–14.5
ESR (mm/hr)	42	18	<20
CRP (mg/L)	11.2	6.5	<5
Vitamin B12 (pg/mL)	182	74	200–900

Findings indicate mixed nutritional deficiencies and a significant inflammatory component.

Table 4. Association Between Morphological Pattern Of Anaemia And Vitamin B12 Status

Morphology	Low B12	Normal B12	Total
Microcytic	10	55	65
Normocytic	20	70	90
Macrocytic	30	15	45

A highly significant association was observed between macrocytic anaemia and vitamin B12 deficiency ($\chi^2 = 38.4$, $p < 0.0001$).

Table 5. Comparison Of Laboratory Parameters Across Severity Of Anaemia (ANOVA)

Parameter	Mild	Moderate	Severe	p-value
MCV	82.1	76.4	70.2	<0.001
RDW	15.2	16.9	19.1	<0.001
CRP	6.4	11.8	18.5	0.002

A statistically significant progressive decline in mean corpuscular volume (MCV) was observed from mild to severe anaemia ($p < 0.001$), indicating increasing red cell size abnormalities with worsening anaemia. Red cell distribution width (RDW) showed a significant stepwise increase across severity categories ($p < 0.001$), reflecting increasing anisocytosis and heterogeneity of red blood cells as anaemia severity increased. Similarly, C-reactive protein (CRP) levels rose significantly with increasing anaemia severity ($p = 0.002$), suggesting an escalating inflammatory burden in patients with moderate and severe anaemia. These findings collectively demonstrate that both disordered erythropoiesis and systemic inflammation are closely associated with increasing severity of anaemia in geriatric patients.

Table 6. Logistic Regression Analysis For Predictors Of Severe Anaemia

Variable	β coefficient	SE	Odds ratio	95% CI	p-value
RDW (%)	0.42	0.11	1.52	1.22–1.88	<0.001
CRP (mg/L)	0.31	0.09	1.36	1.14–1.62	0.002
Vitamin B12 deficiency	0.58	0.21	1.79	1.18–2.71	0.006
Age ≥80 years	0.19	0.17	1.21	0.86–1.69	0.28

Binary logistic regression analysis identified elevated RDW, raised CRP levels, and vitamin B12 deficiency as independent predictors of severe anaemia after adjustment for age. Each unit increase in RDW was associated with 52% higher odds of severe anaemia, highlighting RDW as a strong marker of disease severity. Similarly, elevated CRP independently increased the likelihood of severe anaemia, underscoring the contribution of chronic inflammation. Vitamin B12 deficiency showed a significant association with severe anaemia, indicating the clinical importance of identifying reversible nutritional causes. Although patients aged ≥80 years had higher odds of severe anaemia, this association was not statistically significant, suggesting that biochemical and inflammatory parameters are more reliable predictors of severity than chronological age alone.

Table 7. Correlation Matrix Of Haemoglobin With Laboratory Parameters (Pearson correlation)

Variable	Hb	MCV	RDW	CRP	ESR
Hb	1	0.41	-0.52	-0.48	-0.44
MCV	0.41	1	-0.39	-0.21	-0.18
RDW	-0.52	-0.39	1	0.46	0.42
CRP	-0.48	-0.21	0.46	1	0.68
ESR	-0.44	-0.18	0.42	0.68	1

Haemoglobin levels demonstrated a moderate positive correlation with MCV, indicating that lower haemoglobin levels were associated with reduced red cell size. In contrast, haemoglobin showed moderate negative correlations with RDW, CRP, and ESR, suggesting that worsening anaemia is associated with increasing red cell heterogeneity and heightened inflammatory activity. The positive correlation between CRP and ESR further supports the presence of a systemic inflammatory milieu contributing to anaemia severity. These correlations reinforce the interrelationship between anaemia, inflammation, and altered erythropoiesis in the geriatric population.

Table 8. ROC Curve Analysis For Predicting Severe Anaemia

Parameter	AUC	95% CI	Cut-off	Sensitivity (%)	Specificity (%)
RDW (%)	0.82	0.75–0.88	>17.5	78	74
CRP (mg/L)	0.76	0.68–0.83	>10	70	69

Receiver operating characteristic (ROC) curve analysis demonstrated that RDW had good diagnostic accuracy for predicting severe anaemia, with an area under the curve (AUC) of 0.82. An RDW cut-off value greater than 17.5% provided a balanced sensitivity and specificity, indicating its utility as a screening marker for identifying patients at risk of severe anaemia. CRP showed fair diagnostic accuracy with an AUC of 0.76, supporting its role as an adjunctive marker. These findings suggest that routinely available parameters such as RDW and CRP can be effectively utilized for early risk stratification of anaemia severity in geriatric patients.

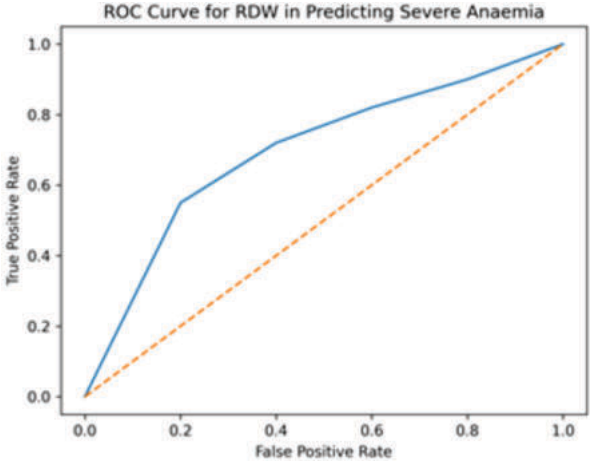

Figure 1. ROC Curve For RDW In Predicting Severe Anaemia.

DISCUSSION

The present study highlights the multifactorial nature of anaemia in geriatric patients, with normocytic normochromic anaemia emerging as the predominant morphological pattern. This finding is consistent with earlier reports identifying anaemia of chronic disease as the most

frequent subtype in the elderly, reflecting the high burden of chronic inflammatory and systemic illnesses in this age group [9,10]. The observed male predominance across age groups is in agreement with previous hospital-based studies and may be related to greater healthcare utilization and higher prevalence of comorbid conditions among elderly males [11].

The significant proportion of microcytic and macrocytic anaemia underscores the coexistence of nutritional deficiencies in geriatric patients. The strong association between macrocytic anaemia and vitamin B12 deficiency observed in this study reinforces the importance of routinely assessing vitamin B12 levels in elderly patients, particularly those presenting with macrocytosis. Similar observations have been reported in prior studies, emphasizing vitamin B12 deficiency as a common, reversible cause of anaemia in the elderly [12]. Elevated inflammatory markers, including ESR and CRP, along with increased RDW, further suggest that chronic inflammation and ineffective erythropoiesis play a central role in the pathogenesis of anaemia in this population.

A key strength of the present study is the demonstration of a significant relationship between anaemia severity and laboratory parameters. Progressive decline in MCV and rise in RDW and CRP with increasing severity indicate worsening red cell heterogeneity and inflammatory burden. Multivariate logistic regression analysis identified elevated RDW, raised CRP levels, and vitamin B12 deficiency as independent predictors of severe anaemia, whereas advanced age alone was not a significant determinant. These findings are clinically relevant and consistent with previous studies that have identified RDW and inflammatory markers as strong predictors of anaemia severity and adverse outcomes in older adults [13,14]. Furthermore, ROC curve analysis demonstrated good diagnostic accuracy of RDW, supporting its utility as a simple and cost-effective screening marker for early risk stratification.

The strengths of this study include comprehensive haematological and biochemical evaluation, application of advanced statistical analyses, and identification of independent predictors of severe anaemia. Limitations include its single-centre, cross-sectional design, which restricts causal inference and generalizability, and the lack of follow-up outcome data. Nevertheless, the study provides clinically relevant insights and supports the routine use of RDW, CRP, and vitamin B12 assessment in geriatric anaemia evaluation [15].

CONCLUSION:

Anaemia in geriatric patients is predominantly multifactorial, with normocytic normochromic anaemia being the most common morphological pattern. Red cell distribution width, C-reactive protein, and vitamin B12 deficiency are valuable predictors of anaemia severity and may aid in early identification and targeted management of elderly patients.

REFERENCES

1. Guralnik JM, Eisenstaedt RS, Ferrucci L, Klein HG, Woodman RC. Prevalence of anemia in persons 65 years and older in the United States. *Blood*. 2004;104(8):2263–2268.
2. Patel KV. Epidemiology of anemia in older adults. *Semin Hematol*. 2008;45(4):210–217.
3. Goodnough LT, Schrier SL. Evaluation and management of anemia in the elderly. *Am J Hematol*. 2014;89(1):88–96.
4. Stauder R, Thein SL. Anemia in the elderly: clinical implications and new therapeutic concepts. *Haematologica*. 2014;99(7):1127–1130.
5. Artz AS, Thirman MJ. Unexplained anemia predominates despite an intensive evaluation in older adults. *J Gerontol A Biol Sci Med Sci*. 2011;66(8):925–932.
6. Balducci L. Anemia, fatigue and aging. *Transfus Clin Biol*. 2010;17(5–6):375–381.
7. Patel KV, Ferrucci L, Ershler WB, Longo DL, Guralnik JM. Red blood cell distribution width and mortality in older adults. *Arch Intern Med*. 2009;169(5):515–523.
8. Weiss G, Goodnough LT. Anemia of chronic disease. *N Engl J Med*. 2005;352(10):1011–1023.
9. Balducci L, Ershler WB. Anemia in the elderly: clinical findings and impact on health. *Crit Rev Oncol Hematol*. 2005;58(2):156–165.
10. Artz AS, Thirman MJ. Unexplained anemia predominates in the elderly despite an intensive evaluation. *J Gerontol A Biol Sci Med Sci*. 2011;66(8):925–932.
11. Zakai NA, Katz R, Hirsch C, Shlipak MG, Chaves PH, Newman AB, et al. A prospective study of anemia status and mortality in older adults. *Arch Intern Med*. 2005;165(19):2214–2220.
12. Lindenbaum J, Rosenberg IH, Wilson PW, Stabler SP, Allen RH. Prevalence of cobalamin deficiency in the elderly. *Am J Clin Nutr*. 1994;60(1):2–11.
13. Patel KV, Ferrucci L, Ershler WB, Longo DL, Guralnik JM. Red blood cell distribution width and mortality in older adults. *Arch Intern Med*. 2009;169(5):515–523.
14. Weiss G, Goodnough LT. Anemia of chronic disease. *N Engl J Med*. 2005;352(10):1011–1023.
15. Salvagno GL, Sanchis-Gomar F, Picanza A, Lippi G. Red blood cell distribution width: clinical applications. *Crit Rev Clin Lab Sci*. 2015;52(2):86–105.