Advances in Obstetrics and Gynecology Research, 2025, Volume 3, Issue 2
https://ojs.bbwpublisher.com/index.php/AOGR
Online ISSN: 2981-8060

Study on the Correlation between Pregnancy Anemia and Serum Ferritin Levels in Jinan Area and Prevention of Iron Deficiency

Xiaojuan Wang, Qiuling Zhu*

Delivery room, Jinan Maternity and Child Care Hospital, Jinan 250000, Shandong, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: *Objective*: To analyze the correlation between pregnancy anemia and serum ferritin (SF) levels in Jinan area and explore methods for preventing iron deficiency. *Methods*: A total of 1000 pregnant women who underwent prenatal check-ups and gave birth in the hospital from January 2020 to July 2022 were selected as samples. Routine blood tests and SF detection were performed, and the number of patients with iron deficiency anemia (IDA) in the second and third trimesters, blood routine data, and SF level data were recorded. *Results*: There were 160 cases (16.00%) of IDA in the second trimester and 200 cases (20.00%) in the third trimester. The erythrocyte parameters and SF levels of IDA pregnant women in the second trimester were lower than those of healthy pregnant women ($P < 0.05$). The incidence of IDA was higher in pregnant women with SF < 10 ng/mL than in those with SF 10–19.9 ng/mL, SF 20–29.9 ng/mL, and SF ≥ 30 ng/mL, and the lower the SF level, the higher the incidence of IDA ($P < 0.05$). There was no statistical difference in adverse pregnancy outcomes between anemic and non-anemic pregnant women among different levels of SF ($P > 0.05$). *Conclusion*: Pregnant women with low SF levels in the second and third trimesters are more prone to IDA. Active intervention can reduce adverse pregnancy outcomes and ensure the safety of mothers and babies.

Keywords: Pregnancy anemia; Serum ferritin level; Correlation; Prevention of anemia

Online publication: April 28, 2025

1. Introduction

IDA is a type of nutritional disorder during pregnancy, which is related to the reduction of the body's iron storage capacity during pregnancy and the inability to produce red blood cells. It is a common type of anemia during pregnancy. In addition, due to the special physiological state during pregnancy and the increase in blood volume, pregnant women's demand for iron increases. Coupled with the growth and development of the fetus, which also requires iron, inadequate intake and absorption of iron by pregnant women can induce IDA. After the occurrence of IDA, the blood cell's oxygen-carrying capacity of pregnant women is further reduced, which can easily lead to adverse events such as low birth weight infants, premature infants, and fetal death in utero. The fetus's congenital deficiency can affect brain development and reduce immunity. Therefore, it is extremely important to carry out iron supplementation therapy for IDA patients in combination with relevant guidelines. SF is a glycoprotein substance with strong iron storage capacity, which can regulate the distribution of iron elements in the human body. The fluctuation of SF levels is not affected by recent iron intake levels and can objectively reflect the iron storage situation of pregnant women. It is sensitive in evaluating iron deficiency diseases [1]. Based on this, this article explores the correlation between SF levels and IDA in pregnant women using 1000 pregnant women who underwent prenatal check-ups and gave birth in our hospital from January 2020 to July 2022 as samples and discusses methods for preventing iron deficiency.

2. Materials and methods

2.1. Materials

A total of 1000 pregnant women who underwent prenatal check-ups and gave birth in our hospital from January 2020 to July 2022 were selected as samples, aged 21–39 years old, with an average age of (28.43 ± 1.58) years old. The number of pregnancies ranged from 1 to 4, with an average of (1.89 ± 0.42) times. The pre-pregnancy BMI ranged from 18 to 29 kg/m^2, with an average of (25.74 ± 1.58) kg/m^2. Inclusion criteria: (1) Singleton pregnancy; (2) Regular prenatal check-ups; (3) Blood routine and SF tests ≥ 2 times in the second and third trimesters. Exclusion criteria: (1) Prenatal bleeding; (2) Immune system diseases; (3) History of hypertension.

2.2. Methods

In the second and third trimesters of pregnancy, 3–4 mL of blood samples were collected from the median cubital vein of the enrolled pregnant women. Routine blood tests were performed using a BC6800-Plus full blood cell analyzer. Platelet and red blood cell results were obtained using the sheath flow impedance method, hemoglobin results were obtained using the colorimetric method, and cell classification and counting were obtained using flow cytometry. Serum ferritin (SF) was detected using an automatic electrochemiluminescence immunoassay analyzer. After collecting 5 mL of peripheral venous blood samples, they were stored in a vacuum blood collection tube without anticoagulant. After resting for 60 minutes, the samples were centrifuged at 3000 revolutions per minute for 10 minutes. The supernatant serum was stored in a refrigerator at -20 ℃, and the examination was completed according to the kit. Based on the "Guidelines for the Diagnosis and Treatment of Iron Deficiency and Iron Deficiency Anemia During Pregnancy" [2] criteria, SF < 20 mg/L was considered as iron deficiency, hemoglobin < 110 g/L was considered as anemia, and meeting both criteria was considered as IDA (iron deficiency anemia). Pregnant women diagnosed with IDA were treated with iron supplementation based on their physiological status.

2.3. Statistical analysis

Data were processed using SPSS 23.0. Count data were recorded as percentages (%) and tested using the chi-square test (χ^2 test). Measurement data were recorded as mean ± standard deviation (SD) and tested using the *t*-test. Statistical differences were considered significant at $P < 0.05$.

3. Results

3.1. Occurrence of IDA in the second and third trimesters of pregnancy

There were 160 cases (16.00%) of IDA in the second trimester and 200 cases (20.00%) in the third trimester.

3.2. Red blood cell parameters and SF levels in healthy and IDA pregnant women

The red blood cell parameters and SF levels in IDA pregnant women were lower than those in healthy pregnant women during the second trimester ($P < 0.05$). See **Table 1** for details.

Table 1. Analysis of red blood cell parameters and SF levels in healthy and IDA pregnant women (mean ± SD)

Group	SF (ng/mL)	Red blood cell count ($\times 10^{12}$/L)	Hemoglobin (g/L)	Mean corpuscular volume (fl)	Mean corpuscular hemoglobin (pg)
IDA pregnant women (*n* = 160)	9.98 ± 1.21	3.52 ± 0.58	101.25 ± 3.26	26.81 ± 1.85	26.33 ± 1.25
Healthy pregnant women (*n* = 840)	47.26 ± 8.69	4.01 ± 0.69	120.48 ± 4.11	30.39 ± 1.96	30.11 ± 1.69
t	54.1432	8.4322	55.9193	21.3616	26.9196
P	0.0000	0.0000	0.0000	0.0000	0.0000

3.3. Correlation analysis between SF level and IDA

Pregnant women with SF levels < 10 ng/mL have a higher incidence of IDA compared to those with SF levels of 10–19.9 ng/mL, 20–29.9 ng/mL, and ≥ 30 ng/mL. Moreover, the lower the SF level, the higher the incidence of IDA ($P < 0.05$). See **Table 2**.

Table 2. Correlation analysis table between SF level and IDA (*n*, %)

SF level	Second trimester (*n* = 160)		Third trimester (*n* = 200)	
	Mild anemia	Moderate anemia	Unresolved anemia from second trimester	Newly developed anemia in third trimester
< 10 ng/mL	73 (45.63)	12 (7.50)	36 (18.00)	70 (35.00)
10–19.9 ng/mL	32 (20.00)	4 (2.50)	14 (7.00)	34 (17.00)
20–29.9 ng/mL	25 (15.63)	4 (2.50)	12 (6.00)	22 (11.00)
≥ 30 ng/mL	6 (3.75)	4 (2.50)	6 (3.00)	6 (3.00)
χ^2/P (1 and 2)	31.9083/0.0000		35.5190/0.0000	
χ^2/P (1 and 3)	42.7321/0.0000		56.9670/0.0000	
χ^2/P (1 and 4)	84.2105/0.0000		106.2147/0.0000	
χ^2/P (2 and 3)	0.9460/0.3307		3.0066/0.0829	
χ^2/P (2 and 4)	17.1628/0.0000		25.4118/0.0000	
χ^2/P (3 and 4)	10.5411/0.0012		11.8890/0.0006	

3.4. Analysis of adverse pregnancy outcomes

Among pregnant women with different levels of SF, there was no statistical difference in adverse pregnancy outcomes between anemic and non-anemic pregnant women ($P > 0.05$). See **Table 3**.

Table 3. Analysis table of adverse pregnancy outcomes (n, %)

SF level		Postpartum hemorrhage	Premature rupture of membranes	Low birth weight infant	Fetal distress	Total	χ^2	P
< 10 ng/mL	Anemia (n = 103)	2 (1.94)	2 (1.94)	1 (0.97)	1 (0.97)	6 (5.83)	0.0092	0.9237
	Normal (n = 55)	1 (1.82)	1 (1.82)	1 (1.82)	0 (0.00)	3 (5.45)		
10–19.9 ng/mL	Anemia (n = 41)	1 (2.44)	1 (2.44)	0 (0.00)	0 (0.00)	2 (4.88)	0.1601	0.6890
	Normal (n = 115)	2 (1.74)	2 (1.74)	1 (0.87)	0 (0.87)	4 (3.48)		
20–29.9 ng/mL	Anemia (n = 33)	0 (0.00)	1 (3.03)	0 (0.00)	0 (0.00)	1 (3.03)	0.0030	0.9565
	Normal (n = 175)	1 (0.57)	2 (1.74)	0 (0.00)	2 (1.74)	5 (2.86)		
≥ 30 ng/mL	Anemia (n = 23)	1 (4.35)	1 (4.35)	0 (0.00)	0 (0.00)	2 (8.70)	0.2930	0.5883
	Normal (n = 455)	8 (1.76)	8 (1.76)	8 (1.76)	3 (0.66)	27 (5.93)		

4. Discussion

Iron is an essential trace element for maintaining the normal functioning of bodily organs. It regulates the oxygen transport of myoglobin and hemoglobin. Inadequate intake or absorption of iron can induce anemia, especially during pregnancy, where the incidence of IDA is relatively high, making it a common type of anemia pathology. IDA can cause malnutrition in pregnant women, leading to various pregnancy complications [3]. Additionally, insufficient nutrient intake can restrict fetal growth and development, indicating that IDA poses a significant hazard to the health of both mother and child. Furthermore, different degrees of anemia in pregnant women manifest as various symptoms. Pregnant women with mild IDA may experience weakness, fatigue, tiredness, dizziness, blurred vision, paleness, inability to concentrate, and memory decline. Those with moderate IDA may suffer from shortness of breath, palpitations, and abdominal distension. In severe IDA, the blood's oxygen-carrying capacity decreases, which can lead to placental hypoxia, resulting in placental villus necrosis and degeneration, thereby increasing the risk of intrauterine distress [4]. According to the data presented in this paper, there were 160 cases (16.00%) of IDA in the second trimester and 200 cases (20.00%) in the third trimester, indicating a relatively high incidence of IDA during pregnancy.

SF is an iron-containing protein belonging to macromolecules that can store iron and control its intracellular distribution. When the level of free iron in the human body rises, SF plays a storage role, reducing cytotoxic reactions. When iron levels decrease, SF releases iron to meet the body's daily needs. Based on the different proportions of SF light subunit (L) and heavy subunit (H), it can be divided into acidic ferritin (dominated by the H subunit) and basic ferritin (dominated by the L subunit), which play roles in areas such as the myocardium, placenta, liver, and spleen tissues [5]. During pregnancy, SF levels undergo changes. This paper monitored blood routine indicators and SF indicators during pregnancy. The results showed that the erythrocyte parameters and SF levels of pregnant women with IDA in the second trimester were lower than those of healthy pregnant women ($P < 0.05$). This indicates abnormalities in both SF and erythrocyte parameters in pregnant women with IDA. Clinically, blood routine results are often used to evaluate anemia, but the sensitivity and accuracy of IDA assessment are insufficient, requiring a comprehensive analysis of anemia status based on other laboratory results [6]. The SF indicator can accurately reflect the body's iron storage state, enabling precise prediction of IDA during pregnancy. Specifically, individuals with lower SF concentrations are more prone to IDA. Additionally, hemoglobin is a primary indicator for screening anemia. Obtaining hemoglobin levels in pregnant women can assist physicians in initially assessing anemia risk. However, numerous factors can influence hemoglobin, such as acute or chronic blood loss, nutritional deficiencies, and lack of hematopoietic materials, which can cause hemoglobin levels to fluctuate. Iron is a crucial component of hemoglobin, and iron deficiency can affect the body's hemoglobin synthesis, leading to decreased hemoglobin concentration and even inducing symptoms like memory loss and tinnitus, posing significant hazards to the physical and mental health of pregnant women [7]. Another set of data presented in this paper demonstrates that pregnant women with SF levels < 10 ng/mL have a higher IDA incidence compared to those with SF levels of 10–19.9 ng/mL, 20–29.9 ng/mL, and ≥ 30 ng/mL. Moreover, the lower the SF level, the higher the IDA incidence ($P < 0.05$). This suggests a certain relationship between SF levels and IDA incidence, making it possible to evaluate the IDA incidence during pregnancy by monitoring SF indicators.

Pregnant women in a healthy state should provide 3–7 mg of iron daily to the fetus, transported via the placenta. However, as the gestational period increases, the pregnant woman's demand for iron increases. Some pregnant women develop IDA (Iron Deficiency Anemia) due to long-term iron deficiency, which can affect placental nutrition supply, restrict normal fetal growth and development, and increase the risk of premature birth and fetal death [8]. Based on the data analysis in this article, there was no statistical difference in adverse pregnancy outcomes between anemic and non-anemic pregnant women among different levels of SF (serum ferritin), with $P > 0.05$. The reason for this is that most of the IDA pregnant women in this study had mild anemia, and all received active treatment after being monitored for anemia, leading to rapid correction of the anemia. Only a few anemia patients remained untreated in the late pregnancy. Additionally, a few patients developed new anemia in the late pregnancy, but as they were close to delivery, the harm of anemia to the fetus was reduced, so anemia did not affect fetal growth and development. In this study, there were no serious adverse pregnancy outcomes among pregnant women with different SF levels, regardless of whether they developed anemia [9].

However, it should be noted that after a pregnant woman is diagnosed with IDA, she should adjust her diet, increase intake of iron-rich foods such as mutton, beef, blood products, and animal liver, and pay attention to vitamin C supplementation to improve the body's iron intake. Pregnant women should also avoid coffee and strong tea, as the calcium and tannic acid in these foods can form insoluble complexes with iron, inhibiting the body's absorption of iron. They should also avoid strenuous activities, excessive fatigue, correct poor sleep habits, and increase daily sleep time to reduce anemia symptoms. If dietary adjustments cannot meet the iron supplementation needs, pregnant women can take iron element such as ferrous gluconate and ferrous sulfate orally as prescribed by a doctor, starting with a small dose and gradually increasing the dose to reduce gastrointestinal irritation. When taking iron supplements, tetracyclines and antacids should be avoided to prevent adverse effects on iron absorption. Some pregnant women who are not tolerant of oral iron supplements can be prescribed iron supplements such as iron sorbitol and iron dextran injections [10]. Additionally, pregnant women should regularly monitor blood routine tests to evaluate changes in red blood cells, hemoglobin SF, and analyze the correction of IDA. They should also periodically review indicators such as transferrin saturation to analyze the storage and utilization of iron elements in pregnant women.

5. Conclusion

In summary, the lower the SF level in the second and third trimesters of pregnancy, the higher the incidence of

IDA. Active management and control after IDA diagnosis can reduce adverse pregnancy outcomes and ensure the health of both mother and baby. However, the number of pregnant women in the second and third trimesters included in this study for blood routine and SF testing was relatively small, and there may be some chance in the evaluation of the correlation between SF and IDA. In the future, the number of pregnant women samples should be increased to further analyze the correlation between SF and IDA, and summarize iron deficiency prevention strategies in clinical practice.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Hu Y, Zeng Q, Li H, et al., 2024, Predictive Value of Red Blood Cells and Iron Parameters in Late Pregnancy for Pregnancy Outcomes in Anemic Pregnant Women in Plateau Areas. Journal of Molecular Diagnostics and Therapeutics, 16(7): 1204–1207.

[2] Zhao Y, Liu C, 2023, Guidelines for Diagnosis, Treatment, and Healthcare of Iron Deficiency Anemia during Twin Pregnancy (2023 edition). Chinese Journal of Practical Gynecology and Obstetrics, 39(4): 419–430.

[3] Liao J, 2024, Value Analysis of Combined Detection of Serum Folate, Vitamin B12, and Ferritin in the Diagnosis of Anemia During Pregnancy. Modern Diagnostics & Therapeutics, 35(7): 1043–1044 + 1047.

[4] Xu H, 2024, Relationship Between Serum Indicators of Pregnant Women and Premature Birth and Neonatal Birth Weight. Chinese Maternal and Child Health Care, 39(21): 4261–4264.

[5] Huang Y, Xie Y, 2024, Correlation Between Serum 25-(OH)D and Ferritin Levels and Thyroid Function in Early Pregnancy. Journal of Central South Medical Science, 52(3): 421–423.

[6] Wu Y, Yang F, Huang G, 2024, Study on the Value of Combined Detection of Reticulocyte Hemoglobin Content and Ferritin in Iron Deficiency Anemia During Pregnancy. Health Research for Men and Women, 2024(10): 94–96.

[7] Cui W, Jiang H, Wang P, 2024, Differences and Correlations of Hb, VA, SF, Zn, and IFA Expression in Anemic and Non-Anemic Pregnant Women. Labeled Immunoassays and Clinical Medicine, 31(2): 218–223.

[8] Li D, Yang X, Cao X, 2024, Predictive Value of Serum Iron and Soluble Transferrin Receptor Detection in Anemic Pregnant Women on Pregnancy Outcomes. Journal of Developmental Medicine (Electronic Edition), 12(1): 30–35.

[9] Luo D, Xu B, Yang Y, et al., 2024, Analysis of the Effect of Traditional Chinese Medicine Treatment on the Efficacy and Pregnancy Outcomes of Pregnancy Complicated With Thalassemia Based on Cohort Studies. Journal of Guangzhou University of Chinese Medicine, 41(10): 2695–2703.

[10] He F, Pu L, Huang M, et al., 2024, Correlation Between Serum Ferritin Levels and Their Dynamic Changes in Early and Mid-Pregnancy and Gestational Diabetes Mellitus. Chinese Maternal and Child Health Care, 39(12): 2140–2145.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.