Estimation of the Hematological Change of Red Blood Cell and Platelet Count of Healthy Pregnant Women in Saudi Arabia

M M Hana 1,2, M R Ramzun1*, Z Nabela1, N A N Zahirah 1, Nik Noor Ashikin Nik Abdul Razak1, A R Azhar 1, S M Iskandar 1 and S Nursakinah1

1School of Physics, Universiti Sains Malaysia, 11800 Pulau Pinang, Malaysia
2Physics Department, College of Science, University of Dammam, King Faisal Road, Dammam, Saudi Arabia

E-mail*: ramzun@usm.my

Abstract. Tremendous changes in hematological values were noticed throughout trimesters of pregnancy. This study is aimed to provide a reference for hematological values based on trimesters, focused on the parameter of red blood cell (RBCs) and platelets (PLTs). There were 4075 local Saudi pregnant women were involved, attending the Maternity and Children Hospital in Dammam and King Fahad University Hospital in Al-Khobar, between 2013 to 2015. The statistical analysis, such as frequency and descriptive were performed. Overall, this study revealed a decline in RBCs and PLTs throughout pregnancy. The RBC, HCT, MPV and MCH mean values were found decreases in the 2nd trimester but increased in the 3rd trimester. On the contrary, the MCV, MCHC, and RDW showed increases in the 2nd trimester and decreased in the 3rd trimester. The changes of the RBCs parameters in 3rd trimester compared to 1st trimester shows increased for MCV while the RBC, HCT, MCH and MCHC decreased. Besides that, most of the respondent suffering from anemia. The hematological values after delivery show decreased for RBC, HCT, MCV, MCH and MPV but an increase in the MCHC, RDW and PLT. Thus, it is highly recommended to request for a complete blood cell screening during pregnancy to provide a better healthcare of the maternal and fetus.

1. Introduction
Normal pregnancy has indicated many changes in blood volume. The most changed were in plasma volume, which increased by 10–15 % from 6th to 12th weeks of GA [1, 2, 3]. The greater plasma induces high of RBCs mass at 8th to 10th weeks of GA, and steadily rises to 20–30 %, which comprise of 250–450 ml above of normal levels for non-pregnant women [4, 5, 6]. A greater expansion of plasma volume relative to the increase in hemoglobin mass and erythrocyte volume is responsible for the modest fall in hemoglobin levels (i.e, physiological or dilutional anemia of pregnancy) observed in healthy pregnant women. The major hematological changes during pregnancy are physiologic anemia. Anemia is most accurately defined as a low concentration of hemoglobin in the blood [7]. There are two common parameters can be defined anemia in pregnant women: i) the hemoglobin concentration was less than 11.0 g/dL, or ii) below the 5th percentile of the distribution of hemoglobin or the hematocrit in a healthy reference population [8].

Low platelets (PLTs) at pregnancy have adverse during the birth process as a result of over bleeding. The platelet counts during normal pregnancies can become decrease [9] or increase [10] but the mean
values do not necessarily reflect both increases and decreases in individual women [11]. Studies such as Osonuga et al. [12] and Shaw et al. [13] have identified the hematological indices of the pregnant woman as one of the factors affecting pregnancy. Anemia was an identified hematological abnormality [5] and it is also associated with adverse pregnancy outcome [14].

The physiological and biochemical changes in pregnancy have an influence on laboratory tests, thus it is important to develop reference intervals for the different time periods during uncomplicated pregnancies. Smith [15] reported that the hematological indices are influenced by many factors such as gender, geographical, pregnancy health and nutritional status. Most laboratories have reference intervals for healthy men and women, but there were not sufficient studies performed on the variety of laboratory tests during normal pregnancies. The RBCs was the common physiologic changes during pregnancy compared to other blood parameters. Nordin et al. [16] reported that reference interval should be traceable to a reference population, as well as to the measurement procedure and its calibration.

In Saudi Arabia, there were inadequate studies performed by trimester for hematological among normal pregnant women. The aim of this study was to assess the changing in hematological among different trimesters of normal pregnancy in Saudi Arabia; display the result with reference ranges for pregnant and non-pregnant women and estimation of the hematological value after delivery.

2. Methodology
A retrospective study was conducted between the September 2013 to February 2015 at the Department of Obstetrics and Gynecology, Hospital Maternity and Children in Dammam and King Fahad University (KFUH) in Alkobar, Saudi Arabia. This is one of the largest tertiary care centers in Dammam, with patients coming from all ethnic strata within the country. A number of 4075 singletons Saudi healthy pregnant women whose taking routinely examination at the Obstetrics Clinics was involved. The exclusion criteria are patients with maternal diseases that could possibly affect the fetal growth, such as hypertension, diabetes mellitus and renal disease, multiple gestations as well as those with fetal malformation and abnormal fetuses.

The RBCs count includes RBC, Hemoglobin (HB), Hematocrit (HCT), Mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH), Mean corpuscular hemoglobin concentration (MCHC), Red cell distribution width (RDW). Additionally, the PLTs which include PLT and Mean Platelet Volume (MPV) were selected for the analysis. This study focus on total change in RBCs, PLTs throughout pregnancy and after delivery. The statistical analysis was done using SPSS software version 22.0. The test utilizes is frequency and descriptive analysis of all parameters selected in the study. The mean values of this study were compared with USA [18] and the data were divided into a low, ideal and high range of blood counts, according to the reference study of USA [18]. Besides, the parameters of RBCs and PLTs after delivery was achieved, to reveal the difference before and after delivery. Furthermore, the values of hematological of pregnant women [25, 27, 26] and non-pregnant women [25, 28, 26] for other studies were recorded to show the differences between the result of this study with others countries.

3. Results and Discussion
The pregnancy causes many changes in blood circulation, according to the rises of the total blood volume by about 1.5 liters [17], these changes affect the hematological parameters. Diagnose these changes can monitor illness in pregnant women. This study includes 4075 healthy pregnant women from Saudi Arabia with mean age 29.23 ± 6.50 years. The background of the respondent is presented in Table 1. The study revealed a decline in RBCs of pregnant women in Saudi Arabia.

Table 2 shows the statistical analysis for RBCs and PLTs parameters include in this study. The mean values of RBCs and PLTs divided by 1st, 2nd and 3rd trimester, respectively, were shown in Figure 1 compared with the reference range from USA [18] for all values except the MCHC value which is not found with the reference value. The RBC, HCT, and MCH mean values were found to be decreased by 8.93%, 6.25%, and 0.93%, respectively in the 2nd trimester, but these parameters increased in 3rd trimester by 6.62%, 6.55%, and 0.55%, respectively. On the contrary, the MCV, MCHC, and RDW
show increased by 2.38%, 0.79%, and 6.73%, respectively in the 2nd trimester, and decreased by 0.26%, 3.92%, and 1.01%, respectively, in the 3rd trimester. The changes of the RBCs parameters in 3rd trimester compared to 1st trimester shows increased for MCV and RDW by 2.11% and 5.65%, respectively, while the RBC, HCT, MCH and MCHC decreased by 2.90%, 0.12%, 0.39% and 3.16% respectively. A 51.16% of the patients had a low range in 1st trimester indicating anemia in the beginning of pregnancy. After ANC care and treatment with the medicine given, the percentage decreased to 28.63% and 21.49% in 2nd and 3rd trimester, sequentially. After the delivery, 80.36% of patients were found to have a low range of Hb suggesting that most Saudi pregnant women suffering from anemia and need help in order to maintain their health.

Table 1. Characteristics of the study population

| No | Respondent background | N   | %   |
|----|-----------------------|-----|-----|
| 1  | All                   | 4075| 100 |
| 2  | Age (years old)       |     |     |
|    | ≤34                   | 3125| 76.69|
|    | ≥35                   | 950 | 23.31|
| 3  | Gravida               |     |     |
|    | Primid                | 991 | 24.32|
|    | 2                     | 956 | 24.36|
|    | 3                     | 717 | 17.60|
|    | 4,5                   | 551 | 13.52|
|    | ≥6                    | 860 | 21.10|
| 4  | Type of delivery      |     |     |
|    | NSD                   | 3538| 86.82|
|    | CS                    | 512 | 12.56|
|    | Vacuum, Breech, Forceps| 25  | 0.62 |
| 5  | Gender of baby        |     |     |
|    | Male                  | 2097| 51.46|
|    | Female                | 1978| 48.54|
| 6  | Weight of baby (kg)   |     |     |
|    | ≤ 2.9                 | 1486| 36.47|
|    | 2.9 - 3.3             | 1397| 34.28|
|    | ≥3.31                 | 1192| 29.25|
| 7  | Apgar score           |     |     |
|    | ≥ 7                   | 3969| 97.40|
|    | < 7                   | 106 | 2.6  |

Table 2. The RBCs and PLTs values for this study.

| Statistics | RBCs Parameters | PLTs Parameters |
|------------|-----------------|-----------------|
|            | RBC (x10^{12}/L) | HCT (L%) | HB (gm/dl) | MCV (fL) | MCH (pg) | MCHC (gm/dL) | RDW (%) | PLT (10^3/µl) | MPV (fL) |
| Mean       | 4.26            | 33.29 | 10.68 | 78.02 | 25.66 | 32.02 | 16.74 | 241.43 | 9.80 |
| SD         | 1.01            | 7.34 | 1.55 | 14.52 | 4.48 | 4.91 | 9.75 | 86.19 | 5.26 |
| N          | 6646            | 6791 | 5188 | 6789 | 6786 | 6783 | 5654 | 6955 | 5500 |
| Mode       | 4.30            | 32.60 | 10.80 | 86.30 | 24.90 | 33.50 | 14.70 | 195.00 | 10.30 |
| Median     | 4.17            | 32.90 | 10.80 | 79.30 | 25.80 | 32.40 | 15.60 | 234.00 | 9.50 |
| Minimum    | 1.00            | 2.20 | 5.00 | 2.70 | 3.00 | 3.10 | 8.00 | 6.70 | 1.00 |
| Maximum    | 12.10           | 74.00 | 17.90 | 133.00 | 87.80 | 335.00 | 547.00 | 395.00 | 25.00 |
Figure 1. The comparison of hematological parameters for Saudi Arabia (this study) and USA [18] divided by trimesters.

The PLT values decreased in the 2nd trimester and 3rd trimester by 4.23% and 13.30%, respectively. Meanwhile, the MPV mean value was found to be decreased in the 2nd trimester by 1.39% and increased in the 3rd trimester by 5.47%. This finding was agreement with previous study for [19], [20] which reported decreased in RBC value in the 3rd trimester also a study was done by Good et al. [21] which mentioned rising in MCV value in the 3rd trimester.

The changes of the PLTs parameters in 3rd trimester compared to 1st trimester shows decreased for PLT by 18.09% and increased for the MPV value by 4.15%. Therefore, the PLT and MPV are both declines throughout pregnancy and continuing decline until the term for PLT, but began to incline at early of 3rd trimester for an MPV. These findings agree with the studies done by Matthews et al. [22] and Verdy et al. [9] that reported significant decreases in PLTs count of pregnant women compared to non-pregnant women, with the PLT values still within normal pregnant range.
After delivery, the RBC, HCT, MCV and MCH decreased by 6.57%, 7.10%, 0.48% and 1.11%, respectively, compared to 3rd trimester value, but the MCHC and RDW were seen to increase by 0.19% and 2.28%, respectively. When the RBCs parameters after delivery are compared with the 1st trimester value, the MCV and RDW increased by 1.63% and 8.06%, respectively, while the RBC, HCT, MCH and MCHC decreased by 9.28%, 7.21%, 1.49% and 2.98%, respectively. Overall, the highest value change percentage was seen for RBC, then followed by HCT, RDW, MCHC, MCV and MCH. For this study, the greater value of MCV and RDW were noticed in order to cover up the loss of other RBCs values, hence increased the opportunity to carry up the oxygen and other needed molecules [23]. Besides that, after delivery the PLT increased by 2.12% compared to the 3rd trimester value, but decreased by 15.64% compared with the 1st trimester value. Meanwhile, the MPV value shows decreased by 0.96% compared to 3rd trimester and increased by 3.22% compared with the 1st trimester value.

Figure 2. shows the RBCs and PLTs data according to a low, ideal and high range of blood counts [18]. The highest percentages of RBCs data were seen within the ideal range for RBC, RDW, and MCHC in all trimesters except high range for RDW and low range for MCHC, in the 2nd trimester. Meanwhile, low range was noticed for MCH and MCV in all trimesters. After the delivery, only MCHC data mostly within the ideal range, but for RBC, MCV and MCH were found in the low range. The RDW data remain in the high range value. The rise in the RDW is a predictor of iron deficiency anemia in pregnancy [24]. A low MCV indicates that red blood cells are smaller than normal values, while a low MCH indicates that the hemoglobin in red blood cells is less than normal values. These measurements explain the different types of anemia [25]. In this study, there are more than 60% of the MCV and MCH data falls within low range values, thus indicated that the pregnant women in Saudi Arabia have smaller red blood cells and low hemoglobin in red blood cells. After delivery, higher RDW is needed to recover the loss of the other RBCs. The highest percentages of PLTs in all trimesters and PLTs data after delivery were noticed within the ideal range values.

Table 3 describes the range value for RBCs and PLTs in this study, and display the value of other studies of pregnant and non-pregnant women. From the comparison, the RBC in this study was seen close to Nigerian pregnant women [26] and Sudanese non-pregnant women [25]. The high value of MCV and MCH were noticed in Taiwan pregnant women [27] while lowest in Sudanese pregnant women. The PLT in this study shows the great value within the value of pregnant women and similar to Nigerian non-pregnant women.
Figure 2. The percentage of RBCs and PLTs data by trimesters according to USA [18] dividing to low, ideal and high range and after delivery.

Table 3. Compare the hematological values of pregnant and non-pregnant women.

| PARAMETERS | Pregnant Value | Non-pregnant value |
|------------|---------------|--------------------|
|            | Saudi Arabia  | Sudan [25]         | Taiwan [27] | Nigeria [26] | Sudan [25] | India [28] | Nigeria [26] |
| RBCs       | RBC(x10^12/L) | 4.26±1.01          | 3.7 ± 0.6   | 3.22 ± 0.44 | 4.27 ± 0.45 | 4.2 ± 0.3  | 4.48 ± 1.20  | 4.60 ± 0.63  |
| HCT        | (L %)         | 33.29±7.34         | -           | 36.9 ± 4.6  | -           | -          | -           | 39.73 ± 4.68 |
| HB         | (gm/dl)       | 10.6±1.55          | 9 ± 1.6     | 11.2 ± 1.5  | 11.80 ± 0.97| 12.0±0.7   | 12.7 ± 0.94  | 12.75 ± 1.69 |
| MCV        | (fL)          | 78.02±14.52        | 73.8 ± 9.2  | 115.0 ± 6.8 | 85.02 ± 6.24| 83.5±3.1   | 96.44 ± 6.02 | 85.81 ± 4.90 |
**Conclusion**

This study estimates the changing in hematological among different trimesters of normal pregnancy in Saudi Arabia and compares it with other population. The MCV, RDW and MPV showed increases in 3rd trimester while the RBC, HCT, MCH, MCHC and PLT decreased. After delivery, the decreased value was seen for RBC, HCT, MCV, MCH and MPV but an increase in the MCHC, RDW and PLT. The PLT show increased after delivery while MPV value shows decreased compared with 3rd trimester. In Saudi Arabia, more than 60% of the MCV and MCH data lied within the low range values, thus indicating that the pregnant women have a smaller RBC with low Hb and suffering from anemia. Regard this changes it is highly recommended to be required the test of hematological and Hb during the visit clinic to provide a better healthcare and well being of the maternal and fetuses.

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