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Anemia Prevalence and Complications Across Pregnancy Trimesters: Insights from a Cohort of Pregnant Women

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ABSTRACT

Background: Anemia is a prevalent condition affecting 40% of pregnant women, posing significant risks to both maternal and fetal health outcomes, including premature birth, low birth weight, infection, postpartum hemorrhage, and the need for cesarean section.

Materials and Methods: This retrospective cohort study examined 390 pregnant women attending the gynecology and obstetrics clinic of Amir Al-Momenin Hospital. Sampling was conducted among referred women on a predetermined date. Data were collected and analyzed using STATA version 11 software. A comparison of pregnancy outcomes between women with and without anemia was performed using independent t-tests, chi-square tests, and multivariate logistic regression models.

Results: The study revealed that low hemoglobin and hematocrit levels in the first trimester of pregnancy did not exhibit a significant association with pregnancy outcomes. However, low hematocrit levels in the second trimester were found to significantly increase the risk of stillbirth, low Apgar score, and premature delivery, although they did not significantly impact other maternal and neonatal outcomes. **Conclusion:** These findings suggest that hematocrit levels in the second trimester of pregnancy may serve as a predictor for certain adverse pregnancy outcomes in both the mother and the infant. Hence, it is imperative to screen for anemia and monitor blood indices in women before and during pregnancy. Timely and appropriate treatment should be administered upon diagnosis of anemia to mitigate potential risks to maternal and fetal health.

Keywords: Hemoglobin; Hematocrit; Anemia; Complications; Pregnancy

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1.Introduction

Hemoglobin, a crucial protein found in red blood cells, plays a pivotal role in oxygen transport to tissues throughout the body. Concurrently, hematocrit, which gauges the proportion of red blood cells in relation to total blood volume, serves as an essential measure of blood composition [1]. During pregnancy, routine assessment of hemoglobin and hematocrit levels is standard practice, typically conducted at the outset of pregnancy and at the 23rd week gestation. For women of reproductive age, normal hemoglobin levels range between 12-16 grams per deciliter, with variations during pregnancy: 11 grams per deciliter in the first and third trimesters and 10.5 grams per deciliter in the second trimester. Hematocrit levels typically fall within the range of 36-48% for women [2].

Statistics underscore the widespread impact of anemia, affecting approximately 40% of women globally, equating to approximately 56 million individuals. Iron deficiency is the predominant cause of anemia, though nutritional deficiencies and infections, such as malaria, tuberculosis, or HIV/AIDS, can also contribute to its onset. Among women with severe anemia, microcytic hypochromic anemia emerges as the most prevalent subtype, affecting 49%, followed by dimorphic anemia (35%), microcytic anemia (10%), and

pancytopenia (6%) [3]. Elevated hemoglobin, hematocrit, and red cell mass in early pregnancy have been identified as risk factors for adverse outcomes including preeclampsia, intrauterine growth restriction, fetal demise, premature birth, low birth weight, and placental infarction [4].

Conversely, anemia during pregnancy poses significant risks, correlating with adverse outcomes such as premature delivery, low birth weight, small gestational age infants, infection, postpartum hemorrhage, and cesarean section. Conversely, the implications of elevated maternal hemoglobin levels have been less scrutinized, potentially being misconstrued as indicative of favorable nutritional status. Increased maternal hemoglobin and hematocrit in the first trimester have been investigated as potential risk factors for preeclampsia later in pregnancy. Moreover, failure of the expected decrease in hemoglobin and hematocrit levels during the second trimester may signal an increased risk of preeclampsia, for which reliable early diagnostic criteria remain elusive [5].

Premature birth, a global concern accounting for 11.1% of live births worldwide, is a paramount consideration in pregnancy care. Prematurity significantly heightens the risk of infant mortality and morbidity, including conditions such as cerebral palsy, cardiovascular and respiratory disorders, and psychological complications. Notably, the incidence

of premature birth and low birth weight escalates markedly in women with hemoglobin levels below 7 g/dL. The prevalence of anemia varies across regions, ranging from 14% to 62% in developing countries and 15% to 29% in developed nations, with severe anemia accounting for 15-20% of maternal deaths globally [6].

Given the substantial burden of anemia-related complications, enhancing awareness of its diverse consequences is imperative for mitigating associated morbidity and mortality. Hence, this study aims to investigate the relationship between hemoglobin, hematocrit levels, and pregnancy complications during the first and second trimesters of pregnancy [7].

2. Material and Method

In this retrospective longitudinal cohort study, we enrolled 390 pregnant women seeking care during the first and second trimesters of pregnancy at the obstetrics and gynecology clinic. Exclusion criteria included women with diabetes and hypertension. The sample size was determined based on a calculated frequency of anemia among pregnant women of 13.6%, as reported in a meta-analysis study, with a 95% confidence interval and a maximum error of 3% (11). Data collection involved a comprehensive assessment including medical history, interviews, examinations, and review of patient files, with all required tests conducted free of

charge during prenatal visits in both the first and second trimesters [8-10].

Throughout the pregnancy, participants received weekly visits from a gynecologist and were provided with pertinent information regarding potential pregnancy complications [11]. They were advised to promptly report any concerning symptoms and to seek specialized care as needed. Following delivery, participants and their neonates underwent further assessment, with relevant data recorded by the researcher. Anemia diagnosis during pregnancy was based on the following criteria: hemoglobin levels below 11 g/dL and hematocrit levels below 33%, with mean corpuscular volume (MCV) below 80 femtoliters in the first trimester, and hemoglobin levels below 10.5 g/dL and hematocrit levels below 31.5%, with MCV below 80 femtoliters in the second trimester [12-15].

3. Statistical Analysis

Data collected from the study underwent comprehensive statistical analysis using Stata version 11. This analysis encompassed various statistical techniques to explore the relationship between anemia and pregnancy outcomes. Specifically, comparisons between pregnant women with and without anemia were conducted using independent t-tests and chi-square tests for continuous and categorical variables, respectively. Additionally, multivariate logistic regression

modeling was employed to assess the severity of the association between anemia and pregnancy outcomes while accounting for potential confounders. Odds ratios were calculated to quantify this relationship, with statistical significance set at a p-value threshold of less than 0.05 [16-18].

4. Results and Discussion

The studied population exhibited a mean age of 29.3 ± 7.5 years and a mean body mass index (BMI) of 25.7 ± 5.6 kg/m². Notably, parity 2 represented the highest proportion among the investigated mothers, accounting for 25.13% of the cases.

Table 1 presents the frequency of various medical histories among the study participants. Specifically, 6.7% of the women had a history of stillbirth, while 6.9% reported a history of diabetes. Additionally, 28.2% of the participants had a history of hypertension. These findings underscore the importance of considering pre-existing medical conditions in the context of pregnancy outcomes.

The prevalence of these medical histories highlights the need for comprehensive prenatal care and risk assessment to mitigate potential complications during pregnancy. Identification and management of pre-existing conditions such as diabetes and hypertension are crucial in optimizing maternal and fetal health outcomes. Further analysis is warranted

to explore the impact of these medical histories on pregnancy outcomes in our study population.

Table 2 provides a comprehensive overview of the haemoglobin and hematocrit levels observed among the studied women during both the first and second trimesters of pregnancy.

In the first trimester, the mean hemoglobin level was recorded at 12.12 ± 1.17 g/dL, with a corresponding mean hematocrit level of 36.78 ± 3.19%. Conversely, during the second trimester, the mean hemoglobin level slightly decreased to 11.70 ± 1.15 g/dL, while the mean hematocrit level slightly increased to 36.95 ± 4.12%. The analysis of normal haemoglobin and hematocrit levels revealed that 339 women exhibited normal hemoglobin levels during the first trimester, with 336 women having normal hematocrit levels. In the second trimester, 355 women had normal hemoglobin levels, while 358 women had normal hematocrit levels. These findings offer valuable insights into the hematological profiles of pregnant women across different stages of pregnancy.

According to Table 3, there was no statistically significant difference observed between women with low hemoglobin and hematocrit levels concerning neonatal outcomes during the first trimester of pregnancy ($P > 0.05$).

According to Table 4, there was no statistically significant difference observed between women

with low hemoglobin and hematocrit levels concerning neonatal outcomes during the second trimester of pregnancy ($P > 0.05$).

According to Table 5, there was no statistically significant difference observed between women with low hemoglobin and hematocrit levels concerning maternal outcomes during the first trimester of pregnancy ($P > 0.05$).

5. Discussion

The findings of this study shed light on the intricate relationship between maternal anemia and adverse pregnancy outcomes, emphasizing the importance of timely identification and management of anemia during pregnancy. Despite its global prevalence, our study revealed that in the first trimester of pregnancy, low hemoglobin and hematocrit levels did not significantly correlate with adverse maternal and neonatal outcomes, including premature birth, preeclampsia, stillbirth, and infant malaise. However, the analysis of second-trimester data presented a different perspective, indicating that while low hemoglobin levels did not significantly influence pregnancy outcomes, low hematocrit levels were associated with a substantial increase in the risk of stillbirths, low Apgar scores, and preterm delivery.

Comparative analysis with existing literature underscores the variability in findings across different studies. Studies conducted in various

regions have reported diverse associations between maternal anemia and pregnancy outcomes, influenced by factors such as sample sizes, definitions of anemia, and criteria for assessing pregnancy outcomes. Notably, the incidence of anemia during pregnancy has been linked to an elevated risk of adverse outcomes such as premature delivery and stillbirth, as observed in studies conducted in Colombia, Switzerland, Taiwan, Nepal, Bangladesh, and New Zealand.

Moreover, amidst the ongoing COVID-19 pandemic, individuals with anemia are recognized to face an increased susceptibility to severe infections due to various pathophysiological mechanisms. These mechanisms, including thrombotic, hemorrhagic, and autoimmune factors, contribute to decreased oxygen availability to cells, heightening the risk of multi-organ failure. Hence, individuals with anemia require heightened vigilance and care to mitigate the potential impact of comorbidities, including infectious diseases like COVID-19.

In conclusion, while our study did not establish a significant association between maternal anemia in the first trimester and adverse pregnancy outcomes, the heightened risk observed in the second trimester underscores the importance of continued monitoring and intervention strategies to address anemia during pregnancy. Collaborative efforts aimed at raising awareness, implementing effective screening

programs, and ensuring timely intervention can significantly contribute to improving maternal and neonatal health outcomes worldwide.

6. Conclusion

In conclusion, our findings highlight the predictive value of second-trimester hematocrit and, to some extent, first-trimester hematocrit in identifying potential pregnancy complications for both the mother and neonate. These results emphasize the importance of routine screening for blood indices and anemia, particularly during the second trimester of pregnancy. Early detection of anemia allows for timely intervention and the classification of high-risk pregnancies, facilitating the provision of specialized care to mitigate adverse outcomes.

Moving forward, it is imperative to conduct further studies with larger sample sizes and across different healthcare settings to validate our findings. Prospective studies can provide more robust evidence regarding the association between hematocrit levels and pregnancy outcomes, aiding in the development of targeted interventions and guidelines for the management of maternal anemia. By enhancing our understanding of the impact of anemia on pregnancy, we can improve maternal and neonatal health outcomes and reduce the burden of preventable complications.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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Table 1: Frequency of history of stillbirth, diabetes, and hypertension in the studied women

Variable		N	%
Stillbirth	Yes	26	6.7
	No	364	93.3
Diabetes	Yes	27	6.9
	No	363	93.1
Hypertension	Yes	110	28.2
	No	280	71.8

Table 2: Hemoglobin and hematocrit levels in the studied women in the first and second-trimester of pregnancy

<i>Variable</i>	<i>Hemoglobin at first trimester</i>	<i>Hematocrit at first trimester</i>	<i>Hemoglobin at second trimester</i>	<i>Hematocrit at second trimester</i>
Mean	12.12	36.78	11.70	36.95
Median	12.10	36.70	11.65	35.60
Std. Deviation	1.17	31.19	1.15	4.23
Minimum	8.00	27.40	8.90	27.50
Maximum	15.90	50.00	15.90	86.00

Table 3: Comparison of Neonatal Outcomes Across Low Hemoglobin and Hematocrit Levels in the First Trimester of Pregnancy

<i>Neonatal outcomes</i>	<i>Blood indices</i>	<i>Adjusted odds ratio</i>	<i>P value</i>	<i>CI 95%</i>
<i>NICU</i>	Low hemoglobin	0.20	0.121	0.03-1.53
	Low hematocrit	0.39	0.363	0.05-3
<i>Stillbirth</i>	Low hemoglobin	4.42	0.270	0.31-62
	Low hematocrit	11.28	0.096	0.65-195
<i>Low Apgar</i>	Low hemoglobin	2.2	0.497	0.22-21
	Low hematocrit	2.63	0.403	0.27-25
<i>Low birth weight</i>	Low hemoglobin	1.18	0.711	0.49-2.81
	Low hematocrit	0.67	0.522	0.19-2.30

Table 4: Comparison of Neonatal Outcomes Across Low Hemoglobin and Hematocrit Levels in the Second Trimester of Pregnancy

<i>Neonatal outcomes</i>	<i>Blood indices</i>	<i>Adjusted odds ratio</i>	<i>P value</i>	<i>CI 95%</i>
<i>NICU</i>	Low hemoglobin	0.19	0.116	0.03-1.53
	Low hematocrit	0.53	0.542	0.05-3
<i>Stillbirth</i>	Low hemoglobin	12.73	0.104	0.31-62
	Low hematocrit	20.02	0.052	0.65-195
<i>Low Apgar</i>	Low hemoglobin	2.39	0.467	0.22-21
	Low hematocrit	13.60	0.013	0.27-25
<i>Low birth weight</i>	Low hemoglobin	1.12	0.802	0.49-2.81
	Low hematocrit	0.87	0.825	0.19-2.30

Table 5: Comparison of Maternal Outcomes Across Low Hemoglobin and Hematocrit Levels in the First Trimester of Pregnancy

Neonatal outcomes	Blood indices	Adjusted odds ratio	P value	CI 95%
Preterm delivery	Low hemoglobin	0.80	0.673	0.30-2.17
	Low hematocrit	0.80	0.720	0.23-2.76
Preeclampsia	Low hemoglobin	1.09	0.828	0.51-2.31
	Low hematocrit	0.73	0.553	0.26-2.03
Admission to the ward	Low hemoglobin	1.43	0.335	0.69-2.98
	Low hematocrit	1.29	0.589	0.52-3.21