

Original Research Article

A study of the haematological profile of nutritional anaemia in patients attending NIMS Hospital, Jaipur, Rajasthan

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ABSTRACT

Background: Nutritional Anaemia, which is both preventable and the most prevalent form of Anaemia, is characterized by a haemoglobin concentration of less than 10 g/dl, as per the World Health Organization guidelines. To diagnose nutritional Anaemia, healthcare professionals assess red blood cell indices and perform a peripheral blood smear microscopy, along with evaluating serum iron parameters and vitamin B12 levels. To determine how often nutritional Anaemia occurs among patients visiting NIMS Hospital in Jaipur. To study the inter play of various CBC indices with different serum Vitamin B12 levels & serum Iron profile.

Method: This is an observational study. In total, 274 samples were obtained from patients suffering from nutritional anaemia in the general medicine outpatient department. Each patient provided two samples to assess their iron profile, vitamin B12 levels, and the morphology of red blood cells in a complete blood count (CBC).

Result: Among the 274 patients diagnosed with anaemia, 150 (55%) were female, and 124 (45%) were male. Of these, 155 individuals (56.57%) exhibited moderate anaemia, comprising 68 men and 87 women, with the majority being women (87 cases). Severe anemia 41 (33%) in male and 41 (27.34%) females were affected.

Conclusion: Microcytic hypochromic was the leading blood smear type, significantly linked to low serum iron and B12 levels. The research indicated that ensuring sufficient intake of iron and vitamin B12, along with maintaining a well-rounded diet, can aid in the prevention and management of nutritional anaemia.

Keywords: Nutritional anemia, Hemoglobin, Microcytic hypochromic

INTRODUCTION

Hematological disorders are caused primarily by iron, vitamin B12, or folate. All of these are essential for the synthesis of normal hemoglobin and red blood cell maturation. Nutritional anemia is widely prevalent. Deficiencies of micronutrients impaired the erythropoiesis and led to a reduced oxygen-carrying capacity of the blood, resulting in fatigue, weakness, decreased productivity, and also increased morbidity. Across all age groups, individuals are affected in geographical regions, mostly in low- and middle-income countries, where the dietary inadequacies are more common.¹ According to the

World Health Organization, estimate the nearly 1.9 billion of the population suffer from anemia caused by iron deficiency, considered the most important and preventable cause. At the global level, anemia remains a major public health problem.

The reproductive age of women, children, and pregnant women carries the highest burden due to increased physiological requirements, poor dietary intake, and repeated infections. This distribution highlights the widespread need for early detection and region-specific strategies to reduce the global impact of nutritional anemia.² In the global anemia burden, especially South

Asian countries, including India, significantly contribute. A diverse range of nutritious foods is crucial in addressing the high nutritional deficiencies caused by limited dietary approaches. In socioeconomic factors, cultural dietary preference. Large Indian population predisposed to different forms of nutritional anemia. Because of the several parts of India, diets remain predominantly cereal-based and low in bioavailable iron and vitamin B12.³

The NFHS-5 found the continuous prevalence of anemia is rising in India, with particularly high rates in Rajasthan. Factors such as high dependency on plant-based food, low consumption of animal-based diets, limited awareness of nutrition, and chronic blood loss contribute significantly to increasing the burden. In rural populations women and socioeconomically weaker groups are particularly vulnerable, making anemia a critical regional health concern.⁴ Depending on the specific nutrient deficiency, show the specific hematological variable pattern present in nutritional anemia. Microcytic hypochromic RBCs typically manifest in iron deficiency-dependent anemia.

While vitamin B12 and folate deficiencies produce macrocytic anemia with characteristic macro-ovalocytes and hyper segmented neutrophils. In Indian settings mixed nutritional deficiencies are very common that overlap the features and complicate the diagnosis process, emphasizing and increasing the need for detailed hematological evaluation.⁵ A complete blood count provides essential information for the anemia hematological analysis that helps in the identification of type and severity. Important information about the underlying causes of disease is found by interpreting the parameters such as hemoglobin, hematocrit, MCV, MCH, MCHC, RDW, and RBC count. The clinician can establish a more accurate diagnosis and appropriate treatment guide when combined with biochemical markers like serum ferritin, serum iron, TIBC, Trans ferritin saturations, and serum vitamin B12.⁶

The vital tool for the diagnosis of nutritional anemia is peripheral smear examination. Evaluating the morphological features such as microcytosis, macrocytosis, anisopoikilosis, target cells, teardrop cells, and hyper segmented neutrophils provide important indications about the type of deficiency.⁷ Northern and western Indian research indicates high rates of iron deficiency, whereas vitamin B12 deficiency is more prevalent in states with predominantly vegetarian dietary habits, including Rajasthan. This variability highlights the importance of local research in understanding region-specific underlying etiologies and hematological characteristics.⁸ Hospital-based studies conducted at tertiary care centers also emphasize the importance of correlating hematological indices with biological profiles. These studies suggest that early changes in MCV, RDW, and peripheral blood smear often provide the first indication of mixed or developing nutritional deficiencies, particularly in adults with chronic dietary imbalances or malabsorption.⁹ Traditional dietary patterns show the

unique combination of urban populations, particularly in Rajasthan, Jaipur. While urban residents may consume processed food low in micronutrients, rural communities often rely on cereal-based diets and limited access to fruits, vegetables, and animal-based proteins. This diversity underscores the need for the regional specific data from clinical settings like NIMS hospital to better understand the burden and patterns of nutritional anemia.¹⁰

NIMS hospital, being a large tertiary care center, serves a significant population of Jaipur and the surrounding districts. Patients from diverse socioeconomic and dietary backgrounds present with various types of nutritional anemia, making it an ideal location to study hematological patterns and biological correlations. Such data significantly contribute to improved clinical diagnosis and public health interventions in this region.¹¹

METHODS

The current study was carried out in the pathology department in collaboration with the General Medicine department at NIMS Hospital, with samples being analyzed in the central laboratory. Pathology and Biochemistry at NIMS Hospital Jaipur Rajasthan. This was an observational study design aimed study the Hematological profile of Nutritional Anaemia in patients attending NIMS Hospital, Jaipur, and Rajasthan.

Study population

The data was collected from department of general Medicine at NIMS Hospital, Jaipur Rajasthan.

Study duration

21 December 2021-May 2022 the study included patients attending the outpatient (OPD) and inpatient (IPD) departments of NIMS Hospital who were clinically suspected or diagnosed cases of nutritional anaemia and met the inclusion criteria. Individuals of different age groups, both males and females, presenting with symptoms such as fatigue, pallor, weakness, dyspnea, and other anemia-related features were considered for sampling.

In total, 274 individuals of both sexes, aged 15 to 60 years, along with patients exhibiting haematological or biochemical signs indicative of nutritional anaemia (such as iron deficiency, vitamin B12 deficiency, or folate deficiency), were included. All patients below 15 years and major illness like malignancies, gastric ulcers, tuberculosis, sickle cell anemia, thalassemia blood transfusion within last 6 months were excluded. Sample collection: About 5 ml of venous blood was collected from the patients. Of this, 3 ml was placed in a plain Vacutainer for assessing the iron profile, while 2 ml was collected in an EDTA vacutainer for conducting haematological tests. Serum will be separated by centrifugation and used for following Biochemical analysis and whole blood is used

for hematological analysis. All laboratory investigations, including hematological and biochemical analyses, were performed in the central laboratory of pathology and Biochemistry, NIMS Hospital. According to the standard operation protocol.

Statistical analysis

Collected data were analyzed using IBM SPSS statistics version 21.0. No advanced inferential statistical methods were used because the study was observational and descriptive in nature. A p value <0.05 was considered statistically significant.

RESULTS

In this study 274 anemic patients' samples were analyzed for the hematological profile and biochemical parameters of anemic patients. Out of the 274 anemic cases 150 (55%) female patients and 124 (45%) male patients were found (Figure 1). In Figure 1 sex wise distribution of the case were depicted.

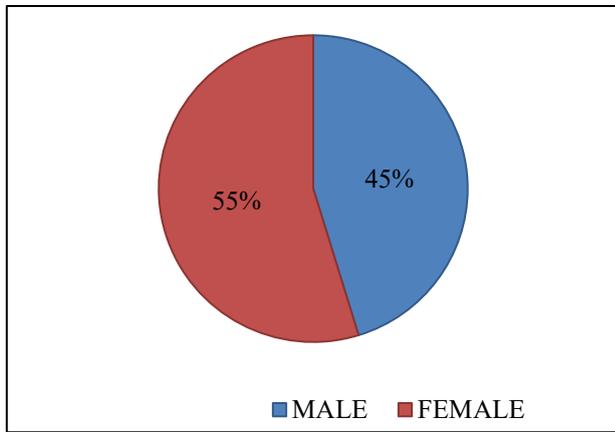


Figure 1: Gender wise distribution of cases.

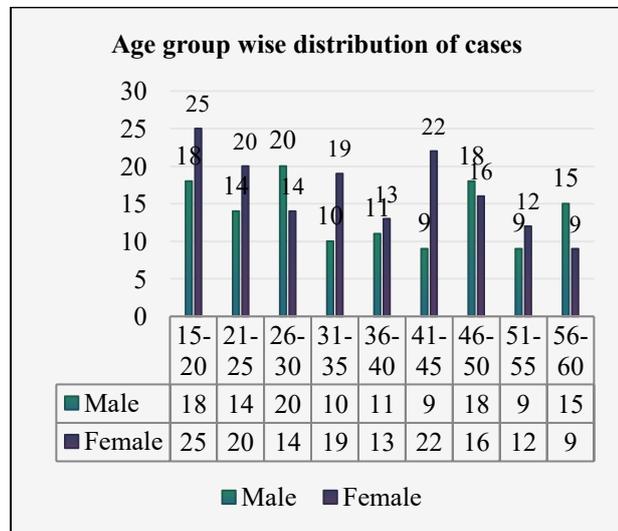


Figure 2: Depicted the age wise distribution of the cases.

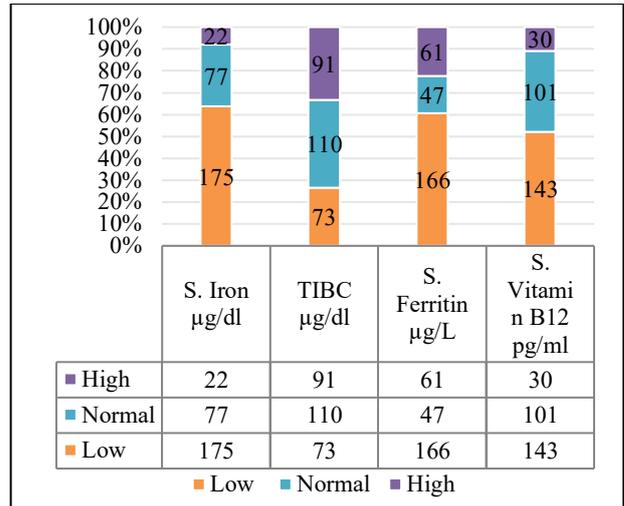


Figure 3: Distribution range of biochemical parameters in anemic patients.

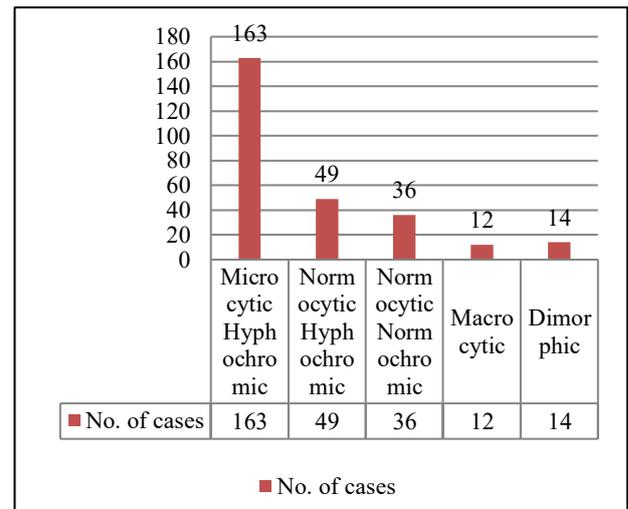


Figure 4: Distribution of cases on the basis of RBC morphology.

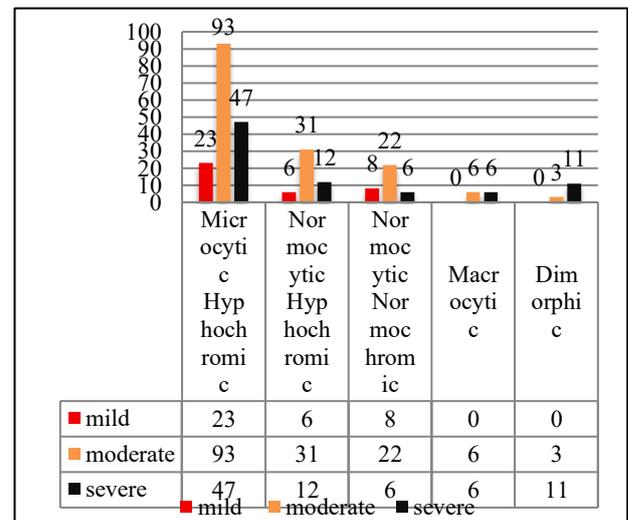


Figure 5: Peripheral smear red cell morphology and severity of anaemia.

Table 1: Sex wise distribution of anemia grading.

Grading of anemia	Male	Male %	Female	Female %	Total number	%	P value
Mild (10-11 g/dl)	15	12.09	22	14.66	37	13.51	0.1162
Moderate (7-9.9 g/dl)	68	54.84	87	58	155	56.57	
Severe (<7 g/dl)	41	33.07	41	27.34	82	29.92	
Total	124	100	150	100	274	100	

Table 2: Depicted of anemia grading according to the age group.

Age (in years)	Mild (10-11 g/dl)	Moderate (7-9.9 g/dl)	Severe (<7 g/dl)
15-20	6	22	15
21-25	4	18	12
26-30	1	19	14
31-35	7	16	6
36-40	2	19	3
41-45	6	13	11
46-50	5	22	7
51-55	1	12	8
56-60	5	14	6

Table 3: Hemoglobin distribution of cases according to dietary pattern.

Anaemia grade	Vegetarian	Percentage	Non vegetarian	%
Mild anaemia	22	16.06	15	10.95
Moderate anaemia	74	54.02	81	59.13
Severe anaemia	41	29.92	41	29.92
Total	137	100	137	100

In (Figure 2) the maximum number of patients belonged to the 15-60 years of age group. The highest number of patients involved were from the 14-20 years of age group, with 43 cases (15.6%). 34 (12.4%) cases were observed in the 21-25, 26-30, and 46-50 age groups. 31 cases (11.3%) belonged to the 41-45 years age group. Followed by 29 (10.6%) belonging to the 31-35 age group and 24 (8.8%) each recorded in the 36-40 and 56-60 age groups. The lowest number, 21 (7.7%), of patients was in the 51-55 age group. A total number of 274 anemic patients were included in this study comprising 124 males and 150 females. Among the patients, 37 individuals (13.51%) exhibited mild anaemia with haemoglobin levels between 10 and 11 g/dl, comprising 15 males (12.09%) and 22 females (14.66%). A total of 155 patients (56.57%) were diagnosed with moderate anaemia, with 68 being men and 87 being women, the latter group forming the majority. In total numbers of 82 patients (29.92%), 41 males (33.07%) and 41 females (27.34%) were affected with severe anemia. Moderate anemia predominated in both genders (Table 1).

In Table 2 moderate anemia was the most prevalent grade in all categories, with the greater number of cases were observed in 15-20- and 46-50-years age groups. Moderate anaemia accounted for the smallest proportion across all age categories, whereas severe anaemia was more frequently observed in younger people, particularly those

aged 15–20 and 26–30. The findings indicate that severe anaemia varied among different age groups, while moderate anaemia was consistently more common regardless of age. Low serum iron and ferritin levels were predominant among the anemic individuals, according to their biochemical characteristics. In 175 patients' low serum iron was found, while in 166 patients serum ferritin showed a low level, indicating depleted iron stores in a majority of cases. TIBC showed variable distribution, in 91 individuals had high TIBC levels, indicating a higher potential to bind iron. Additional serum vitamin B12 levels were low in 143 patients. In (Figure 3) 143 patients serum vitamin B12 was shown to be low in level, suggesting a significant contribution of vitamin B12 deficiency to anemia. These values highlight the role of iron deficiency along with associated nutritional deficiencies in the study population.

According to the analysis of red blood cell morphology, in 274 anaemic patients, microcytic hypochromic anaemia was the predominant pattern, accounting for 59.49% of cases. In 49 patients (17.89%), normocytic hypochromic anaemia was identified, as shown in (Figure 4), whereas normocytic normochromic anaemia was found in 36 patients (13.14%). Demographic anaemia was noted in 5.10% of the cases, and macrocytic anaemia was the least common, accounting for 4.38%. These findings evaluate the iron deficiency-related morphological patterns that

were the most prevalent in the research population. Based on the morphology of red blood cells and the severity of microcytic hypochromic anaemia, 23 cases were classified as mild, 93 as moderate, and 47 as severe. Consequently, normocytic hypochromic morphology was identified in 6 mild cases, 31 moderate cases, and 12 severe cases. In contrast, normocytic normochromic anaemia included 6 severe cases, 22 moderate cases, and 8 mild cases (Figure 5). Additionally, in microcytic anaemia, there were 6 severe cases, with no moderate or mild cases. Dimorphic anaemia presented as severe in 11 cases, moderate in 3, and mild in none. 137 individuals were divided into two dietary groups (Table 3). Mild anemia was predominant or more common among vegetarians, observed in 16.06% of cases. Compared to 10.95% in non-vegetarians. Moderate anemia was the most prevalent grade found in both groups: 54.02% in vegetarians and 59.1% in non-vegetarian. Severe anemia was observed equally in both groups, affecting 29.92% of vegetarians and non-vegetarians.

DISCUSSION

In this study, 124 male patients (45%) and 150 female patients (55%) were identified with nutritional anaemia. The occurrence of nutritional anaemia was higher among female patients compared to male patients. This finding aligns with the research conducted by Dhanuka et al and Pandey et al where 18 female patients were found to have higher nutritional anaemia rates than 12 male patients.^{12,13} Similarly, Pandey et al in 2013 reported a higher prevalence of female patients compared to male patients, with percentages of 42 (93.3%) for females and 3 (6.7%) for males by Cedrick et al.¹⁴

In present study, most common affected age group with anaemia was 15-20 years (15.6%) followed by 21-25 years old (12.4%), 26-30 years old (12.4) and 46-50 years old (12.4) the age group with the lowest number of cases was noted in 51-55 years old (7.7%) these findings are consistent with earlier research by Cedrick et al and they discovered that the most common aged group with a high frequency of nutritional anemia was 15-19 years old (21.7%), followed by second commonest age group prevalence of nutritional anaemia was 20-29 years (15.2%), and the lowest number of cases was in 40-49 years (5.4%) and they found that common aged group had high prevalence of nutritional anaemia was aged 15-19 years (21.7%), second commonest aged group prevalence of nutritional anaemia was 20-29 years (15.2%), and lowest number of cases was in 40-49 years (5.4%) also, study conducted by Ratre et al.^{14,15}

Contrary to our findings, her research revealed that individuals aged 21-30 years had a 40% prevalence of nutritional anaemia, while those aged 15-20 years had a higher prevalence at 50%, and the lowest prevalence was observed in the 51-60 age group at 4%. In the current study, moderate anaemia was the most common type, with 155 cases (56.57%), followed by severe anaemia in 82 cases (29.92%), and mild anaemia in 37 cases (13.51%).

This suggests that the majority of patients were experiencing moderate nutritional anaemia. Gender wise analysis showed that moderate anaemia was more common in females affecting 87 (58%) compared to the male patients 68 (54.86%). Severe anaemia was found to be almost similar in both genders with 41 (27.84%) females and 41 (33.07%) males affected. Mild anaemia was slightly more prevalent among females with 22 (14.66%) cases, compared to 15 (12.09%) cases in males. The research aligns with the findings of several other scholars for instance, Dhanuka et al reported that the occurrence of mild anaemia was more common than that of moderate and severe anaemia.¹² Mild anaemia was more commonly observed among female patients with 14 (46.67%) cases compared to male patients, who accounted for 13 (72.22%) cases.

Moderate anaemia was also more prevalent in females affecting 12 (40%) patients whereas only 3 (16.67%) male patients were found to have moderate anaemia. Severe anaemia was the least prevalent, with a nearly equal distribution between genders: 4 (13.33%) female patients and 2 (11.11%) male patients a study by Ratre et al revealed that moderate anaemia was more common than both severe and mild anaemia.¹⁵ In their findings, moderate anaemia was observed in 62 (31.0%) male patients, which was higher than in female patients at 52 (26.0%).

Severe anaemia was equally present in both female and male patients, with 41 (20.5%) each, while mild anaemia was found in 3 (1.5%) male patients and 1 (0.5%) female patient. In the current study, a greater number of cases, 150 (55%), were non-vegetarians compared to 124 (45%) vegetarians. This observation was in contrast to other studies by Kalaiselvam et al where a higher number of anaemic patients were vegetarian 126 (70.8%) compared to non-vegetarian 52 (29.2%).¹⁶ In the present study, peripheral smear examination revealed that the present study peripheral smear examination revealed the most common red blood cell morphology was microcytic hypochromic, observed in 163 (59.49%) cases highlighting iron deficiency as a major contributing factor in nutritional anaemia.

This was at per with the findings of studies done by Kalaiselvam et al as in their study found that microcytic and hypochromic 176 (98.8%). So according to Ratre et al was in number than microcytic and hypochromic 118 (59%).^{15,16} Second commonest morphological pattern observed was normocytic hypochromic 49 (17.89%), and normocytic normochromic 36 (13.14%). In the study conducted by Rani et al a similar pattern was noted, with normocytic normochromic accounting for 28 (62.2%). In contrast, the research by Ratre et al identified normocytic normochromic in 12 (06%) of cases, but also reported dimorphic as the second most prevalent RBC morphology pattern, with 52 (26%).^{15,17} The third most common morphological pattern observed was dimorphic, with 14

(5.10%), which aligns with the findings of Kalaiselvam et al who reported dimorphic at 2 (1.2%).¹⁶

This study is subject to several limitations. The six-month duration, single-centre design, and relatively small sample size constrain the generalizability of the findings. Additionally, the observational nature of the study, which included concurrent haematological and biochemical markers, was limited by the small sample size and the presentation of advanced disease. Furthermore, clinical information such as symptoms and comorbidities was not comprehensively addressed. These limitations, particularly concerning Haematological and Biochemical parameters, should be considered when interpreting the results.

CONCLUSION

Nutritional anemia showed higher prevalence in females (55%) than males (45%), peaking in the 15-20 age group. Moderate anemia dominated (56.57%), followed by severe (29.92%) and mild (13.51%). Non-vegetarians constituted a slightly higher proportion (55%) than vegetarians (45%) among anaemic patients. Microcytic hypochromic was the leading blood smear type, significantly linked to low serum iron and B12 levels. Dietary patterns directly impacted these deficiencies, confirming diet's role in anemia occurrence. Adequate iron and vitamin B12 supplementation along with a full balanced diet can help in prevention and control wide spread Jaipur awareness campaigns can effectively prevent and control this prevalent issue in rural areas.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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