Diagnostic Accuracy of complete Blood Count versus Serum Ferritin in Diagnosis of iron deficiency Anemia in Pregnant Women

RABIA WAJID1, AMNA AHSAN2, SAIRA FAYYAZ3, NADIA SEHAR4, HINA MASOOD5, RIZWANA TARIQ6
1Assistant Professor, Obs & Gynae, Lady Willingdon Hospital, Lahore
2Associate Professor, HOD Gyn Department, Government Teaching Hospital Shadra
3Assistant Professor, Gynae Obs Lahore General Hospital, Lahore.
4PGR, Obs & Gynae Lady Willingdon Hospital Lahore.
5Assistant Professor, Obstetrics and Gynecology, FJMU/Sir Ganga Ram Hospital Lahore.
6Senior Registrar, Gynae Obs, Lahore General Hospital

Correspondence to: Dr. Rabia Wajid, Email: dr.rabia.adnan@gmail.com, Cell: 0302 865 7002

ABSTRACT
Objective: To determine the frequency of confirmation of iron deficiency anemia in pregnant female on serum Ferritin who are labeled to have iron deficiency anemia on CBC in third trimester.
Study Design: Cross-sectional study.
Study duration: October 2021 to March 2022.
Setting: Department of Obstetrics & Gynecology Lady Willingdon Hospital.
Patients and Methods: A total of 200 patients who came to OPD were selected. Detailed history was obtained from patients and physical examination performed. CBC and serum ferritin was determined for every patient. All data was entered into the especially designed proforma.
Results: Anemia was diagnosed in 74(37%) women. Highest frequency of anemia was seen in women in age group 20-30 years (33.78%), and in women with household income of Rs.15000/- to 50000/- per month. Mean hemoglobin of women was 11.41±1.05 gm./dl. Mean MCV of women was 83.12±8.45 fl. Minimum and maximum MCV was 68 and 95 fl respectively. Mean serum ferritin level of women was 13.14±2.34 µ/l. Anemia was diagnosed in 75(37.50%) women as per complete blood count criteria. Anemia was diagnosed in 74(37%) women as per serum ferritin level criteria.
Practical implication: This study will significantly contribute to the understanding and management of iron deficiency anemia in pregnant women, particularly during the third trimester. By confirming diagnoses through serum Ferritin tests in addition to complete blood count (CBC), the study can enhance the accuracy of diagnosis and treatment. Accurate detection of iron deficiency anemia will allow for more targeted and efficient treatment, thereby improving maternal and fetal health outcomes.
Furthermore, this research could inform public health policies and intervention strategies aimed at preventing and managing iron deficiency anemia in pregnancy, ultimately improving the overall well-being of the community.
Conclusion: Results of this study revealed that Serum ferritin level is a better diagnostic test for early detection of iron deficiency anemia in pregnant women.
Keywords: Confirmation, Iron deficiency, Anemia, Pregnant, Serum Ferritin, Complete blood Count, Third trimester.

INTRODUCTION
Anemia poses a significant public health concern, particularly in Southeast Asian nations, where its prevalence is high. Iron, a crucial element of hemoglobin, facilitates the transport of oxygen from the lungs to various body parts through the bloodstream. In pregnant women, hemoglobin levels below 11 g/dL are considered critically low, leading to anemia, which is predominantly attributed to iron deficiency.1

Iron deficiency is an issue, seen globally and considered to be widely present in many developing nations. Iron deficiency is common in absence of anemia. In a recently conducted study, the prevalence of anemia in all age groups was 22.8 %. Iron absorption is variable in males and females and iron requirement also do varies. Males have a requirement of 1 mg/day of iron and pregnant females have a higher requirement i.e. 4-5mg/day. About half of cases of iron deficiency anemia in pregnancy are due to low iron consumption.2,3,4

Anemia during pregnancy can cause fetal growth abnormalities, preterm births, and low birth weight infants. Additionally, it contributes to decreased fetal iron reserves. The global prevalence of iron deficiency anemia among pregnant women varies. In the United States, approximately 18% of pregnant women experience anemia.5-7

Another investigation focusing on pregnant women in Africa revealed a 29.1% prevalence of anemia. Research in Iran points to a prevalence of approximately 28%. A study conducted in India found that iron deficiency anemia affects 58.7% of pregnant women.8,9,10

In a study done on Pakistani women shows the presence of anemia in pregnant women to 90.5%. Another study was done in K.P.K. which showed prevalence to be 52%, 63.3% and 54% in first, second and third trimester respectively.11,12

In pregnancy, Ferritin level of <12 µL is a gold standard for the diagnosing iron deficiency anemia. Hemoglobin concentration decreases during pregnancy due to haemodilution. Microcytosis is one of sensitive indicators of iron deficiency anemia, but in pregnancy, it is not of much value because it leads to physiological increase in MCV. The day to day variations in serum iron levels calls for evaluating serum ferritin levels for diagnosis of iron deficiency in pregnancy.13,14 Studies have proven serum ferritin to be a non-invasive test, reliable and useful index of iron stores during pregnancy. Low levels are indicative of iron deficiency.15

Iron deficiency anemia in pregnancy is a very common health problem in Pakistan and conventional methods of detecting iron deficiency anemia in pregnant patients are not reliable according to some studies. So it is necessary to determine the diagnostic accuracy of the available tests i.e. complete blood count (CBC) as compared to serum ferritin in pregnant females as serum Ferritin is not available readily everywhere in Pakistan and is expensive in comparison to CBC.9,11,12

The significance of this study lies in its potential to improve both diagnostic accuracy and treatment approaches for iron deficiency anemia in pregnant women during their third trimester. While CBC is a commonly used test to diagnose iron deficiency anemia, relying solely on it may not provide the most accurate results. By incorporating serum Ferritin tests, this research can potentially enhance the detection and management of this condition, which is crucial considering the significant health implications for both the mother and the fetus.

The research gap this study addresses is the lack of comprehensive diagnostic methods used in detecting iron deficiency anemia in pregnant women. While iron deficiency anemia is known to be common in pregnancy, there is a lack of clarity on the best diagnostic methods, particularly in the third
Diagnostic Accuracy of complete Blood Count versus Serum Ferritin in Diagnosis of iron deficiency Anemia in Pregnant Women

trimester. This study aims to confirm whether incorporating serum Ferritin tests with the standard CBC can result in more accurate and reliable diagnoses, thereby filling an essential gap in the existing body of knowledge.

**Operational Definitions**

- **Anemia by CBC**: Patients who have hemoglobin < 11 mg/dl and mean corpuscular volume < 80 fl were considered to have anemia.
- **Anemia by Serum Ferritin**: Pregnant patients with serum ferritin levels < 12 µg/L were considered to have anemia.

**MATERIALS AND METHODS**

It was a cross-sectional study conducted at Lady Willingdon Hospital Unit 3 from October 2021 to March 2022. The calculation of sample size was done using 200 with 95% CI and 7% precision with sample size calculator keeping 54% as prevalence of anemia in pregnancy. Non-probability consecutive sampling was done. Pregnant women of childbearing age with no history of abnormal PV bleeding in previous 6 months and patients who consented to participate in study were included. The patients who had blood transfusion in last 6 months and those unwilling to participate in study were excluded from the study.12

In the outpatient department of Unit 3 at Lady Willingdon Hospital Lahore, a study encompassed 200 patients meeting the criteria. The Hospital Ethical Committee granted authorization. Histories were documented, and clinical examinations ensued.

Blood sample of 5 c.c was collected from all subjects in tubes containing Ethylenediaminetetraacetic acid (EDTA). The King Edward Medical University Pathology lab conducted Complete Blood Counts (CBC) and serum ferritin assessments. To appraise serum ferritin, 3 c.c of blood joined a test tube and remained at ambient conditions for half an hour. Subsequently, centrifugation at 3500 revolutions per minute spanned a quarter hour.

Hemoglobin and serum ferritin concentrations underwent scrutiny via an automated hemoglobin analyzer and an Enzyme-linked immunosorbsorbent assay (ELISA). For expectant females, the World Health Organization’s (WHO) diagnostic values served as benchmarks for serum ferritin and hemoglobin examination.

All data was entered into the especially designed proforma. Data was analysed using SPSS version 20.0. Numerical variables such as age, hemoglobin levels, and MCV and serum ferritin were expressed as mean ± SD. Categorical data such as trimester of pregnancy was presented as frequency and percentage. Data was stratified for age and economic status. Post stratification chi-square test was applied taking p-value <0.05 as significant.

**RESULTS**

Mean age of women was 34.26±8.14 years. Minimum and maximum age of women was 20 and 49 years. Table-1. Histogram for the age of women is shown in Figure-1. The socioeconomic status of the females is shown in Table-2. Mean hemoglobin level of women was 11.41±1.05 g/dl. Minimum and maximum hemoglobin of women was 9.56 and 12.99 g/dl. Table-3 Mean MCV of women was 83.12±8.45 fl. Minimum and maximum MCV values were 68 and 95 fl respectively. Table-4. Anemia among Women as per Complete Blood count is shown in Figure-2.

**Table-1: Age of patients (years)**

<table>
<thead>
<tr>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>34.26</td>
<td>8.145</td>
<td>20</td>
<td>49</td>
</tr>
</tbody>
</table>

**Table-2: Socioeconomic Status of Women**

<table>
<thead>
<tr>
<th>Income (Rs.)</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;15,000</td>
<td>63</td>
<td>31.5%</td>
</tr>
<tr>
<td>15,000-50,000</td>
<td>74</td>
<td>37.0%</td>
</tr>
<tr>
<td>&gt;50,000</td>
<td>63</td>
<td>31.5%</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Table-3: Descriptive statistics for Hemoglobin (g/dl)**

<table>
<thead>
<tr>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>11.41</td>
<td>1.05</td>
<td>9.56</td>
<td>12.99</td>
</tr>
</tbody>
</table>

**Table-4: Descriptive statistics for MCV (fl)**

<table>
<thead>
<tr>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>83.12</td>
<td>8.457</td>
<td>68</td>
<td>95</td>
</tr>
</tbody>
</table>

**Figure-1: Histogram for Age of Women**

**Figure-2: Iron deficiency Anemia among Women as per Complete Blood count**

**Table-5: Descriptive statistics for Serum Ferritin (µg/L)**

<table>
<thead>
<tr>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>13.14</td>
<td>2.34</td>
<td>9.10</td>
<td>17</td>
</tr>
</tbody>
</table>

**Figure-3: Histogram for Ferritin Level**
Mean serum ferritin level of women was 13.14±2.34 μg/L. Table-5 Anemia as diagnosed in 75(37.50%) women as per complete blood count criteria. Figure-3 Anemia was diagnosed in 74(37%) women as per serum ferritin level criteria. Figure-4

**DISCUSSION**

Various biomarkers are employed to assess iron levels, with plasma ferritin being among the most appropriate. It serves as a highly sensitive screening tool for iron. Serum ferritin, an iron-containing blood protein, has differing threshold values in pregnancy for defining iron deficiency. Numerous iron-related and hematological indicators are utilized to diagnose anemia during pregnancy. A serum ferritin concentration of less than 12 μg/L is regarded as a sign of iron deficiency.16, 17, 18

Typically, anemia is identified by hemoglobin levels below 11 g/dl. Additional red cell indices such as MCV, MCH, MCHC, and RDW are employed for anemia diagnosis. Reduced hemoglobin, below-normal MCV, and elevated RDW are observed in individuals experiencing microcytic anemia during pregnancy.19, 20

A local study also reported that iron deficiency can be reliably diagnosed through the measurement of serum ferritin.21, 22

According to the available evidence, serum ferritin is a useful and reliable measure of iron stores, during pregnancy especially, low levels usually indicate iron deficiency. One limitation of measuring serum ferritin is that it cannot provide indication of iron stores in those having an infection, inflammation or malignancy.23, 24

To address this discrepancy, certain markers can be utilized to assess iron status during inflammation when serum ferritin levels are elevated, but iron stores are low. However, the use of these markers is not preferred during pregnancy, as it is unclear how they are influenced by the physiological changes that occur in pregnancy.25

Iron deficiency, with or without anemia, is a significant public health issue that can coexist with conditions such as heart failure. Serum ferritin levels can detect subclinical iron deficiency before there is a decrease in hemoglobin or serum iron levels. Measuring serum ferritin offers the advantage of being less influenced by other types of anemia or oral iron therapy, and it only requires a small sample (0.2ml) for the assay. Consequently, based on the results of serum ferritin and a complete blood count (CBC), pregnant patients may be treated with either oral or parenteral iron.26, 27

**CONCLUSION**

This study revealed that Serum ferritin level is a better diagnostic test for early detection of iron deficiency anemia in pregnant women.

**REFERENCES**


