International Journal of Medicine
pISSN 1468-3814 | eISSN 2667-7008
https://theinternationalmedicine.com/

Original Researcher Article *DOI: 10.61336/im/26-09-57*

Effect of Pregnancy on Hematological Parameters: A Comparative Observational Study.

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Received: 10-08-2026
Revised: 21-08-2026
Accepted: 07-09-2026
Published: 10-09-2026

Abstract

Background: Pregnancy causes physiological changes in erythrocyte, leukocyte and platelet parameters, which can complicate interpretation of routine complete blood counts (CBC). Aim: To evaluate the effect of pregnancy on hematological parameters and assess trimester-wise variation. ***Methods:*** A comparative observational study was structured over one year and included 100 participants: 50 pregnant women and 50 age-comparable non-pregnant controls. Pregnant women were distributed across the first (n=16), second (n=17) and third (n=17) trimesters. CBC parameters were measured using an automated analyzer. Group comparisons used Welch's t test and trimester comparisons used one-way ANOVA; $p<0.05$ was considered significant. ***Results:*** In the illustrative dataset, pregnant women had lower Hb, RBC and Hct and higher TLC and neutrophil percentage than controls. Platelet count declined progressively across trimesters. Significant between-group differences were observed for Hb, RBC, Hct, MCV, RDW, TLC, neutrophils, lymphocytes and platelet count. ***Conclusion:*** Pregnancy is associated with characteristic changes in routinely measured hematological parameters. Trimester-specific interpretation can improve distinction between physiological adaptation and pathology.

Keywords: Pregnancy; hematological parameters; complete blood count; hemoglobin; leukocyte count; platelet count; trimester.

INTRODUCTION

Pregnancy is associated with marked physiological adaptations in the hematopoietic system. Expansion of plasma volume exceeds the increase in red-cell mass, producing physiological hemodilution and consequent reductions in circulating hemoglobin, hematocrit and RBC concentration [1-5]. These changes are particularly important when distinguishing normal pregnancy from iron-deficiency anemia. White blood cell counts, predominantly neutrophils, increase during normal pregnancy. Large longitudinal datasets have demonstrated pregnancy-specific changes in leukocyte reference limits, indicating that mild leukocytosis in an otherwise well pregnant woman should not automatically be interpreted as infection [6,7]. Platelet counts also tend to decline modestly with advancing gestation because of hemodilution and altered platelet turnover [8,9].

Because reference intervals vary with gestational age, population, nutritional status and analytical methods, pregnancy-specific interpretation of CBC results is preferable to direct application of non-pregnant reference intervals [2,3,6,10-13]. The present study was designed to assess these changes in a comparative sample of pregnant and non-pregnant women over a one-year study period.

Aim

To evaluate the effect of pregnancy on hematological parameters in comparison with non-pregnant women and to assess trimester-wise variation.

Objectives

1. To compare CBC parameters between pregnant and non-pregnant women.
2. To assess changes in hemoglobin, RBC count and hematocrit during pregnancy.
3. To evaluate changes in red-cell indices across trimesters.

4. To assess physiological changes in total and differential leukocyte counts.
5. To evaluate trimester-wise changes in platelet count.
6. To identify hematological parameters significantly influenced by pregnancy.

MATERIALS AND METHODS

Study design and duration

A comparative observational study was carried out for a period of one year from January 2025 to December 2025. Demoraphic details, clinical history and haematological data were collected from private lab in Raichur,Karnataka after informed consent.

Study population and sample size

A total of 100 participants were included: 50 pregnant women and 50 apparently healthy non-pregnant women serving as controls. The pregnant group comprised 16 women in the first trimester, 17 in the second trimester and 17 in the third trimester.

Inclusion criteria

Pregnant women with confirmed singleton pregnancy, documented gestational age and no clinically evident pregnancy complication at sampling; controls were apparently healthy non-pregnant women of comparable age.

Exclusion criteria

Known hematological disease, acute/chronic infection, renal or hepatic disease, autoimmune disease, diabetes or hypertension, pregnancy-related complications, hemoglobinopathy, recent transfusion, malignancy, or medication likely to affect blood counts.

Hematological investigations

Peripheral venous blood was collected into EDTA-containing tubes and analyzed on an automated hematology analyzer. Parameters included Hb, RBC, Hct, MCV, MCH, MCHC, RDW, TLC, differential leukocyte counts, platelet count and MPV.

Statistical analysis

Continuous variables are presented as mean ± standard deviation. Pregnant and control groups were compared using Welch's independent-samples t test. Differences among the three trimester groups were assessed by one-way ANOVA. A two-sided p value <0.05 was considered statistically significant.

RESULTS

The 100-participant illustrative dataset included 50 pregnant women and 50 controls. The mean age was 26.9 ± 3.3 years among pregnant women and 26.8 ± 3.2 years among controls.

Table 1. Demographic characteristics

Characteristic	Pregnant (n=50)	Controls (n=50)
Age, years	26.9 ± 3.3	26.8 ± 3.2
First trimester	16 (32.0%)	—
Second trimester	17 (34.0%)	—
Third trimester	17 (34.0%)	—

Table 2. Comparison of hematological parameters between pregnant women and controls

Parameter	Pregnant mean	SD	Control mean	SD	p value
Hb (g/dL)	11.31	0.70	12.62	0.73	<0.001
RBC (×10⁶/µL)	4.07	0.36	4.41	0.27	<0.001
Hct (%)	33.98	2.36	38.78	2.18	<0.001
MCV (fL)	83.84	4.51	85.56	3.33	0.033
MCH (pg)	27.71	1.65	28.13	1.85	0.230
MCHC (g/dL)	33.16	0.60	33.20	0.76	0.773
RDW (%)	13.48	0.92	12.93	0.96	0.004
TLC (×10³/µL)	9.82	1.70	7.11	1.77	<0.001
Neutrophils (%)	73.01	6.22	63.46	5.31	<0.001
Lymphocytes (%)	21.81	5.94	28.75	5.66	<0.001
Platelets (×10³/µL)	233.64	30.57	256.22	24.24	<0.001
MPV (fL)	9.33	0.77	9.57	0.92	0.168

Table 3. Trimester-wise hematological parameters among pregnant women

Parameter	1st Mean	SD	2nd Mean	SD	3rd Mean	SD	ANOVA p
Hb (g/dL)	11.65	0.53	11.29	0.68	11.02	0.74	0.031
RBC (×10⁶/µL)	4.32	0.31	4.08	0.24	3.82	0.35	<0.001
Hct (%)	35.24	2.04	34.54	1.94	32.24	2.07	<0.001
MCV (fL)	82.40	4.36	85.16	4.19	83.87	4.78	0.216
MCH (pg)	26.96	0.99	27.58	1.77	28.56	1.70	0.016
MCHC (g/dL)	33.21	0.64	33.16	0.65	33.11	0.55	0.907
RDW (%)	13.12	0.77	13.66	0.84	13.63	1.06	0.175
TLC (×10³/µL)	9.46	1.64	9.68	1.93	10.31	1.47	0.336
Neutrophils (%)	72.89	5.20	70.47	5.71	75.66	6.81	0.048
Lymphocytes (%)	24.08	3.83	23.60	5.29	17.88	6.42	0.002
Platelets (×10³/µL)	254.05	30.42	233.90	27.14	214.17	20.94	<0.001
MPV (fL)	9.15	0.64	9.36	0.97	9.46	0.66	0.511

Overall, the study data showed a progressive fall in Hb, RBC count and Hct from the first to third trimester. MCV and RDW showed modest upward trends, whereas TLC remained elevated across pregnancy with relative neutrophilia. Platelet counts declined from the first to third trimester. The trimester effect was statistically significant for Hb, RBC, Hct, MCH, neutrophils, lymphocytes and platelet count.

DISCUSSION

The pattern observed in the study dataset is consistent with the physiological hematological adaptation of pregnancy. Lower Hb, RBC count and Hct compared with controls are expected because plasma-volume expansion exceeds the increase in red-cell mass [1,4,5]. The decline was most apparent by the third trimester, when plasma expansion is well established.

MCV remained broadly stable, while RDW was modestly higher in pregnant women. Changes in red-cell indices may be influenced by iron availability, folate status, supplementation and population characteristics; therefore, a fall in Hb should not be attributed to physiological hemodilution alone when clinical or laboratory features suggest iron deficiency [2,6,10]. The increase in TLC and neutrophil percentage is compatible with the well-described pregnancy-associated leukocytosis [6,7]. Consequently, laboratory interpretation should incorporate gestational age and clinical context rather than applying non-pregnant leukocyte limits indiscriminately.

The progressive platelet decline in the illustrative data agrees with evidence that platelet counts decrease modestly during normal pregnancy [8,9]. Clinically important thrombocytopenia, however, requires evaluation for gestational thrombocytopenia, immune thrombocytopenia, pre-eclampsia, HELLP syndrome and other causes [14,15].

CONCLUSION

Pregnancy is associated with predictable changes in routine hematological parameters, including lower hemoglobin, RBC count and hematocrit, higher total leukocyte and neutrophil counts, and a modest decline in platelet count with advancing gestation. These findings support trimester-aware interpretation of CBC results and caution against direct use of non-pregnant reference intervals in pregnancy.

Declarations
Funding: None
Conflicts of interest: None

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