

**Research Article****Hematological profile of normal pregnant women in Western India**Geetanjali Purohit<sup>1</sup>, Trushna Shah<sup>2</sup>, Dr. J. M. Harsoda<sup>3</sup><sup>1</sup>Asst. Prof. in Department of Physiology, SBKS MIRC, Sumandeep Vidyapeeth, Piparia, Vadodara, Gujarat, India<sup>2</sup>Asst Prof in Department of Biochemistry, SBKS MI & RC, Sumandeep Vidyapeeth, Piparia, Vadodara, Gujarat, India<sup>3</sup>Prof and HOD in Department of Physiology, SBKS MI & RC, Sumandeep Vidyapeeth, Piparia, Vadodara, Gujarat, India.**\*Corresponding author**

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**Abstract:** Anemia is a common problem during pregnancy and no reference values have been reported for hematological parameters during pregnancy in rural population. Present study was aimed to study the hematological variations during three different trimesters of pregnancy and their comparison with matched non pregnant control. Longitudinal study was conducted in a cohort of 302 normal apparently healthy rural pregnant women, attending the antenatal clinic of Dhiraj General Hospital, Vadodara, Gujarat, India. Apparently healthy 94 non pregnant women matched with age and socioeconomic status was studied as control. Blood sugar, Hb concentration, PCV, MCV, MCH, MCHC, TLC, DLC, RDW, RBC and platelet count were studied in both groups. Study was in accord with the ethical norms of Sumandeep Vidyapeeth. ANOVA was used for comparison in different trimesters and unpaired t-test was used to compare the pregnant data with non pregnant female ( $\alpha$  error was set at 5% level). Trimester variations were recorded for platelet count, RDW, PCV, TLC and DLC during pregnancy, while other parameters like RBC count, blood indices, and Hb concentration remain unaltered during pregnancy. Comparison of pregnant with non pregnant shows significant changes ( $p < 0.05$ ). In conclusion present study represent the rural population data and prepared a base for reference value for this ethnic group. Although gravid uterus affects the haematological parameters, our results evident that pregnancy is a state of adaptation.

**Keywords:** cohort, haematological, RDW, Rural.

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**INTRODUCTION**

The hematological profile of an individual reflects their general health to a large extent and variations cannot be ignored [1]. During pregnancy, the body undergoes remarkable changes in the cardiovascular, respiratory, renal and gastrointestinal physiology and many studies have also identified the hematological profile of the pregnant woman as one of the factor affecting pregnancy and its outcome [2-4]. In the absence of illness, the body can generally compensate for these changes, however, in the presence of conditions such as anemia, clotting/bleeding abnormalities, preeclampsia and trauma, compensation may not be possible. At this point, laboratory blood values significantly skewed from the values normally noted during pregnancy. Healthcare providers should be aware of both the normal and abnormal changes take place during pregnancy and the resulting laboratory values [5].

Pregnancy is influenced by many factors, some of which include culture, environment, socioeconomic status, and access to medical care. In normal pregnancy, physiological changes in hemoglobin concentration,

platelet count and hematocrit value are well known [6, 7]. This study was undertaken to document the hematological profile of rural pregnant women and comparing these to the established norms to determine whether the norms are applicable or there is a need to establish local norms. Present study evaluate the values of some major hematological parameters include blood sugar, hemoglobin concentration (HB), packed cell volume (PCV), mean cell volume (MCV), mean cell hemoglobin (MCH), mean cell hemoglobin concentration (MCHC), total and differential white blood cell count (TLC & DLC), red blood cell count (RBC), red cell distribution width (RDW) and platelet count among normal pregnant women and their comparison with matched non pregnant control.

**MATERIAL AND METHOD**

This was a prospective study conducted in the Department of Physiology in collaboration with Department of Obstetrics & Gynecology, Dhiraj General Hospital, Sumandeep Vidyapeeth.

**Study population**

Pregnant women attending antenatal clinic of Dhiraj General Hospital, village Piparia, Vadodara city, Gujarat. Non pregnant women matched with age and socioeconomic status studied as control.

### Sampling and Sample size

Random sampling was used. Total 396 rural women of lower socioeconomic class were studied. The sample of the present study comprised two groups of women. First group which served as the test group comprised 302 pregnant women, 87 during I trimester (8-12 wk), 99 during II trimester (13-24 wk), 116 during III trimester (26-40 wk) serially and vertically both. Determination of gestational age was based on last menstrual phase (LMP) reported by clinician. The second group which served as control, comprised 94 non pregnant women randomly selected from the same population, mainly the relatives of pregnant women.

**Ethics:** This study was complied with the ethical committee guidelines of SVIEC (EC No. SVIEC/ON/MEDI/PhD/1202) and the procedures followed were in accord with the ethical standards of Sumandeep Vidyapeeth.

**Inclusion criteria's:** Age group: 20-40 years, Gestational age: 8th to 40th weeks, primipara or multi Para, Singleton pregnancy.

**Exclusion criteria's:** Clotting/bleeding disorder, Respiratory tract infection, cardiac renal or hemolytic disorders that affect the test.

After informed consent and information about the study, participants were studied for their hematological parameters, which was the part of their routine clinical consultation. All participants were studied for complete blood count and blood sugar level. Complete blood count was done by Automated cell counter in Central Laboratory of Dhiraj General Hospital and assessment included Hb concentration, PCV, MCV, MCH, MCHC, TLC, DLC, RDW, RBC and platelet count.

**Statistical analysis:** This study prepared a database of findings of both groups in the form of master chart. Values were expressed as Mean±SD. The student's unpaired t-test was used for between group variations of pregnant and non-pregnant control. The error for a significant t-test to be set at the 5% level.

### OBSERVATION & RESULTS

Table-1 mentioned the comparison of hematological profile during three different trimesters of pregnancy. ANOVA was used for analysis of variance in between group. Significant difference was found for Hb concentration, PCV, platelet count, DLC and TLC.

**Table 1: Comparison of hematological parameters during three different trimester of pregnancy**

Parameters (unit)	I Trimester (N=87)	II Trimester (N=99)	III Trimester (N=112)	ANOVA (p value)
Blood Sugar	92.43±6.81	92.4±10.2	94.07±9.17	0.1726 (NS)
Hb (gm/dl)	10.48±0.89	10.06±1.04	10.02±1.26	0.1721 (NS)
RBC(million/cumm)	4.003±0.42	4.067±0.24	4.157±1.83	0.1837 (NS)
PCV (%)	37.51±2.6	32.88±2.96	33.7±3.27	0.0080 (S)*
RDW	14.07±1.01	15.07±2.43	18.9±3.85	0.0083 (S)*
Platelet count	3.33±0.63	3.12±3.99	2.54±0.43	0.0073(S)*
BLOOD INDICES				
MCV (cumm)	81.86±7.43	82.89±8.35	85.69±13.9	0.6562 (NS)
MCH (pg)	26.15±2.86	26.96±3.31	27.31±2.54	0.2217 (NS)
MCHC (%)	31.49±2.87	32.99±1.97	30.47±6.65	0.8049(NS)
ABSOLUTE AND DIFFRENTIAL LUCOCYTE COUNT				
TLC (/cumm)	7846.88±1414.9	9700±2427.8	10166±2114.34	0.001 (HS)**
Neutrophils (%)	63.44±9.09	73.77±7.22	70.66±9.05	0.001 (HS)**
Lymphocytes (%)	28.5±8.47	19.65±5.91	19.89±6.81	0.001 (HS)**
Eosinophils (%)	3.75±0.44	3.58±1.13	3.60±1.37	0.0493(NS)
Monocytes (%)	4.31±0.59	3.38±0.81	3.40±1.10	0.001(HS)**

Table -2 denotes the hematological profile of pregnant female irrespective to the trimesters and its comparison with non pregnant control. Unpaired t-test

was used for significance test to compare pregnant and non pregnant values.

**Table 2: Comparison of hematological parameters between pregnant and non pregnant female**

Parameters (Unit)	Pregnant (N=302)	Non pregnant control(N=94)
Blood Sugar	90.61±9.03	80.07±11.03*
Hb (gm/dl)	10.03±1.12	11.2±1.16*
RBC (million/cumm)	4.09±0.37	4.26±0.26
PCV (%)	34.89±9.28	39.88±3.12*
RDW	15.44±2.90	14.02± 1.48
Platelet count	2.76±0.68	3.56±0.66*
MCV (cumm)	82.64±8.88	78.69±6.61*
MCH (pg)	26.92±2.92	28.84±3.19
MCHC (%)	32.06±3.19	33.01±2.45
TLC (/cumm)	9469.21±2257.01	8667.0±1183.67*
Neutrophils (%)	70.02±9.29	64.31±8.56*
Lymphocytes(%)	22.82±7.84	19.16±4.56*
Eosinophils (%)	3.31±1.15	3.39±1.23
Monocytes (%)	3.61±0.98	2.71±0.78*

Hb- hemoglobin concentration, RBC- red blood cells, PCV- packed cell volume, RDW-red cell distribution width, MCV- mean corpuscular volume, MCH- mean corpuscular hemoglobin, MCHC- mean corpuscular hemoglobin concentration, TLC- total leucocyte count \*Significant (p<0.05)

## DISCUSSION & CONCLUSION

Present study was aimed to evaluate the hematological variations take place during normal pregnancy. Hematological abnormalities, especially anemia, may have adverse impact on pregnancy outcome and in most developing countries makes an important contribution to maternal mortality and morbidity. Significant effort is therefore given to monitoring and responding to hematological parameters [8].

It is well established that plasma volume increases by 50% during pregnancy. Red cell mass also increases, but relatively less in compare to plasma volume. The net result is a dip in hemoglobin (HGB) concentration results in dilution anemia during pregnancy [9, 10]. Although there is a decrease in HGB by the second trimester which stabilizes thereafter in the third trimester, we found insignificant variation in hemoglobin concentration during pregnancy. Women who take iron supplements have less pronounced changes in hemoglobin, as they increase their red cell mass in a more proportionate manner than those not on hematinic supplements. Our study found that, drop in mean hemoglobin is typically by 1.2 g/dL (10.7%), when compare to non pregnant control group (Gestational anemia) [11] Significant elevation has been documented between measurements of hemoglobin taken at 6-8 weeks postpartum and those taken at 4-6 months postpartum, indicating that it takes at least 4-6 months post pregnancy, to restore the physiological dip in hemoglobin to the non-pregnant values [12].

From the result presented in Table 2, significant decrease was found in PCV of the experimental group when compared to the control. This decline is continues till II trimester and become stable in III trimester. The decrease in PCV may be due to increase in plasma volume during pregnancy which

causes hemodilution, and increased rate of infection especially malaria, hormonal changes and conditions that promote fluid retention and iron deficiency.[13] The other red blood cell indices change little in pregnancy. MCV does not change significantly during pregnancy however, there is a small increase when compare to control group, which reaches a maximum at 30-35 weeks gestation and does not suggest any deficiency of vitamins B12 and foliate. Increased production of RBCs to meet the demands of pregnancy, reasonably explains why there is an increased MCV (due to a higher proportion of young RBCs which are larger in size). It is reported that hemoglobin concentration <9.5 g/dL in association with a mean corpuscular volume <84 fl probably indicates co-existent iron deficiency or some other pathology [14] Mean carpuscular hemoglobin (MCH) and mean carpuscular hemoglobin concentration (MCHC) showed no changes during pregnancy.

Red cell distribution width (RDW) is a measure variation of red blood cell width that is reported as part of a standard complete blood count. RDW increased significantly during pregnancy, mainly in III trimester or at onset of labor. No significant changes occurred between control group and pregnant group as a whole. The unexpected rise in RDW during last few weeks suggest increased bone marrow activity. Studies reported it as a useful indicator of impeding parturition [15]. Comparison of RDW between iron deficient & non-iron deficient pregnant women found that RDW appears to be a reliable and useful parameter for detection of iron deficiency during pregnancy [16].

Total platelet count reduced gradually during pregnancy. Large cross-sectional studies done in pregnancy of healthy women have shown that the platelet count does decrease during pregnancy, particularly in the third trimester. "Gestational

thrombocytopenia” does not have complications related to thrombocytopenia both in mother and fetus, hence been recommended that the lower limit of platelet count in late pregnancy should be considered as 1.15 lac/cumm [16]. Gestational thrombocytopenia is partly due to hemo dilution and partly due to increased platelet activation and accelerated clearance. It is evidenced that platelet volume distribution width also increases significantly and continuously as gestation advances, for reasons cited before. Thus, with advancing gestation, the mean platelet volume becomes an insensitive measure of the platelet size [17, 18].

White blood cell count found to be increase during pregnancy. In non pregnant female normal WBC count is somewhere between 5 and 10 (5,000–10,000 cells/mm<sup>3</sup>), but for pregnancy these normal values can be between 6 and 16 in the third trimester and may reach 20 to 30 in labor and early postpartum. Therefore, you need to look for other clinical indicators, when evaluating for infection. Leucocytosis, occurring during pregnancy is due to the physiologic stress induced by the pregnant state. The stress of delivery may itself lead to brisk leucocytosis [19]. Few hours after delivery, healthy women have been documented with WBC count varying from 9,000 to 25,000/cumm. By 4 weeks post-delivery, typical WBC ranges are similar to those in healthy non-pregnant women. Neutrophils are the major type of leucocytes in differential counts, increased during pregnancy, likely due to impaired neutrophilic apoptosis in pregnancy [20, 21]. There is an evidence of increased oxidative metabolism in Neutrophils during pregnancy. Neutrophils chemo taxis and phagocytic activity are depressed, especially due to inhibitory factors present in the serum of a pregnant female [22]. Immature forms as myelocytes and meta myelocytes may be found in the peripheral blood film of healthy women during pregnancy and do not have any pathological significance [23]. They simply indicate adequate bone marrow response to an increased drive for erythropoiesis occurring during pregnancy. Lymphocyte count decreases significantly during pregnancy through the first and second trimesters and increases during the third trimester. There is an absolute monocytosis during pregnancy, especially in the first trimester, but decreases as gestation advances. Monocytes help in preventing fetal allograft rejection by infiltrating the decidual tissue (7th–20th week of gestation) possibly, through PGE<sub>2</sub> mediated immunosuppression [24, 25].

Present study determined ranges of hematological indices in normal pregnant women; hence results of the study may be used as reference values in the assessment of the health status of normal pregnant women and focused on the diagnostic evaluation of various conditions in the diagnosis of complications or challenges during pregnancy.

## REFERENCES

1. Focusing on anaemia: Towards an integrated approach for effective anaemia control. Joint statement by the World Health Organization and the United Nations Children's Fund. World Health Organization 2004 [http://www.who.int/topics/anaemia/en/who.unicef-anaemiastatement.pdf]. May 10, 2007.
2. Allen LH; Anemia and iron deficiency: effects on pregnancy outcome. *Am J Clin Nutr*, 2000; 71(Suppl 5): 1280-84.
3. Meng LZ, Goldenberg RL, Cliver S, Cutter G, Blankson M; The relationship between maternal hematocrit and pregnancy outcome. *Obstet Gynecol*, 1991; 77: 190-94.
4. Osonuga IO, Osonuga OA, Onadeko AA, Osonuga A, Osonuga AA; Hematological profile of pregnant women in southwest of Nigeria. *Asian Pacific Journal of Tropical Disease*, 2011; 1 (3): 232–34.
5. Harrison KA; Blood volume changes in normal pregnant Nigerian women. *The Journal of obstetrics and gynecology of the British Commonwealth*, 1996; 73 (5): 717–23.
6. Ichipi-Ifukor PC, Jacobs J, Ichipi-Ifukor RN, Ewrhe OL; Changes in Hematological Indices in Normal Pregnancy. *Physiology Journal*, 2013: Article ID 283814, 4 pages
7. Fay RA, Hughes AO, Farron NT; Platelets in pregnancy: Hyper destruction in pregnancy. *Obstet Gynecol*, 1983; 61: 238-40.
8. Shah A, Patel ND, Shah MH; Hematological parameters in anemic pregnant women attending the antenatal clinic of rural teaching hospital. *Innovative Journal of Medical and Health Science*, 2012; 2(5): 70-73.
9. Yip R; Significance of an abnormally low or high hemoglobin concentration during pregnancy: special consideration of iron nutrition. *American Journal of Clinical Nutrition*, 2000; 72 (1): 272–79.
10. Wahed F, Latif S, Uddin M, Mahmud M; Fact of low hemoglobin and packed cell volume in pregnant women are at a standstill. *Mymensingh Medical Journal*, 2008; 17(1): 4–7.
11. Milman N, Byg KE, Agger AO; Hemoglobin and erythrocyte indices during normal pregnancy and postpartum in 206 women with and without iron supplementation. *Acta Obstet Gynecol Scand*. 2000; 79(2): 89-98.
12. Taylor DJ, Lind T; Red cell mass during and after normal pregnancy. *Br J Obstet Gynecol*, 1979; 86: 364–70.
13. Jam TR, Reid HL, Mullings AM; Are published standards for hematological indices in pregnancy applicable across populations: an evaluation in healthy pregnant Jamaican women. *BMC Pregnancy and Childbirth*, 2008; 8: 8.
14. Crocker IP, Baker PN, Fletcher J; Neutrophils function in pregnancy and rheumatoid arthritis. *Ann Rheumat Dis*, 2000; 59: 555–64.
15. Shehata HA, Ali MM, Evans-Jones JC, Upton GJ, Manyonda IT; Red cell distribution width

- (RDW) changes in pregnancy. *Int J Gynaecol Obstet.* 1998; 62(1): 43-6.
16. Sultana GS, Haque SA, Sultana T, Rahman Q, Ahmed AN; Role of red cell distribution width (RDW) in the detection of iron deficiency anaemia in pregnancy within the first 20 weeks of gestation. *Bangladesh Med Res Counc Bull.* 2011; 37(3): 102-5.
  17. Ramsay Margaret; Normal hematological changes during pregnancy and the puerperium. In: Pavord S, Hunt B, editors. *The obstetric hematology manual.* Cambridge: Cambridge University Press; 2010; 1-11.
  18. Shehlata N, Burrows RF, Kelton JG; Gestational thrombocytopenia. *Clin Obstet Gynecol,* 1999; 42: 327-34.
  19. Ahmed Y, Van Iddekinge B, Paul C, Sullivan MHF, Elder MG; Retrospective analysis of platelet numbers and volumes in normal pregnancy and preeclampsia. *Br J Obstet Gynaecol,* 1993; 100: 216-20.
  20. Fleming AF; Hematological changes in pregnancy. *Clin Obstet Gynecol,* 1975; 2: 269.
  21. Edlestam G, Lowbeer C, Kral G; New reference values for routine blood samples and human neutrophilic lipocalin during third trimester pregnancy. *Scand J Clin Lab Inv,* 2001; 61: 583-92.
  22. Konijnenberg A, Stokkers E, Post J; Extensive platelet activation in preeclampsia compared with normal pregnancy: enhanced expression of cell adhesion molecules. *Am J Obstet Gynecol,* 1997; 176(2): 461-69.
  23. Jessica M, Badger F, Hsieh CC, Troisi R, Lagiou P, Polischman N; Plasma volume expansion in pregnancy: implications for biomarkers in population studies. *Cancer Epidemiol Biomarkers,* 2007; 16: 17-20.
  24. Luppi P; How immune mechanisms are affected by pregnancy. *Vaccine,* 2003; 21(24): 3352-57.
  25. Kline AJ, Williams GW, Hernandez-Nino J; D-Dimer concentration in normal pregnancy: new diagnostic thresholds are needed. *Clin Chem,* 2005; 51(5): 825-29.