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Original Article

Comparative Study of Hematological Profile Variation in Three Trimesters of Pregnancy

Madiha Iqbal[1], Anam Farzand[1*], Ijaz Ahmad[1], Sidra Iqbal[1] and Azka Mubeen[1]

[1]Deparment of Allied Health Sciences, Superior University, Lahore, Pakistan

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***Corresponding Author:**

Anam Farzand
Deparment of Allied Health Sciences, Superior University, Lahore, Pakistan
anam.farzand@superior.edu.pk

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ABSTRACT

Pregnancy or gestation is a physiological condition in which various physiological changes occur. Although pregnancy is a normal phenomenon, several hematological parameters are varied to fulfill the needs of the developing fetus. Sometimes pregnancy becomes complicated due to these changes. **Objective:** To determine the changes in the hematological profile of healthy pregnant females. **Methods:** 180 females aged 21 to 34 participated in this study and were placed in a first, second, and third group according to their trimesters, while the fourth group was the control. Each contained 45 females. These women were examined for 12 hematological parameters. **Results:** When compared with control, it was observed that Hb and RBCs (p-value < 0.05) were lower than control while WBCs (p-value ≤ 0.03) were increased. MCV, MCH and MCHC (p-value < 0.05) showed discontinuous variations along three trimesters. Increase in platelets and neutrophils while a decrease in monocytes, eosinophils, and lymphocytes was observed (p-value <0.02). **Conclusions:** This study reported several changes in pregnant females' hematological parameters, which helped determine the reference ranges for these parameters. Moreover, pregnant women should have a balanced diet, and their hematological profile should be regularly monitored.

INTRODUCTION

Pregnancy or gestation is a condition in which a complete offspring develop from the fertilized egg (zygote). The gestational period comes up with various changes in the body's organs due to significant disruptions in the physiological, hormonal, hematological, and biochemical parameters. These alterations are considered necessary for the women to adapt to the stage of pregnancy and help in the growth and survival of the fetus [1]. Different hematological parameters include red blood cells (RBCs), white blood cells (WBCs), hematocrit (HCT), hemoglobin (Hb), mean cell hemoglobin (MCH), and mean cell hemoglobin concentration (MCHC), and platelets [2]. Variations are usually accompanied by a decrease in the blood and plasma volume, which leads to an increase in the mass of red blood cells. As a result, hematocrit falls, and in some cases, anemia occurs. These changes start appearing as early as the 6th week of gestation and continue up to 6 weeks after the delivery [3]. Abnormal and independent changes in the plasma volume (+40) and corpuscular volume (15+) are the efficient causes of physiologic anemia, the most significant and potent hematological variation. Hem dilution is a phenomenon that can cause false anemia by producing changes in the hematocrit and hemoglobin. For anemia to be present in pregnancy, the required hemoglobin threshold presented by the Centre for Disease Control and Prevention (CDC) must be lower than 11.0g/dl in 1st and 3rd trimesters. It should be lower than 10.5g/dl for anemic women in the 2nd

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trimester. After anemia, some other significant variation that occurs is thrombocytopenia. Almost 7 to 10% of pregnant females suffer from this complication. An increased level of Thromboxane A2 ends up in the increased consumption and aggregation of platelets. This results in lowering the platelet count in the blood. However, it is a multifactorial change, so there could also be other reasons behind thrombocytopenia [4, 5]. An increase in WBCs occurs in the 2nd month of pregnancy, and their concentration reaches up to 9000-15000 cells/µL [6]. If the leukocytosis occurs during 1st trimester, it is probably due to any complication [7]. Hematological parameters reflect these accommodative changes that become important baseline parameters to gauge all imminent complications throughout the physiological state. Pregnancy places extreme stress on the hematological system. It is thus very essential that understanding the physiological changes is obligatory to interpret needing for therapeutic intervention [8]. The Hb and HCT lower down when plasma volume increases but the value of HCT increases in late pregnancy. Anemia is the most frequent problem during pregnancy due to a reduction in hemoglobin concentration. Several studies reported a reduction of platelets during pregnancy because of the dilution effects. Platelets are also reduced when they pass over the rough and scarred surface of the placenta and get destroyed. However, thrombocytopenia has mild effects during gestation on the pregnant mother and the developing fetus [9]. Lymphocytes decrease more efficiently during 1st and 2nd trimesters, and their concentration is elevated during the 3rd trimester. Monocytes are essential in suppressing allograft rejection by the fetus; hence, monocytes occurs during early gestation, but it decreases as the gestation progresses. Basophils and eosinophils do not change much during pregnancy.

METHODS

In this facility-based cross-sectional study, 180 pregnant females of 21-34 year of age from gynae department of different hospitals were involved. 5 ml of the venous blood was collected from each participant by a sterile and disposable syringe and transferred into the tube containing ethylene diamine tetra acetic acid (EDTA). These tubes were labeled with essential information like the patient's name, age, and laboratory number (for identification). The sample was not refrigerated and kept at room temperature till further processing. The sample was preceded for further laboratory analysis within 24 hours of the collection. These 180 women were divided into three groups depending upon their trimesters. There were 3 groups accommodating females from the first, second, and third trimesters while the fourth group was the control and examined for hematological parameters. The blood sample collected from each participant was analyzed by the Elite 3 analyzer, which measures almost 22 hematological parameters. CBC parameters were measured using this three-part differential analyzer like RBCs, WBCs, Hb, HCT, RDW, MCV, MCH, MCHC, and platelets. 25 µl of the anticoagulated blood sample was used for the in vitro analysis.

RESULTS

The age groups of females and their percentages are shown in table 1.

Age	Frequency (%)
21-25 year	67 (38%)
25-30 year	61 (34%)
31-34 year	52 (28%)

Table 1: Age wise total number of females

Comparison of hematological parameters in three trimesters about WBCs, Hb, HCT, RDW, MCV, MCH, MCHC and platelets is shown in figure 1 and 2.

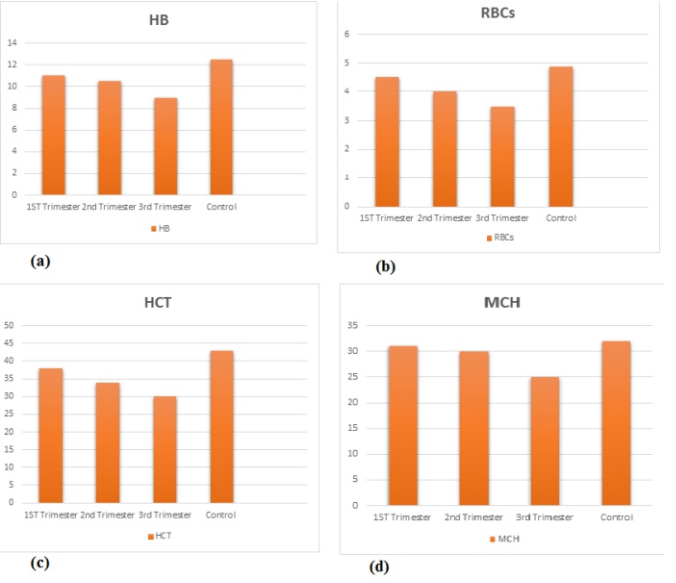

Figure 1: (a) Comparison of Hb in three trimesters (b) Comparison of RBCs in three trimesters (c) Comparison of Hematocrit in three trimesters (d) Comparison of MCV in three trimesters

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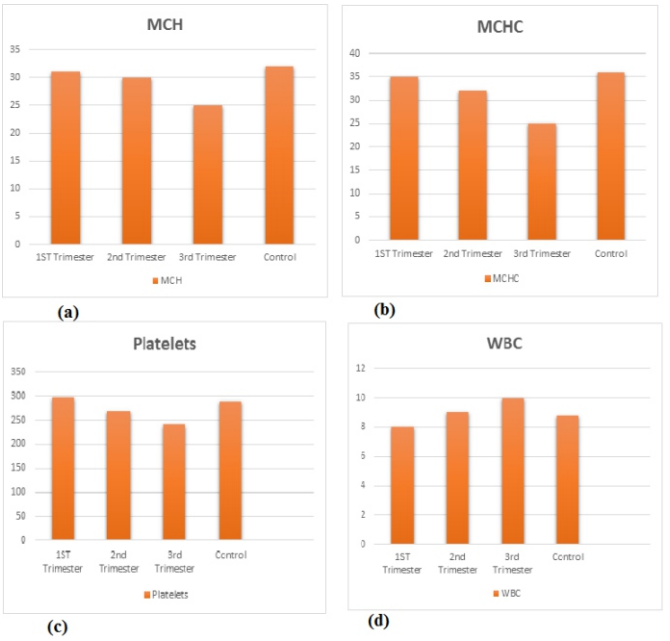

Figure 2: (a) Comparison of MCH in three trimesters (b) Comparison of MCHC in three trimesters(c) Comparison of PLT in three trimesters(d)Comparison of WBC in three trimesters

The average control values for blood-related parameters like Hb, RBCs, and HCT were 12.104 g/dl, 4.449 ×106/ µl, and 8.336 ×106/µl, while the mean values for MCV, MCH, MHCH, and platelets were recorded as 80.485 fL, 27.007 pg, 33.278 g/dL, 282.83×109/l respectively. Various WBC parameters like Total WBCs, neutrophils, lymphocytes, monocytes and eosinophils were presented as 36.373×103/ul, 60.783%, 29.769%, 6.033%, and 2.945%, respectively. Results were grouped according to the trimesters and were compared with the control values. In the first trimester, the overall mean value of hemoglobin (P=0.045) and RBCs (P=0.037), compared with control, appeared to be lower than the control, while HCT was slightly high. When calculated for MCV, MCH, MCHC, and platelets, mean values were 81.287 ± 8.60, 26.754 ± 3.45, and 32.727 ± 3.41, respectively. When measured in the pregnant women in the first trimester, WBC count and lymphocytes were higher than in control, while the reduction was seen in neutrophils, monocytes, and eosinophils (P≤ 0.03) and the hemoglobin value is low (10.5 g/dl). In the 2nd trimester, the value of hemoglobin is gradually low (10.2 g/d). In the third trimester, the value of hemoglobin is also low (9.7 g/dl). In the first trimester, the value of RBCs is average (4.7 × 106/µl). In the 2nd trimester, the value of RBCs is gradually low (4.0 × 106/µl). In the third trimester, the value of RBCs is also low (3.5 × 106/µl). In the first trimester, the value of HCT is average (38%). In the 2nd trimester, the value of HCT is normal (32%). In the third trimester, the value of HCT is also normal (30%). In the second trimester, the fluctuation of blood parameters was monitored. Hence, the mean values for the Hb, RBCs and HCT were 10.793 ± 1.96, 4.116 ± 0.55 and 33.750 ± 6.02 respectively showing decrease in these parameters (P < 0.01) There was an increase in platelets (P= 0.014) and MCV (0.03) while a reduction in MCH (P< 0.03) and MCHC (P<0.01). Examination of WBCs parameters like neutrophils, lymphocytes, monocytes, and eosinophils showed an increase in neutrophils while a decrease in the remaining three values (P<0.01). In the third trimester, the level of WBCs (P=0.03) was higher as compared to the first and second trimesters, with a mean value of 9.092 ± 2.89. At the same time, neutrophils, lymphocytes, monocytes, and eosinophils were decreased by 71.103 ± 8.70, 21.806 ± 7.61, 4.463 ± 2.79, and 1.966 ± 1.40, respectively (P≤0.02). Levels of Hb (P<0.01), RBCs (P<0.01), and HCT (P<0.05) were decreasing at a greater rate, as shown by their mean values of 9.613 ± 1.40, 3.954 ± 0.69, and 30.936 ± 4.86 respectively. Mean values of MCV (P=0.05), MCH (P<0.006) and MCHC (P<0.04) were 76.44 ± 10.32, 23.716 ± 3.79 and 30.583 ± 3.23 respectively.

DISCUSSION

This study aimed to evaluate the differences in hematological parameters of pregnant women. The level of Hb was monitored in three trimesters. Compared with control females, the results were that the average Hb level in the first trimester was 11.974 g/dl, in the second trimester was 10.793g/dl, and in the third trimester was 9.613 g/dl. The results of Hb values compared to controls are eventually decreased in pregnancy which was also reported [8]. The reason for reducing hemoglobin concentration lies in the fact that there is an increase in plasma volume during pregnancy, which results in hemodilution, due to which the Hb level falls [10, 11]. Apart from Hb levels, RBCs level was also monitored in all trimesters of pregnancy. The RBCs levels were significantly elevated during the third trimester compared to controls. The same findings of RBCS levels were seen in a study by Jain and Saxena in which results of RBCs were 4.23 x10^12/l ± 0.10 in the first trimester, 4.01 x 10^12/l ± 0.11 in the second trimester and 3.85 x 1012/l ± 0.11 in the third trimester [11]. There was a significant difference in the values of WBCs between the pregnant women and nonpregnant controls in this study. The mean values of WBCs in 100 females during the first trimester were 8.676 x109/l, the second trimester was 8.884 x109/l, and the third trimester was 9.092 x109/l. When these average values of WBCs were compared with the controls as a reference, it was found that their levels were raised during the third trimester. In one study, such findings of increased levels of WBCs during pregnancy were reported [12]. In this study, neutrophils were increased more specifically in the second and third trimesters up to 67.5 % and 71.1 %. Respectively than first (64.4 %) of pregnancy

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compared to the controls. This finding was also supported by the analysis performed, whose study provided the values of neutrophils as 63.44 ± 9.09% for the first, 73.77 ± 7.22% for the second, and 70.66 ± 9.05% for the third trimester [13]. The level of hematocrit was also checked in all pregnant females. These values were initially higher in the first trimester and decreased gradually till the third trimester. The importance of hematocrit in this study was 36.564 x 1012/l, 33.750 x1012/l in the second trimester, and 30.936 x1012/l in the third trimester, which was contrary to the findings of Ifeanyi who reported a low level of hematocrit during first trimesters of pregnancy which increased in the second trimester which eventually dropped down in the third trimester [13]. Total platelet count was compared within three trimesters with the control samples. The control value of the platelets was 282.83 x 109/l, while the values calculated for the first, second, and third trimesters were 304.44 x 109/l, 298.05 x 109/l, and 291.66 x 109/l respectively. The results showed that the level of platelets was higher than the control but gradually decreased along the trimesters. A similar observation regarding the mean platelet count for each group was shown [15-17]. Platelet count was higher than usual in all these studies but decreased within trimesters. Reduction in the platelet count may be due to increased blood volume, elevated platelet activation, and reduced life duration of uteroplacental circulation .The values of mean cell volume (MCV) were higher than the control value in the first two trimesters, 81.287 fl (first trimester) and 80.886 fl (second trimester) but lower in the third one (76.44 fl). It was concurrent with the findings of study in which the values of MCV in the 1st, 2nd and 3rd trimesters were 89.83fl, 88.07 fl, and 87.23 fl., the importance of MCH in study was lower than control values in the first, second, and third trimesters with 26.754 pg, 25.253 pg, and 23.716 pg respectively in the first, second, and third semester. In the previous study, the mean values of MCHC were 32.727 g/dl, 31.563 g/dl, and 30.583 g/dl showing a gradual reduction. A study by Kadas et al., reported non-significant changes in MCH and MCHC values [18]. Monocyte levels also decreased in the pregnant females compared to no pregnant females with 5.391%, 4.297%, and 4.463% in the first, second, and third trimesters respectively. The slight increase in value in the third trimester may be due to monocytes' prevention of fetal allograft rejection. These values fluctuate in a non-linear manner due to the patient distribution in contrast to Mba et al., who reported an increase in monocyte values in pregnancy [19]. Reduction in the eosinophil values (2.524 % in the first trimester, 2.245 % in the second trimester in the second trimester, and 1.966 % in the third trimester) was observed in this study, unlike reported non-significant changes in eosinophil count for consecutive three trimesters [20]. In this study, Norton et al., the mean values of lymphocytes were decreased (27.813% in the first, 24.809% in the second trimester, and 21.806% in the third trimester), which agreed with study reported an increase in lymphocytes during pregnancy while a decrease in lymphocytes during the third trimester was due to increased immune response by other leucocytes [21].

CONCLUSIONS

This study established a range of hematological parameters in healthy pregnant women; hence results of this study can be used as reference values for assessing the health status of pregnant women and the diagnosis of complications during pregnancy. It was revealed that women in the third trimester are more prone to impaired hematological parameters in which decreased Hb and increased WBCs were more common. Moreover, MCV has risen significantly in the first two trimesters. During pregnancy, proper nutrition is necessary. Therefore, it is strongly recommended to educate women about a balanced and healthy diet during the entire state of pregnancy.

Conflicts of Interest

The authors declare no conflict of interest

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