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A Study Of Red Cell Indices And Hemogram Parameters In Anemic Patients At A Rural Tertiary Care Center

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Abstract:

Background*: Anemia is a prevalent global health concern, particularly affecting vulnerable populations such as children, adolescent girls, and women of reproductive age. Understanding red cell indices and hemogram parameters is crucial for effective anemia management, especially in rural settings with limited resources.*

Materials and Methods*: This cross-sectional observational study conducted at Swami Ramanand Teerth Rural Government Medical College, Ambajogai, involves analyzing hemogram parameters and red cell indices in 200 anemic patients. Demographic data, blood samples, and laboratory analyses were obtained following ethical guidelines.*

Results*: Demographic analysis revealed a predominance of anemia among women and individuals aged 19-45. Most patients exhibited microcytic and hypochromic anemia, with low Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and Mean Corpuscular Hemoglobin Concentration (MCHC) levels. Additionally, a high Red Cell Distribution Width (RDW-CV) suggested significant variation in red blood cell size.*

Discussion: *The findings underscore the high prevalence of iron deficiency anemia in the study population, necessitating targeted interventions addressing nutritional deficiencies and healthcare access. Advanced hematology analyzers and quality control measures ensured the reliability of results.*

Conclusion: *This study contributes valuable insights into anemia in rural populations, advocating for multifaceted approaches encompassing nutritional education, fortification programs, and improved healthcare access. By addressing the root causes of anemia, public health initiatives can enhance the well-being of affected populations and reduce the burden of this widespread condition.*

Key Word*: Anemia, Red cell indices, Hemogram parameters, Rural healthcare, Iron deficiency*

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I. Introduction

Anemia represents a significant worldwide health issue, especially impacting young children, adolescent girls who are menstruating, and women who are either pregnant or have recently given birth. According to the World Health Organization, about 40% of children between the ages of 6 and 59 months, 37% of expectant mothers, and 30% of women aged 15 to 49 suffer from anemia globally.[1] This condition affects approximately one-third of the world's population and is linked to increased morbidity and mortality.[1] Anemia can lead to poor birth outcomes, reduced work productivity in adults, and hindered cognitive and behavioral development in children.[1] Preschool Children (PSC) and Women of Reproductive Age (WRA) are especially vulnerable.

To effectively identify anemia and mitigate its adverse effects, it is vital to establish appropriate Hb thresholds and red cell indices.[2,3] Comprehending the varied and intricate causes of anemia is essential for devising targeted interventions that tackle the specific causes prevalent in low- and middle-income countries (LMICs) and for tracking the effectiveness of anemia control programs.[4, 5]

The red cell indices, including Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and Mean Corpuscular Hemoglobin Concentration (MCHC), alongside the Red Cell Distribution Width (RDW), play a crucial role in diagnosing and classifying anemia.[2,6,7] These indices offer insights into the size, hemoglobin content, and uniformity of red blood cells (RBCs), which are essential for determining the nature of anemia—whether it be microcytic, macrocytic, or normocytic.

In rural areas, where nutritional deficiencies, infectious diseases, and lack of medical resources are common, anemia can be a harbinger of broader health issues. It is not merely a reduction in hemoglobin levels or RBC count; it reflects a complex interplay of socioeconomic factors, dietary habits, genetic predispositions, and

environmental influences.[8,9,10] The hemogram, a complete blood count, further provides a detailed picture of the patient's blood components, including white blood cells and platelets, which can indicate concurrent infections or inflammatory processes.[11]

This study is particularly significant as it focuses on a rural tertiary care center, where the spectrum of anemia might differ from urban centers due to distinct lifestyle and environmental factors. By analyzing the red cell indices and hemogram parameters, we can identify patterns and correlations that are unique to this setting. This information is invaluable for tailoring effective treatment strategies and preventive measures that address the specific needs of the rural population.

II. Material And Methods

A cross-sectional observational study conducted at Swami Ramanand Teerth Rural Government Medical College, Ambajogai. The study involves collecting EDTA anticoagulated blood samples from 200 patients diagnosed with anemia and analyzing various hemogram parameters and red cell indices.

Study Design: Cross-sectional observational study

Study Location: This was a Rural tertiary care teaching hospital-based study done in Department of Pathology at Swami Ramanand Teerth Rural Government Medical College.

Sample size: 200 patients.

Subjects & selection method: The study will include patients of all ages who have been diagnosed with anemia based on criteria mentioned as follows:

Adult Males	Less than 12 g/dL
Adult Females	Less than 11 g/dl
Children 6 to 12 Years	Less than 11.5 g/dl
Children 6 months to 6 years	Less than 11 g/dl
Children 2 to 6 months	Less than 10 g/dl

A total of 200 anemic patients will be randomly selected from the outpatient department (OPD) of the Hospital.

Inclusion criteria:
1. Patients diagnosed with anemia.
2. Consent to participate in the study.

Exclusion criteria:
1. Patients with a history of blood transfusion within the last three months.
2. Patients undergoing treatment for cancer.

Procedure methodology
Data Collection: Demographic data, including age, gender, and medical history, will be collected through patient interviews and medical records. Blood samples will be drawn by trained phlebotomists using standard venipuncture techniques.
Laboratory Analysis: Complete blood counts (CBC) will be performed using an automated hematology analyzer (Erba H360) to measure hemogram parameters such as hemoglobin concentration, hematocrit, RBC count, white blood cell (WBC) count, and platelet count. Red cell indices including MCV, MCH, MCHC, and RDW will be calculated from the CBC data.
Quality Control: To ensure the accuracy of the laboratory results, daily calibration of the hematology analyzer will be performed, and internal quality control samples will be run alongside patient samples.
Ethical Considerations: The study is conducted in accordance with the Declaration of Helsinki, and ethical approval is obtained from the Institutional Review Board (IRB). Informed consent is obtained from all participants or their legal guardians.

III. Result

In this study of 200 anemic patients at a rural tertiary care center, the demographic data revealed that the majority of patients were in the 19-45 age group, constituting 47% of the sample, followed by the 0-18 age group with 24%. Patients aged 46-65 accounted for 18.5% of the sample, while those aged 65 and above comprised 11.5%.

Regarding gender distribution, females represented a significantly higher proportion of the sample, constituting 77% of patients, while males accounted for 23%.

The distribution of patients based on Mean Corpuscular Volume (MCV) showed that the majority had MCV levels below the normal range (<80 fL), with 72% of males and 72% of females falling into this category. A smaller proportion fell within the normal range (80-100 fL), comprising 23.5% of males and 23% of females, while very few had MCV levels above the normal range (>100 fL), constituting only 4.5% of females and none in the male group.

For Mean Corpuscular Hemoglobin (MCH), the majority of patients had MCH levels below the normal range (<27 pg), with 76.5% of males and 76.5% of females falling into this category. Within the normal range (27-34 pg), 17.5% of males and 17.5% of females were observed, while only 6% of females had MCH levels above the normal range (>34 pg), with no males falling into this category.

In terms of Mean Corpuscular Hemoglobin Concentration (MCHC), the majority of patients had MCHC levels below the normal range (<32-36 g/dL), with 77.5% of males and 77.5% of females falling into this category. Within the normal range, 19.5% of males and 19.5% of females were observed, while only 4.5% of females had MCHC levels above the normal range (>36 g/dL), with no males falling into this category.

Lastly, the distribution of patients according to Red Cell Distribution Width - Coefficient of Variation (RDW-CV) showed that the majority had RDW-CV levels above the normal range (>16), with 74% of males and 74% of females falling into this category. A smaller proportion fell within the normal range (4 to 16), comprising 26% of males and 26% of females.\

Table no 1: Demographic Data of Patients

Age Group	Number of Patients	Percentage
0-18	48	24%
19-45	92	47%
46-65	37	18.5%
65+	23	11.5%

Table no 2: Gender Distribution of Patients

Gender	Number of Patients	Percentage
Male	46	23%
Female	154	77%

Table no 3: Distribution of patients according to MCV

MCV	NUMBER OF PATIENTS		PERCENTAGE
	Male	Female	
Above Range (>100 fL)	1	8	4.5%
Normal Range(80-100 fL)	11	36	23.5%
Below Range(<80 fL)	34	110	72%

Table no 4: Distribution of patients according to MCH

MCH	NUMBER OF PATIENTS		PERCENTAGE
	Male	Female	
Above Range (>34 pg)	0	12	6%
Normal Range(27-34 pg)	8	27	17.5%
Below Range(<27 pg)	38	115	76.5%

Table no 5: Distribution of patients according to MCHC

MCHC	NUMBER OF PATIENTS		PERCENTAGE
	Male	Female	
Above Range (>36 g/dL)	0	9	4.5%
Normal Range(32-36 g/dL)	4	35	19.5%
Below Range(<36 g/dL)	42	113	77.5%

Table no 6: Distribution of patients according to RDW – CV

RDW-CV(%)	NUMBER OF PATIENTS		PERCENTAGE
	Male	Female	
Above Range (>16)	31	117	74%
Normal Range(04 to 16)	15	37	26%

IV. Discussion

The present study conducted at Swami Ramanand Teerth Rural Government Medical College, Ambajogai, provides insights into the hemogram parameters and red cell indices of anemic patients in a rural setting.

The demographic distribution indicates a higher prevalence of anemia in the younger population, with nearly half of the patients falling within the 19-45 age group. This could reflect nutritional deficiencies or chronic diseases prevalent in this demographic.[12,13] The significant female predominance (77%) is consistent with global trends and highlights the need for targeted interventions addressing women's health and it also suggests that gender-specific factors such as menstrual blood loss or pregnancy-related anemia could be contributing to the higher incidence in females.[14,15]

The majority of patients exhibiting MCV levels below the normal range suggests a high incidence of microcytic anemia, commonly associated with iron deficiency or chronic disease.[16,17] This finding is corroborated by the parallel observation of low MCH values, which further supports the likelihood of iron deficiency anemia being a major concern in this population.

The high percentage of patients with MCHC levels below the normal range reinforces the presence of hypochromic anemia, which is characteristic of iron deficiency. This is a critical public health issue, as iron deficiency anemia can have profound effects on cognitive development, productivity, and overall quality of life.[4,14]

The majority of patients exhibiting MCV, MCH, and MCHC levels below the normal range is indicative of microcytic and hypochromic anemia, commonly associated with iron deficiency. This is further supported by the high percentage of patients with elevated RDW-CV levels, suggesting a significant variation in red blood cell size, which is a hallmark of iron deficiency anemia.

The study's reliance on automated hematology analyzers for CBC and red cell indices ensures a high level of accuracy and reproducibility in the results. However, it also underscores the importance of quality control measures, such as daily calibration and internal quality checks, to maintain the integrity of the data.[18,19]

V. Conclusion

The study has illuminated the hemogram parameters and red cell indices in a rural anemic population, highlighting the pressing public health challenge posed by anemia. The findings reveal a significant prevalence of microcytic and hypochromic anemia, predominantly among women and individuals in the 19-45 age group, suggesting a potential link to nutritional deficiencies and the need for enhanced healthcare services.

The data points towards iron deficiency as the primary cause of anemia in this cohort, evidenced by the low MCV, MCH, and MCHC levels, coupled with high RDW-CV. These indicators not only reflect the current health status but also signal the necessity for public health initiatives focusing on dietary improvement and accessible medical care.

The study's reliance on advanced automated hematology analyzers and stringent quality control protocols ensures the reliability of the results. In conclusion, this study contributes valuable knowledge to the understanding of anemia in rural settings and advocates for targeted health interventions.

It calls for a multifaceted approach that includes nutritional education, fortification programs, and improved healthcare access to mitigate the burden of anemia and enhance the quality of life for affected populations.

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