

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 Shahdra

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 commoner 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.^{5,6,7}

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 μ L 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.^{9,12,13,14}

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

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 < 11mg/dl and mean corpuscular volume < 80 fl were considered to have anemia.

Anemia by Serum Ferritin: Pregnant patients with serum ferritin levels < 12µ/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 immunosorbent 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±8.14years. 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 is Table-2. Mean hemoglobin level of women was 11.41±1.05 g/dl. Minimum and maximum hemoglobin of women were 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)

N	200
Mean	34.26
SD	8.145
Minimum	20
Maximum	49

Table-2: Socioeconomic Status of Women

Income (Rs.)	Frequency	Percent
<15,000	63	31.5%
15,000-50,000	74	37.0%
>50,000	63	31.5%
Total	200	100%

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

N	200
Mean	11.41
SD	1.05
Minimum	9.56
Maximum	12.99

Table-4: Descriptive statistics for MCV (fl)

N	200
Mean	83.12
SD	8.457
Minimum	68
Maximum	95

Figure-1: Histogram for Age of Women

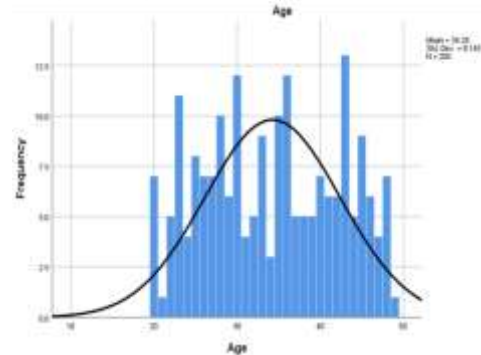


Figure-2: Iron deficiency Anemia among Women as per Complete Blood count

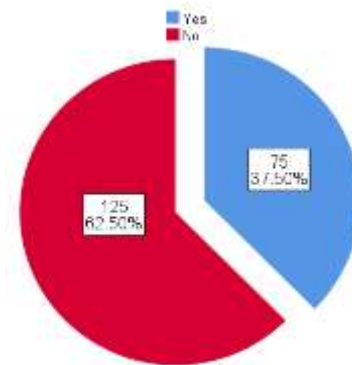


Table-5: Descriptive statistics for Serum Ferritin (µ/l)

N	200
Mean	13.14
SD	2.34
Minimum	9.10
Maximum	17

Figure-3: Histogram for Ferritin Level

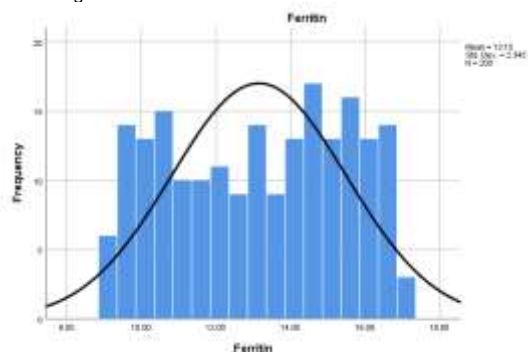
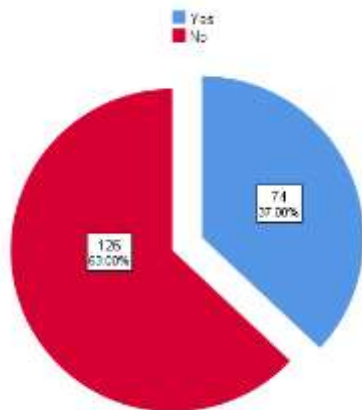


Figure-4: Iron deficiency Anemia among Women as per Serum Ferritin Level



Mean serum ferritin level of women was $13.14 \pm 2.34 \mu\text{g/L}$. 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 $12 \mu\text{g/L}$ 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 revealed that the number of pregnant women identified as having low iron stores through serum ferritin levels was significantly higher than when using other hematological parameters. As a result, serum ferritin is considered one of the most sensitive markers for detecting iron deficiency during pregnancy. A local study also reported that iron deficiency can be reliably diagnosed through the measurement of serum ferritin.^{21, 22, and 23}

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.^{24, 25}

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.²⁶

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.^{27, 28}

CONCLUSION

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

REFERENCES

- Sunuwar DR, Singh DR, Chadhary NK, Pradhan PMS, Rai P. Prevalence and factors associated with anaemia among women of reproductive age in seven South and southeastern countries : Evidence of nationally representative surveys. *PLoS ONE*.2020;15(8):e236449.
- Tan G, He G, Qbody mass i Y. Prevalence of anemia and iron deficiency anemia in Chinese Pregnant women (IRON WOMEN):a national cross -sectional survey. *BMC Pregnancy Childbirth*.2020;670
- Gardner W, Kassebaum N. Global, regional and national prevalence of anemia and its cause in 204 countries and territories. *Current developments in nutrition*.2020;4(2): 83
- Camaschella C. Iron deficiency. *Blood* 2019;133:30–9.
- Georgieff MK. Iron deficiency in pregnancy. *Am J Obstet Gynecol* 2020;223:516–24.
- Lammi-Keefe CJ, Couch SC, Kirwan JP. *Handbook of nutrition and pregnancy*: Springer; 2008.
- Mei Z, Cogswell ME, Looker AC, Pfeiffer CM, Cusick SE, Lacher DA, et al. Assessment of iron status in US pregnant women from the National Health and Nutrition Examination Survey (NHANES), 1999–2006. *The American journal of clinical nutrition* 2011;93(6):1312-20.
- Baingana RK, Enyaru JK, Tjalsma H, Swinkels DW, Davidsson L. The aetiology of anaemia during pregnancy: a study to evaluate the contribution of iron deficiency and common infections in pregnant Ugandan women. *Public health nutrition* 2015;18(8):1423-35.
- Karimi M, Yarmohammadi H, Kadivar R. Assessment of the prevalence of iron deficiency anemia, by serum ferritin, in pregnant women of Southern Iran. *Medical Science Monitor* 2002;8(7):CR488-CR92.
- Sciences IIFP. *National family health survey (NFHS-3), 2005-06*: India: International Institute for Population Sciences; 2007.
- Baig-Ansari N, Badruddin SH, Karmaliani R, Harris H, Jehan I, Pasha O, et al. Anemia prevalence and risk factors in pregnant women in an urban area of Pakistan. *Food and nutrition bulletin* 2008;29(2):132-9.
- Attaullah GNK, Ahmad B, Iqbal N, Ahmad N. In district Swat Khyber Pakhtunkhwa Pakistan anemia (iron deficiency) in pregnant women of different ages as a public health problem becomes a reality. *J Entomol Zool Stud* 2017;5(2):1266-9.
- Khusun H, Yip R, Schultink W, Dillon DH. World Health Organization hemoglobin cut-off points for the detection of anemia are valid for an Indonesian population. *The Journal of nutrition*. 1999 Sep 1;129(9):1669-74.
- Alper BS, Kimber R, Reddy AK. Using ferritin levels to determine iron-deficiency anemia in pregnancy. *Journal of Family Practice* 2000;49(9):829-32.
- Anand IS, Gupta P. Anemia and iron deficiency in heart failure: current concepts and emerging therapies. *Circulation* 2018;138:80–98.
- Abdelgader E, Diab T, Kordofani A, Abdalla S. Hemoglobin level, RBCs Indices, and iron status in pregnant females in Sudan. *Basic Res J Med Clin Sci* 2014;3(2):8-13.
- Tunkyi K, Moodley J. Anemia and pregnancy outcomes: a longitudinal study. *The Journal of Maternal-Fetal & Neonatal Medicine* 2018;31(19):2594-8.
- Qureshi HJ. Serum Ferritin as the Most Sensitive Measure of Iron Stores in Pregnant Women. *JPMA The Journal of the Pakistan Medical Association* 1988;38(7):185-7.
- Asif N, Ijaz A, Rafi T, Haroon ZH, Bashir S, Ayyub M. Diagnostic accuracy of serum iron and total iron binding capacity (TIBC) in iron deficiency state. *J Coll Physicians Surg Pak* 2016;26(12):958-61.
- Milman N. Iron and pregnancy—a delicate balance. *Annals of hematology* 2006;85(9):559-65.
- Monárrez-Espino J, Martínez H, Greiner T. Iron deficiency anemia in Tarahumara women of reproductive-age in Northern Mexico. *salud pública de méxico* 2001;43:392-401.
- Puolakka J, Jänne O, Pakarinen A, Vihko R. Serum ferritin in the diagnosis of anemia during pregnancy. *Acta Obstetrica et Gynecologica Scandinavica* 1980;59(sup95):57-63.
- Peyrin-Biroulet L, Williet N, Cacoub P. Guidelines on the diagnosis and treatment of iron deficiency across indications: a systematic review. *The American journal of clinical nutrition* 2015;102(6):1585-94.
- Snook J, Bhala N, Beales ILP. British Society of Gastroenterology guidelines on the management of iron deficiency in adults. *Gut* 2021;70:2030-51
- Thomas DW, Hincliffe RF, Briggs C, Macdougall IC, Littlewood T, Cavill I, et al. Guideline for the laboratory diagnosis of functional iron deficiency. *British journal of haematology* 2013;161(5):639-48.
- Muñoz M, Gómez-Ramírez S, Bhandari S. The safety of available treatment options for iron-deficiency anemia. *Expert Opin Drug Saf* 2018;17:149–59.
- von Haehling S, Ebner N, Evertz R et al. Iron deficiency in heart failure. *JACC Heart Fail* 2019;7:36–46.
- Gómez-Ramírez S, Shander A, Spahn DR et al. Prevention and management of acute reactions to intravenous iron in surgical patients. *Blood Transfus* 2019;17:137–45.