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Study of Clinical Parameters in Pregnant Women with Anemia

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ABSTRACT

Background & Objective: Anemia is the most common maternal health problem during pregnancy. It is associated with various physiological changes, including metabolic and hematological alterations. This study aimed to explore the relationship between anemia and selected clinical parameters in pregnant women, and to assess how age and body mass index (BMI) influence hematological and biochemical indices.

Materials & Methods: The study was conducted at Al-Hakim Hospital and affiliated medical clinics between June and September 2025. A total of 80 pregnant women aged 25–35 years were enrolled and divided into three groups: Group 1 (Control), 40 non-anemic pregnant women aged 25–35 years. Group 2, 20 anemic pregnant women aged 25–30 years and Group 3, 20 anemic pregnant women aged 30–35 years. Data were expressed as mean ± standard deviation (SD) and analyzed using one-way ANOVA followed by Tukey's HSD test, with statistical significance set at $p \leq 0.05$.

Results: Compared to the control group, anemic women showed a significant decrease in hemoglobin (Hb), red blood cell count (RBC), platelet count (PLT), calcium (Ca), and vitamin D levels, while white blood cell count (WBC) and fasting blood glucose (FBG) levels were significantly increased. A positive association was found between BMI and anemia, with 49% of anemic women classified as obese (BMI 30–39.9) and 26% as overweight.

Conclusion: This study highlights notable alterations in complete blood count (CBC), biochemical markers, and BMI among some of pregnant women in Maysan, Iraq. Anemia represents a hematological disorder linked to systemic metabolic imbalances influenced by inflammation, nutrient deficiencies, and obesity. Routine screening for Hb, RBC, FBG, Ca, and vitamin D_3 is strongly recommended during pregnancy to enable early detection and effective management of anemia, particularly among women with higher BMI or advanced maternal age.

Keywords: Anemia, Pregnant Women, Hematologic Tests, Clinical Parameters

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1. Introduction

Pregnancy is accompanied by numerous physiological changes and adaptations across various body systems. Among the most common maternal health concerns during this period is anemia, which remains a significant public health issue, particularly in developing countries (1). According to the WHO, anemia is defined as a condition in which the number or size of red blood cells, or the concentration of hemoglobin, falls below normal levels. Pregnant women are considered anemic when their hemoglobin concentration is less than 11.0 g/dL, whereas non-pregnant women are classified as anemic when their hemoglobin level is below 12.0 g/dL s (2). Anemia during pregnancy arises mainly from three underlying causes: nutritional deficiencies, infectious diseases, and genetic disorders affecting hemoglobin ynthesis (3). The CBC is one of the most essential laboratory tests used in evaluating hematological abnormalities and monitoring maternal health during pregnancy (4). Common hematologic alterations during pregnancy include physiological anemia, mild thrombocytopenia, neutropenia, increased coagulation factors, and reduced fibrinolysis. Anemia is the most common hematologic disorder in pregnancy which is linked with adverse pregnancy outcomes, followed by thrombocytopenia, which typically returns to normal within a few weeks after delivery (5, 6). Anemia is one of the most common blood diseases in the world, causing about 20% of maternal

deaths (7). Globally, anemia remains one of the most common blood disorders, contributing to approximately 20% of maternal deaths (7).

Several forms of anemia exist, each with distinct etiologies and varying degrees of severity ranging from temporary to chronic conditions (2). Garzon et al (8) reported that the prevalence of anemia among pregnant women reaches 14% in developed countries and 51% in developing countries, with nearly one-third of the world's population suffers from anemia (8).

Additionally, obesity complicates pregnancy and increases the risk of adverse outcomes for both the mother and the fetus. Obese women are more prone to developing hypertension, gestational diabetes mellitus (GDM), preeclampsia (PE), and delivery complications (9-11). Obesity is also linked to metabolic and nutritional disturbances, such as impaired iron metabolism, which contributes to anemia and increases susceptibility to various chronic diseases (12, 13).

Given the high prevalence of anemia among pregnant women, particularly in regions such as Iraq, where it contributes to elevated maternal morbidity and mortality, this study was conducted to investigate the condition in greater detail. The research focuses on key hematological and biochemical parameters including hemoglobin (Hb), red blood cell count (RBC), white blood cell count (WBC), platelet count (PLT), calcium (Ca), and vitamin D_3 levels that play significant roles in the development of anemia. The study also investigates the relationship between obesity and anemia to identify the harms of anemia during pregnancy and its causes, to identify the age group most affected by anemia during pregnancy, in order to give the competent authorities an idea about the prevalence and severity of anemia.

2. Materials and Methods

This study was conducted at Al-Hakim Hospital and several health centers in Misan Province, Iraq, over a four-month period from June to September 2025. A total of 80 pregnant women were enrolled and divided into three groups: A total of 80 pregnant women aged 25–35 years were enrolled and divided into three groups: Group 1 (Control), 40 non-anemic pregnant women aged 25–35 years. Group 2, 20 anemic pregnant women aged 25–30 years and Group 3, 20 anemic pregnant women aged 30–35 years.

Inclusion Criteria: the control group consisted of healthy individuals without clinical signs of metabolic disorders, presenting normal hematological and biochemical parameters, and with a body mass index (BMI) below 25 kg/m². The anemic groups included participants with hemoglobin (Hb) levels below 11.0 g/dL. All participants provided written informed consent and expressed willingness to comply with the study protocols.

Exclusion Criteria: Participants were excluded if they had a history of diseases other than anemia that could affect pregnancy outcomes, such as hypertension, cardiovascular disease, diabetes, or kidney disease. Additionally, individuals taking medications that could influence anemia or the absorption of iron and vitamin D during pregnancy were excluded.

2.1 Data collection

Written informed consent was obtained from all participants prior to data collection. Demographic and clinical data were gathered through direct interviews. Venous blood samples were drawn at 10:00 a.m. Hematological parameters including Hb, WBC, RBC, and platelet counts were determined using an automated hematology analyzer (Mindray, China). Fasting blood glucose was measured using an ACCU-CHEK Active device (Germany). Serum calcium and vitamin D levels were analyzed with an automated biochemistry analyzer (Siemens Dimension EXL 200, USA). BMI was calculated as weight (kg) divided by the square of height (m^2).

2.2 Statistical analysis

Data were expressed as mean ± standard deviation (SD). Statistical analysis was performed using one-way ANOVA in the Statistical Package for the Social Sciences (SPSS) version 22.0. Tukey's post-hoc test was applied to determine significant differences among groups at a probability level of $P \leq 0.05$.

3. Result

As presented in Table 1, hemoglobin, RBC count, and platelet levels were significantly lower in both anemic groups compared to the control group, while WBC counts were significantly higher in the anemic groups.

According to Table 2, FBG evels were elevated in the older anemic group. Both calcium and vitamin D3 levels were significantly lower among anemic participants, particularly in those aged 30–35 years.

Figure 1 illustrates the distribution of anemia severity among pregnant women according to hemoglobin concentration. Only 25% of participants had normal hemoglobin levels (≥11 g/dL), whereas 41% had mild anemia (10–10.9 g/dL), 19% had moderate anemia (7–9.9 g/dL), and 15% had severe anemia (<7 g/dL).

As shown in Figure 2, BMI analysis revealed that 49% of anemic women were obese (BMI 30–39.9), and 26% were overweight. These findings indicate a positive association between obesity and the prevalence of anemia among pregnant women.

Table 1. Comparison of Hb, RBCs, WBCs, and PLT between the groups.

Parameters	Groups			P-value*
	Healthy group1 (control) (n=40)	Anemic women2 (n=20)	Anemic women3(n=20)	
Hb (g/dL)	12.39 ± 0.189	9.315 ± 0.303	9.09 ± 0.235	<0.0001
WBC *(x10 ^{9}/mL)	9.315 ± 0.303	10.786± 0.802	13.67 ± 0.167	< 0.0001
RBC (x10^{12}/L)	7.262 ± 0.793	4.433 ± 0.093	3.879 ±0.052	<0.0001
PLT (x10^{9}/L)	239.5 ± 3.825	159.4 ±3.696	138.35 ±5.467	<0.0001

Table 2. Link of FBG, Ca, and Vitamin D3 between the groups.

Parameters	Groups			P-value*
	Healthy group1 (control) (n=40)	Anemic women2 (n=20)	Anemic women3 (n=20)	
FBG, (mg/dL)	95.15 ± 0.954	116.425±4.931	35.42 ± 2.618*	<0.0001
Ca, (mg/dL)	9.228 ± 0.214	8.26 ± 0.126	8.49 ± 0.046	<0.0001
Vitamin D3	35.42 ± 2.618	34.135 ± 1.507	26.549± 2.274	<0.0001

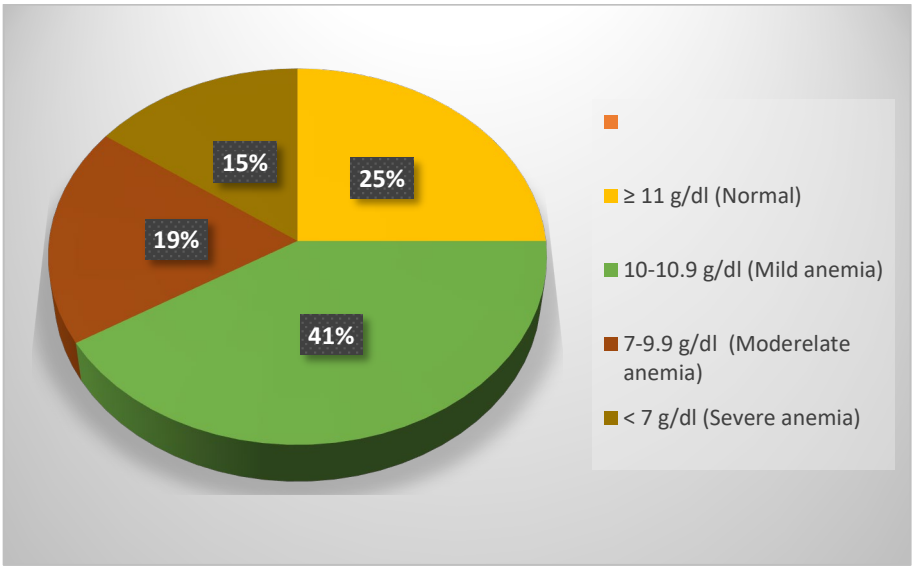

Figure 1. Types of anemia in pregnant women (**Prepared by Authors, 2025**).

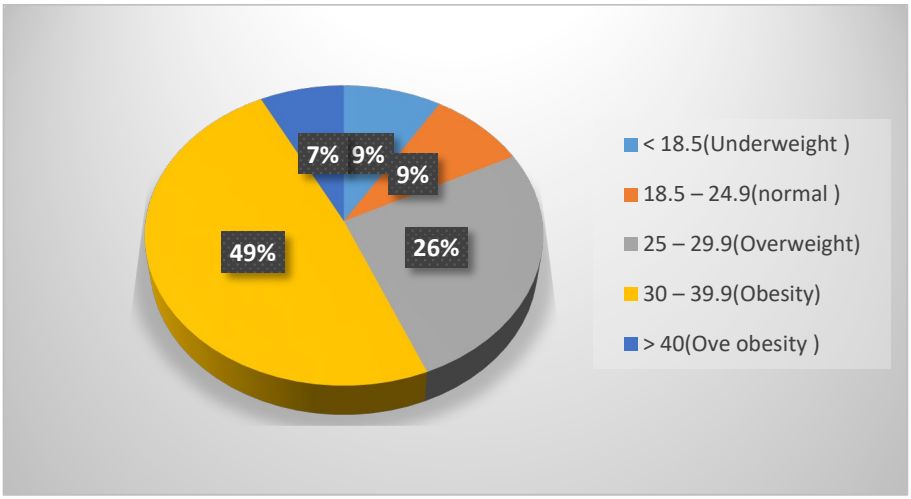

Figure 2. Relationship between anemia and obesity in pregnant women (**Prepared by Authors, 2025**).

4. Discussions

In the present study, three groups of pregnant women (healthy controls, anemic women – moderate, and anemic women – severe) were compared with respect to hematological indices. The findings revealed a clear downward trend in Hb, RBC and PLT count as the severity of anemia increased (healthy: Hb ~12.39 g/dL, anemic moderate ~9.315 g/dL, anemic severe ~9.00 g/dL; RBC &PLT likewise). WBC counts showed elevation in the severe anemia group compared to the control. The p-values for all comparisons were <0.0001, indicating high statistical significance.

During pregnancy, hemoglobin decreases because of physiologic changes. Additional fetal growth and placental demands may be lead maternal iron deficiency and which be able to impair erythropoiesis (14, 15).

Waters and CRNFA reported findings consistent with the present study, showing reduced hemoglobin and RBC levels, along with increased red blood cell destruction and blood loss. A decline in RBC production may stem from poor nutritional status, particularly deficiencies in essential nutrients such as iron, vitamin B12, or folate. These deficiencies can result from inadequate dietary intake or impaired nutrient absorption. Additionally, factors such as bone marrow suppression or disorders, hormonal imbalances, chronic diseases, and infections can contribute to reduced erythropoiesis (16). In many regions, pregnant women with anemia frequently experience bacterial or parasitic infections, inflammation, or multiple nutrient deficiencies. Active infection or inflammation typically triggers an increase in white blood cell (WBC) count. Conversely, deficiencies in iron and vitamins weaken the immune system, heightening susceptibility to infection and perpetuating a self-reinforcing cycle of anemia and immune dysfunction (17).

Our study found a significant decrease in platelets in anemic women's group compared to the control. PLT counts decrease due to physiological changes mainly in late pregnancy. The coagulation system activation leads to more increased platelet depletion (18). For this reason, about 7–10% of pregnant women capability gestational thrombocytopenia (19). Elstrott et al (20) observed that the mechanism for thrombocytopenia in severe anemia is not wholly elucidated but may involve iron-dependent megakaryocytopoiesis or diversion of stem cells toward erythroid lineage (so-called "stem cell steal"). Our results are consistent with those of other studies So et al (21).

The present study demonstrated significant differences in fasting blood glucose, serum calcium (Ca), and vitamin D3 levels among healthy pregnant women and those with varying degrees of anemia. The results revealed a marked elevation in FBG levels among anemic women compared with the control group. The mean FBG value in healthy women was 95.15 ± 0.954 mg/dL, whereas it increased to 116.42 ± 5.93 mg/dL in anemic subjects. This elevation may indicate altered glucose metabolism and potential insulin resistance associated with anemia, these consequentially facts is supported by studies Saad and Qutob (22), and Parham et al (23). According to the data acquired from Table 2, there are significant decrease in (Ca and vitamin D3) levels between group2 and 3 compared with control group. A study by Fairweather et al. revealed that decreased Ca levels because of a deficiency anemia may be linked with disturbances in minerals and trace elements (e.g, calcium), possibly because of common absorption pathways in the gastrointestinal tract (24). Low calcium, in turn, may contribute to inhibiting vitamin D3 production as a physiological compensatory mechanism. In the same way, serum vitamin D3 decreased between groups, this decrease suggests a mutual role between vitamin D3 metabolism and iron status, as previous research has shown that iron deficiency may affect the hepatic enzymes (cytochrome P450) responsible for vitamin D3 activation (25). The results of the current study indicate a positive association between a high body mass index and the incidence of anemia during pregnancy. A high percentage of women with anemia were found to be overweight or obese. This observation is consistent with

several recent studies like Hilton et al (26), that have confirmed that obesity is not only a risk factor for metabolic disorders but is also associated with iron deficiency anemia, despite the body's abundance of nutrients. Obesity is a low-grade chronic inflammatory condition characterized by elevated levels of inflammatory cytokines such as IL-6 and TNF-α, which stimulate the release of hepcidin from the liver. Hepcidin is the main regulator of iron metabolism in the body, preventing iron absorption from the intestine and sequestering it within macrophages and hepatocytes. Thus, despite increased iron stores (ferritin) in some cases of obesity, iron remains unavailable for hemoglobin formation, leading to functional iron deficiency anemia (27).

5. Conclusion

Together, these results indicate a close relationship between anemia and metabolic disturbances of important vital elements such as vitamin D3, glucose and calcium reinforcing the hypothesis that anemia not only affects blood components but also extends its influence to include the body's overall metabolic and nutritional balance. Our results confirm that pregnancy in women with anemia requires a comprehensive nutritional, hematological and biochemical assessment to prevent metabolic derangements during pregnancy.

6. Declarations

6.1 Acknowledgments

The authors acknowledge College of Basic Education, University of Misan, Maysan, Iraq. In addition, we would like to thanks Al-Hakim Hospital for their assistance in obtaining samples.

6.2 Ethical Considerations

This study was approved in accordance with the ethical standards of the College of Medicine, University of University of Misan, Maysan, Iraq in approval number MHD2025.

6.3 Authors' Contributions

The study design and performed the experiments have been done by Faten Khudhair AL_Husaini and Alla Abd Al Hassan Al Hilfy. In addition, Faten Khudhair AL_Husaini and Alla Abd Al Hassan Al Hilfy analyzed the data and write the manuscript. All authors reviewed, edited, and approved the final version of the manuscript.

6.4 Conflict of Interest

The authors declare that they have no competing interests.

6.5 Fund or Financial Support

There are no funds for this study and this research was funded by the authors.

6.6 Using Artificial Intelligence Tools (AI Tools)

The authors were not utilized AI Tools.

7. Publisher's Note

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