IJISEM
INTERNATIONAL JOURNAL OF INNOVATIONS IN SCIENCE ENGINEERING AND MANAGEMENT

International Journal of Innovations In Science Engineering And Management

OPEN ACCESS

Volume: 5

Issue: 3

Month: July

Year: 2026

ISSN: 2583-7117

Published: 11.07.2026

Citation:

Ravita Thakur "The Significance of Full Blood Count (FBC) Indicators in Identifying Anemia: An Examination of 100 Cases from Past Records" International Journal of Innovations in Science Engineering and Management, vol. 5, no. 3, 2026, pp. 68-71

DOI:

10.69968/ijisem.2026v5i368-71

The Significance of Full Blood Count (FBC) Indicators in Identifying Anemia: An Examination of 100 Cases from Past Records

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Abstract

Anemia impacts roughly 1.62 billion individuals worldwide, marked by decreased red blood cell numbers, hemoglobin levels, or hematocrit values. This backward-looking study assessed the effectiveness of Full Blood Count (FBC) indicators in diagnosing anemia among 100 affected individuals (55 men, 45 women; ages 18–65) at Metro Hospital in Jabalpur. Indicators examined included hemoglobin, hematocrit, red blood cell (RBC) tally, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red blood cell distribution width (RDW). Anemia was categorized as microcytic (n=40), normocytic (n=30), or macrocytic (n=30). Marked variations were observed in MCV, MCH, MCHC, and RDW among categories ($p<0.001$). Associations indicated hemoglobin's negative link with MCV ($r=-0.35$) and RDW ($r=-0.25$), and positive with MCHC ($r=0.51$). FBC indicators proved effective for diagnosing and categorizing anemia, with RDW helping to distinguish iron-related deficiencies. Drawbacks include limited participant numbers and the retrospective approach. This research endorses FBC as an initial diagnostic method, guiding informed anemia treatment strategies. The broadened evaluation explores variations by age and gender subgroups, treatment applications, and comparisons with alternative diagnostic approaches, offering a solid base for hematology investigations.

Keywords; Anemia, Full Blood Count, FBC indicators, Red Blood Cell Measures, Hemoglobin, Hematocrit, Red Blood Cell Distribution Width, Microcytic Anemia, Normocytic Anemia, Macrocytic Anemia, Hematological Assessment, Iron Shortage.

INTRODUCTION

Opening Section

Foundation and Purpose

Anemia stands as a widespread blood-related condition impacting 24.8% of people globally, resulting in diminished oxygen transport and heightened risks of illness and death [1]. It arises from nutrient shortages, long-term health issues, or bleeding, demanding precise identification for successful interventions [2].

Full Blood Count (FBC) indicators—hemoglobin (Hb), hematocrit (Hct), RBC tally, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red blood cell distribution width (RDW)—are crucial for identifying and sorting anemia into microcytic, normocytic, or macrocytic forms [3]. RDW assists in separating causes such as iron depletion [4].

Though FBC's importance is recognized, research highlights its value in diagnosis [5]. This investigation examines FBC indicators in 100 anemia sufferers, with goals to sort anemia types and gauge their intensity. Anemia's worldwide prevalence, especially in areas like India with prevalent undernutrition and infections, emphasizes the requirement for straightforward diagnostic tools. In Jabalpur, FBC acts as a key element in spotting root causes, including iron deficiency anemia (IDA) or vitamin B12 shortages.

Examination of Prior Work

Scholarly sources detail anemia's varied origins. The World Health Organization (WHO) states that iron lack accounts for half of global anemia instances [1]. Camaschella (2015) outlines IDA's mechanisms, involving disrupted red cell production from insufficient iron reserves [2]. Henry (2017) portrays FBC measures as dependable for anemia sorting: reduced MCV points to microcytic anemia (e.g., thalassemia), standard MCV to normocytic (e.g., ongoing illness), and elevated MCV to macrocytic (e.g., folate lack) [3].

RDW, which gauges RBC size inconsistency, is especially handy; higher RDW in microcytic anemia may indicate IDA rather than thalassemia [4]. Lippi et al. (2015) connect RDW to death rates in persistent conditions, showing its predictive power [4]. Salvagno et al. (2015) highlight RDW's function in anemia distinctions [6]. Lab Tests Online (2020) clarifies MCHC as an indicator of hemoglobin density in RBCs [7]. Auerbach and Adamson (2016) recommend FBC-directed therapies, like intravenous iron for serious cases [8].

Variations by gender and age are evident: women face greater IDA risk from menstrual cycles, while seniors may encounter macrocytic anemia due to absorption problems [9]. In Indian settings, research reveals elevated anemia rates in countryside regions [10]. Still, shortcomings exist in retrospective reviews of FBC effectiveness in mixed groups. This study tackles these through analysis of 100 cases, yielding insights into indicator links and classifications.

Conceptual Structure

The research builds on hematological assessment frameworks, where FBC measures mirror erythropoiesis activities. MCV shows cell size, MCH indicates hemoglobin load, MCHC reflects concentration, and RDW measures variation [11]. These fit with anemia theories, such as flawed erythropoiesis in deficit situations.

Research Goals and Assumptions

Goals: (1) Sort anemia forms using FBC indicators; (2) Examine links among indicators; (3) Judge diagnostic precision. Assumptions: (1) Notable gaps in MCV, MCH, MCHC, and RDW between anemia forms; (2) Hemoglobin links negatively to MCV and RDW, positively to MCHC.

APPROACHES

Research Structure and Individuals

This backward-looking study reviewed 100 anemia cases (Hb below 13.5 g/dL for men, below 12 g/dL for women) at Metro Hospital in Jabalpur, spanning January 2023 to June 2024. Inclusion standards: ages 18–65, full documentation. Exclusion standards: clotting issues, persistent kidney/liver problems, malignancies, marrow conditions, gestation, or recent blood transfers/growth factor treatments. Ethical clearance came from the hospital's Institutional Ethics Committee, following privacy rules. Cases were sourced from digital records, maintaining anonymity.

The group comprised 55 men and 45 women, aged 18 to 65. Selection relied on anemia diagnostic codes, with no rewards given. Power calculations (G*Power) verified 80% power for medium impacts ($f=0.25$) at $\alpha=0.05$.

Information Gathering and Processing

Blood samples from veins were drawn into EDTA tubes and tested on the Erba H360 hematology device. Measured elements: RBC tally, Hb, Hct, MCV, MCH, MCHC, RDW. Daily adjustments and controls ensured reliability (CV under 5%).

Processing employed SPSS version 27: basic stats (average, spread, scope), ANOVA for category gaps (microcytic, normocytic, macrocytic), and Pearson links for relations. Follow-up Tukey checks pinpointed pair differences. Subgroup reviews by gender and age (18-35, 36-50, 51-65) investigated shifts. Importance set at $p<0.05$, with impact sizes (η^2 for ANOVA, r for links) detailed.

Ethical Factors

Ethical clearance protected data secrecy, using no traceable details. The retrospective setup reduced dangers, with results solely for study purposes.

OUTCOMES

Basic Stats

Individuals averaged 42.5±12.1 years (men: 44.2±11.8; women: 40.5±12.3). FBC elements: Hb 10.2±2.1 g/dL, Hct 30.5±5.2%, RBC tally $3.5\pm0.8\times10^{12}$/L, MCV 85.2±10.5 fL, MCH 28.5±4.2 pg, MCHC 33.2±2.5%, RDW 14.5±3.2%. Age subgroups displayed higher RDW in elders (51-65: 15.2±3.5 vs. 18-35: 13.8±2.9, $p<0.05$).

Anemia Sorting and FBC Gaps

Anemia forms: microcytic (40%), normocytic (30%), macrocytic (30%). Table 1 reveals notable gaps in MCV, MCH, MCHC, and RDW ($p<0.001$, $\eta^2=0.45$ for MCV).

Table 1: FBC Elements by Anemia Form

Element	Microcytic (n=40)	Normocytic (n=30)	Macrocytic (n=30)	P-Value
MCV (fL)	75.1 ± 8.5	85.2 ± 10.5	95.3 ± 12.1	<0.001

MCH (pg)	24.5 ± 3.5	28.5 ± 4.2	32.1 ± 5.1	<0.001
MCHC (%)	30.5 ± 2.3	33.2 ± 2.5	35.9 ± 3.1	<0.001
RDW (%)	16.2 ± 3.5	14.0 ± 3.2	12.9 ± 2.9	<0.1

Follow-up checks showed microcytic vs. macrocytic gaps in all elements ($p<0.001$).

Associations

Hb linked negatively to MCV ($r=-0.35$) and RDW ($r=-0.25$), positively to MCHC ($r=0.51$). Hct and RBC tally followed alike (Table 2).

Table 2: Associations Between Hb, Hct, RBC Tally, and FBC Elements

Element	Hb (g/dL)	Hct (%)	RBC Tally (×10¹²/L)
MCV (fL)	-0.35	-0.32	-0.28
MCH (pg)	0.42	0.38	0.35
MCHC (%)	0.51	0.48	0.45
RDW (%)	-0.25	-0.22	-0.20

Subgroup reviews: Women showed stronger links (e.g., Hb-MCHC: $r=0.58$ vs. men: $r=0.45$). Figure 1 shows Hb vs. MCV scatter chart.

Figure 1: Scatter Chart of Hemoglobin vs. Mean Corpuscular Volume (N=100) [Description: The chart displays a negative link ($r=-0.35$), with microcytic instances grouped at lower MCV.] Regression equations accounted for 22% of Hb variation via MCHC ($\beta=0.51$, $p<0.001$).

DEBATE

Main Findings and Explanations

FBC elements are essential for anemia identification, as shown by notable gaps in MCV, MCH, MCHC, and RDW among forms, matching existing knowledge [3,4]. Reduced MCV/MCHC signals microcytic anemia (e.g., iron lack), while increased MCV points to macrocytic (e.g., vitamin shortage) [5]. RDW's rise in microcytic cases helps in separation [6].

Associations affirm Hb's part in intensity evaluation, with MCHC mirroring hemoglobin density [7]. This backs FBC as a primary tool, directing actions like iron boosts [8]. Gender gaps (stronger in women) may tie to hormonal elements [9].

Effects for Application and Guidelines

Findings promote standard FBC in anemia checks, particularly for vulnerable groups. Facilities should adopt automated devices for precise RDW readings. Guideline suggestions include anemia education drives in India.

Restrictions and Strengths

Restrictions: Backward-looking setup, small group, absence of non-anemic comparisons. Strengths: Thorough element review, statistical solidity.

Future Investigation Directions

Forward-looking studies with bigger groups and extra tests (e.g., ferritin) are required.

FINAL REMARKS

This study shows that a standard **Complete Blood Count (CBC)** is a quick, cheap, and reliable way to find and sort anemia. By looking at simple blood markers like MCV, MCH, MCHC, and RDW in these 100 cases, doctors can easily tell if a patient has microcytic, normocytic, or macrocytic anemia. This means patients do not always need to get expensive extra tests right away.

In smaller or local clinics, checking the RDW parameter is incredibly helpful for spotting iron deficiency anemia. Even though this was a small study based on past hospital records, it proves that a routine CBC test is a powerful tool. Using it first helps doctors give the right treatment faster and provide much better care for patients in the region.

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