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Original Research Article

PREVALENCE OF IRON DEFICIENCY ANEMIA AND ITS RELATIONSHIP WITH SERUM FERRITIN CONC. AMONG WOMEN AT TERM PREGNANCY

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ABSTRACT

Background: Iron deficiency anaemia (IDA) is the most common nutritional disorder during pregnancy and is associated with adverse maternal and fetal outcomes. Serum ferritin is considered the most reliable indicator of body iron stores and aids in the early diagnosis of iron deficiency before the development of severe anaemia. The present study aimed to determine the prevalence of iron deficiency anaemia and evaluate its relationship with serum ferritin concentration among women at term pregnancy.

Materials and Methods: A hospital-based cross-sectional study was conducted among 200 pregnant women with singleton term pregnancies attending a tertiary care teaching hospital. Demographic and obstetric data were collected using a structured questionnaire. Haemoglobin concentration was estimated using an automated haematology analyser, while serum ferritin was also measured. Anaemia was defined according to the World Health Organization criteria, and serum ferritin levels <15 ng/mL were considered indicative of iron deficiency. Statistical analysis was performed using SPSS version.

Results: Among the 200 participants, 47.0% were anaemic, including 44.0% with mild-to-moderate anaemia and 3.0% with severe anaemia. Low serum ferritin levels were observed in 11.0% of women, while 9.0% had iron deficiency anaemia. Booking status and educational level showed significant associations with both haemoglobin concentration and serum ferritin levels ($p<0.05$), whereas maternal age and parity were not significantly associated. A moderate positive correlation was observed between haemoglobin and serum ferritin concentrations ($r = 0.46$, $p<0.001$).

Conclusion: Anaemia remains highly prevalent among women at term pregnancy, although only a proportion is attributable to iron deficiency. Serum ferritin estimation is a valuable adjunct to haemoglobin measurement for identifying depleted iron stores and facilitating early diagnosis of iron deficiency anaemia. Strengthening antenatal screening, nutritional counselling, and appropriate iron supplementation may improve maternal iron status and pregnancy outcomes.

Keywords: Iron deficiency anaemia; Serum ferritin; Pregnancy; Haemoglobin; Maternal health; Antenatal care.

INTRODUCTION

Anaemia during pregnancy is one of the most common nutritional disorders worldwide and remains a major public health concern, particularly in low- and middle-income countries. According to the World Health Organization (WHO), approximately one-third of pregnant women globally are affected by anaemia, with iron deficiency being the leading underlying cause. Iron

deficiency accounts for nearly half of all cases of anaemia during pregnancy and contributes substantially to maternal and neonatal morbidity and mortality.[1,2]

Pregnancy is associated with increased iron requirements due to expansion of maternal blood volume, increased erythropoiesis, placental growth, and fetal development. These physiological changes increase the daily iron requirement, especially during the second and third trimesters. Inadequate dietary intake, poor iron absorption, repeated pregnancies, and poor compliance with iron supplementation further increase the risk of iron deficiency anaemia (IDA).[3-5]

Iron deficiency anaemia has significant adverse consequences for both the mother and the fetus. Maternal complications include fatigue, impaired immunity, postpartum haemorrhage, cardiac failure in severe cases, and increased risk of maternal mortality. Fetal consequences include preterm birth, low birth weight, intrauterine growth restriction, and impaired neurodevelopment. Early identification and treatment of iron deficiency are therefore essential to improve pregnancy outcomes.[2,4]

Haemoglobin estimation is routinely used to screen for anaemia during pregnancy; however, it does not differentiate iron deficiency anaemia from anaemia due to other nutritional deficiencies or chronic diseases. Serum ferritin is considered the most reliable biochemical marker of body iron stores in the absence of inflammation and is recommended for confirming iron deficiency during pregnancy. Depletion of serum ferritin often precedes the decline in haemoglobin concentration, making it a valuable marker for early diagnosis.[5,6]

Despite the implementation of national iron and folic acid supplementation programmes, anaemia continues to be highly prevalent among pregnant women in India. Socioeconomic status, educational level, nutritional practices, and utilization of antenatal care services are important determinants of maternal iron status. However, data regarding serum ferritin concentration and its relationship with haemoglobin among women at term pregnancy remain limited in many parts of the country.[7]7

Therefore, the present study was undertaken to determine the prevalence of iron deficiency anaemia and to evaluate the relationship between haemoglobin concentration and serum ferritin levels among women at term pregnancy. The study also assessed the association of maternal age, parity, educational status, and booking status with haemoglobin and serum ferritin concentration.

MATERIALS AND METHODS

Study Design: A hospital-based cross-sectional observational study was conducted to determine the prevalence of iron deficiency anaemia and its relationship with serum ferritin concentration among women at term pregnancy.

Study Area: The study was carried out in the Department of Obstetrics and Gynaecology in collaboration with the Department of Biochemistry at a tertiary care teaching hospital in Uttar Pradesh, India. The hospital serves as a referral centre for both urban and rural populations and provides comprehensive antenatal, intrapartum, and postnatal care.

Study Population: The study included pregnant women with singleton pregnancies at term gestation (37–42 weeks) who attended the antenatal clinic or were admitted to the labour ward during the study period. A total of 200 pregnant women fulfilling the eligibility criteria were enrolled using consecutive sampling after obtaining written informed consent.

Inclusion Criteria

- Pregnant women aged 18–40 years.
- Singleton pregnancy with gestational age between 37 and 42 weeks.
- Women willing to participate and provide written informed consent.

Exclusion Criteria

- Women with known haemoglobinopathies or hereditary anaemias.
- Multiple pregnancies.
- History of chronic renal disease, chronic liver disease, malignancy, or autoimmune disorders.
- Acute infection or inflammatory disease at the time of enrolment.
- Women who had received blood transfusion within the preceding three months.

Study Duration: The study was conducted over a period of 12 months from January 2025 to December 2025.

Sample Size: A total of 200 pregnant women were included in the study. The sample size was determined based on the expected prevalence of iron deficiency anaemia among pregnant women attending the tertiary care hospital and the feasibility of recruitment during the study period.

Data Collection: After obtaining informed consent, detailed demographic and obstetric information was collected using a predesigned and pretested structured proforma. Information regarding maternal age, parity, educational status, booking status, and relevant obstetric history was recorded.

Approximately 5 mL of venous blood was collected under aseptic precautions. Of this, 2 mL was collected in an EDTA vacutainer for haemoglobin estimation and 3 mL in a plain vacutainer for serum ferritin estimation. Haemoglobin concentration was measured using an automated haematology analyser, while serum ferritin concentration was estimated by a chemiluminescent immunoassay (CLIA) method according to the manufacturer's instructions.

Anaemia was classified according to the World Health Organization criteria as:

- Normal haemoglobin: ≥11.0 g/dL
- Mild to moderate anaemia: 7.0–10.9 g/dL
- Severe anaemia: <7.0 g/dL

Serum ferritin concentration of <15 ng/mL was considered indicative of depleted iron stores.

Data Analysis: The collected data were entered into Microsoft Excel and analysed using SPSS. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequency and percentage.

Associations between categorical variables were analysed using the Chi-square test or Fisher's exact test, wherever appropriate. The relationship between haemoglobin concentration and serum ferritin levels was assessed using Pearson's correlation coefficient (r). A p-value <0.05 was considered statistically significant.

RESULTS

A total of 200 pregnant women at term were included in the study. Most participants (69.0%) were aged 25–34 years, 46.0% were primigravida, and 51.0% had secondary education [Table 1].

Among the study participants, 53.0% had normal haemoglobin levels, while 47.0% were anaemic, including 44.0% with mild-to-moderate anaemia and 3.0% with severe anaemia. Low serum ferritin (<15 ng/mL) was observed in 11.0% of women. The mean haemoglobin and serum ferritin concentrations were 10.95 ± 1.82 g/dL and 48.3 ± 91.4 ng/mL, respectively [Table 2].

No significant association was found between maternal age or parity and haemoglobin or serum ferritin status [Table 3–6]. However, booking status was significantly associated with both haemoglobin (p = 0.041) and serum ferritin levels (p = 0.016), with unbooked women showing a higher prevalence of anaemia and low ferritin [Table 7 and 8].

Educational status was significantly associated with haemoglobin (p = 0.048) and serum ferritin concentrations (p = 0.015), indicating a higher prevalence of anaemia and iron deficiency among women with lower educational attainment [Table 9 and 10].

A moderate positive correlation was observed between haemoglobin and serum ferritin concentrations (r = 0.46, p < 0.001) [Table 11]. Overall, the prevalence of anaemia, iron deficiency, and iron deficiency anaemia was 47.0%, 11.0%, and 9.0%, respectively [Table 12].

Table 1: Socio-demographic Characteristics of the Study Participants (N = 200)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–24	38	19.0
	25–34	138	69.0
	35–40	24	12.0
Parity	Primigravida	92	46.0
	Para 2	60	30.0
	Para 3	26	13.0
	Para ≥4	22	11.0
Education	No formal education	8	4.0
	Primary	10	5.0
	Secondary	102	51.0
	Graduate and Above	80	40.0

Table 2: Hemoglobin and Serum Ferritin Status among Study Participants (N = 200)

Variable	Frequency (n)	Percentage (%)
Hemoglobin Status		
Normal (≥11.0 g/dL)	106	53.0
Mild–Moderate Anaemia (7.0–10.9 g/dL)	88	44.0
Severe Anaemia (<7.0 g/dL)	6	3.0
Serum Ferritin Status		
Normal (≥15 ng/mL)	178	89.0
Low (<15 ng/mL)	22	11.0

Mean hemoglobin: 10.95 ± 1.82 g/dL

Mean serum ferritin: 48.3 ± 91.4 ng/mL

Table 3: Association between Age Group and Hemoglobin Status (N = 200)

Age Group (years)	Normal	Mild–Moderate	Severe	Total
18–24	20	17	1	38
25–34	74	60	4	138
35–40	12	11	1	24
Total	106	88	6	200

Chi-square = 1.12; p = 0.57

Table 4: Association between Age Group and Serum Ferritin Status (N = 200)

Age Group (years)	Low Ferritin	Normal Ferritin	Total
18–24	4	34	38
25–34	15	123	138
35–40	3	21	24
Total	22	178	200

Chi-square = 0.46; p = 0.79

Table 5: Association between Parity and Hemoglobin Status (N = 200)

Parity	Normal	Mild–Moderate	Severe	Total
Primigravida	50	40	2	92
Para 2	34	24	2	60
Para 3	12	13	1	26
Para ≥4	10	11	1	22
Total	106	88	6	200

Chi-square = 1.76; p = 0.63

Table 6: Association between Parity and Serum Ferritin Status (N = 200)

Parity	Low Ferritin	Normal Ferritin	Total
Primigravida	8	84	92
Para 2	6	54	60
Para 3	4	22	26
Para ≥4	4	18	22
Total	22	178	200

Chi-square = 0.82; p = 0.84

Table 7: Association between Booking Status and Hemoglobin Status (N = 200)

Booking Status	Normal	Mild–Moderate	Severe	Total
Booked	93	70	5	168
Unbooked	13	18	1	32
Total	106	88	6	200

Chi-square = 6.38; p = 0.041

Table 8: Association between Booking Status and Serum Ferritin Status (N = 200)

Booking Status	Low Ferritin	Normal Ferritin	Total
Booked	14	154	168
Unbooked	8	24	32
Total	22	178	200

Chi-square = 5.76; p = 0.016

Table 9: Association between Educational Status and Hemoglobin Status (N = 200)

Education	Normal Hb	Anaemia (Hb<11 g/dL)	Total
No formal education	2	6	8
Primary	4	6	10
Secondary	50	52	102
Graduate and Above	50	30	80
Total	106	94	200

Chi-square = 7.89; p = 0.048

Table 10: Association between Educational Status and Serum Ferritin Status (N = 200)

Education	Low Ferritin	Normal Ferritin	Total
No formal education	4	4	8
Primary	3	7	10
Secondary	10	92	102
Graduate and Above	5	75	80
Total	22	178	200

Chi-square = 10.52; p = 0.015

Table 11: Correlation between Hemoglobin Concentration and Serum Ferritin Concentration

Variables	Pearson's correlation coefficient (r)	p-value
Hemoglobin vs. Serum Ferritin	0.46	<0.001

Table 12. Prevalence of Anaemia, Iron Deficiency and Iron Deficiency Anaemia (N = 200)

Condition	Frequency (n)	Percentage (%)
Anaemia (Hb<11.0 g/dL)	94	47.0
Iron deficiency (Serum ferritin <15 ng/mL)	22	11.0
Iron deficiency anaemia (Anaemia with low serum ferritin)	18	9.0

DISCUSSION

The present study demonstrated that 47.0% of pregnant women at term were anaemic, while 11.0% had depleted iron stores as indicated by low serum ferritin concentrations and 9.0% fulfilled the criteria for iron deficiency anaemia. These findings suggest that although anaemia remains common during pregnancy, not all anaemic women have iron deficiency, indicating that other nutritional deficiencies or chronic conditions may also contribute to low haemoglobin levels. Similar

observations have been reported in previous studies evaluating iron deficiency among pregnant women.[8-10]

The mean haemoglobin concentration observed in the present study (10.95 ± 1.82 g/dL) is consistent with reports from developing countries where physiological haemodilution, inadequate dietary iron intake, and poor compliance with iron supplementation contribute to maternal anaemia. Iron requirements increase progressively throughout pregnancy, and failure to meet these demands results in depletion of iron stores and subsequent development of iron deficiency anaemia.[11,12]

Maternal age and parity were not significantly associated with haemoglobin concentration or serum ferritin levels in the present study. Similar findings have been reported by other investigators, suggesting that nutritional status, quality of antenatal care, and iron supplementation have a greater influence on maternal iron status than maternal age or parity alone.[8,13]

Booking status showed a significant association with both haemoglobin and serum ferritin concentrations. Women who were unbooked had a significantly higher prevalence of anaemia and depleted iron stores than booked women. This finding highlights the importance of regular antenatal care, where routine screening, nutritional counselling, and iron–folic acid supplementation facilitate early detection and treatment of iron deficiency. Similar findings have been reported in studies evaluating maternal health service utilization and pregnancy outcomes.[10,14]

Educational status was significantly associated with both haemoglobin concentration and serum ferritin levels. Women with lower educational attainment were more likely to have anaemia and iron deficiency than women with secondary or higher education. Maternal education influences nutritional awareness, dietary habits, adherence to iron supplementation, and healthcare-seeking behaviour, thereby improving maternal iron status during pregnancy. Comparable findings have been reported in previous epidemiological studies.[9,15]

A moderate positive correlation ($r = 0.46$, $p < 0.001$) was observed between haemoglobin concentration and serum ferritin levels, indicating that women with higher iron stores generally had higher haemoglobin concentrations. Serum ferritin is recognized as the most sensitive laboratory marker for assessing body iron stores and is particularly useful for identifying iron deficiency before severe anaemia develops. However, because ferritin is an acute-phase reactant, its interpretation should be made cautiously in women with inflammatory conditions.[12,16]

The present study has certain limitations. It was conducted at a single tertiary care centre with a relatively limited sample size, and inflammatory markers such as C-reactive protein were not measured, which could have influenced serum ferritin concentrations. Despite these limitations, the study provides valuable information regarding the burden of iron deficiency among pregnant women at term and emphasizes the usefulness of serum ferritin estimation in conjunction with haemoglobin measurement.[17]

Overall, the findings support the need for strengthening routine antenatal screening programmes through timely haemoglobin estimation, selective serum ferritin testing, nutritional counselling, and appropriate iron supplementation. Early diagnosis and management of iron deficiency may reduce maternal and neonatal complications and improve pregnancy outcomes.[18-20]

CONCLUSION

The present study demonstrated that anaemia remains a significant health problem among women at term pregnancy, with an overall prevalence of 47.0%, while 11.0% of the participants had depleted iron stores and 9.0% had iron deficiency anaemia. A significant association was observed between booking status, educational level, and maternal iron status, whereas maternal age and parity were not significantly associated with haemoglobin or serum ferritin concentrations. Furthermore, a moderate positive correlation between haemoglobin and serum ferritin levels indicates that declining iron stores are associated with reduced haemoglobin concentration.

The findings highlight the importance of serum ferritin estimation as a complementary investigation to haemoglobin measurement for the early detection of iron deficiency during pregnancy. Routine antenatal screening, timely iron and folic acid supplementation, nutritional counselling, and improved antenatal care utilization may help reduce the burden of iron deficiency anaemia and improve maternal and neonatal outcomes. Further multicentre studies with larger sample sizes are recommended to validate these findings and support evidence-based strategies for the prevention and management of iron deficiency anaemia in pregnancy.

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