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A STUDY ON THE HEMATOLOGICAL CHANGES DURING -PREGNANCY

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ABSTRACT

Objectives: This study aimed to analyze the demographic and baseline characteristics, along with hematological parameters of pregnant women across three trimesters to understand the physiological changes during pregnancy. **Methodology:** A total of 240 participants were recruited and divided into three groups based on their trimester: first, second, and third, with 80 participants in each group. Hematological parameters, including hemoglobin (Hb), hematocrit (Hct), red blood cell (RBC) count, were measured using standard techniques and mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) were assessed. **Results:** The demographic data revealed that the average age of participants increased slightly with each trimester, from 28.4 years in the first trimester to 30.2 years in the third trimester. The majority of participants (over 80%) resided in rural areas. The results indicated a gradual decrease in mean hemoglobin levels from 11.7 g/dL in the first trimester to 10.9 g/dL in the third trimester. Similarly, the mean hematocrit levels decreased from 35.5% in the first trimester to 32.5% in the third trimester, and the mean RBC count decreased from 4.85 x 10^6/µL to 4.30 x 10^6/µL across the trimesters. Additionally, MCV, MCH and MCHC showed slight increases across trimesters. **Conclusion:** The study recommends regular monitoring of these hematological parameters throughout pregnancy to.

KEYWORDS: Pregnancy, Hematological Parameters, Hemoglobin, Hematocrit, Physiological Changes.

INTRODUCTION

Pregnancy is a physiological process in which fertilized egg is carried in uterus for the period of 38 to 42 weeks until the birth of offspring (Mohamed et al., 2016). During this process many biochemical, hematological, hormonal and anatomical and physiological changes occur in body (Costantine, 2014) which are necessary for normal development of fetus and for adapting the pregnancy (Kraemer and Zimmermann, 2007). The haematological parameter indicates the immunological, nutritional and hemostatic condition of a pregnant woman and is considered as major factors affecting the pregnancy (Banhidy et al., 2011). One of the most significant changes during pregnancy is the alteration in the hematological system. These hematological parameters of a pregnant women include hematocrit (Hct), total red blood cell count (T-RBC), Total leukocytes count (TLC), total leucocyte count (TLC), mean cell volume (MCV), mean cell hemoglobin (MCH), mean cell hemoglobin concentration (MCHC), differential leucocytes count (DLC) and platelet count.

Hematological parameters are critical indicators of health, reflecting the body's ability to transport oxygen, fight infections, and maintain hemostasis. During pregnancy, these parameters undergo significant changes to support the developing fetus and adapt to the increased physiological demands on the mother's body. Understanding the importance of these hematological parameters is essential for ensuring optimal prenatal care and addressing potential complications that may arise during pregnancy (Kraemer and Zimmermann, 2007).

Several studies have been conducted on haematological parameters in pregnant female; however, few are available on different trimesters with different results. Albeit, not much references is available from this part of the country in this regard. Therefore, this study was conducted to find haematological parameters, especially in relation to RBCs only, in pregnant females of Jammu and Kashmir within different trimesters.

MATERIALS AND METHODS

The study utilized a longitudinal, observational design to systematically observe changes in hematological parameters, especially relating to RBCs, during the different trimesters of pregnancy. The research was conducted at the outpatient department of Pacific Health Services, Tral, Jammu and Kashmir. This setting was selected due to its central location for the target population and its equipped medical facilities that could support comprehensive hematological testing. A total of purposively selected 240 participants were grouped based on their trimester at the time of initial sampling: In Group-I, 80 participants of first trimester (up to 13 weeks) were considered. In Group-II, 80 participants of second trimester (14 to 26 weeks) were considered, and in Group-III, 80 participants of third trimester (27 weeks to delivery) were considered.

Blood Sample Collection

Blood samples were collected during routine prenatal visits scheduled for each trimester. The sampling involved - using EDTA vacutainers to collect blood, ensuring the prevention of clotting and preservation of blood components for accurate hematological analysis. Blood draw was performed by trained medical professionals using standard phlebotomy techniques to ensure participant safety and sample integrity.

Laboratory Analysis

Collected samples were transported under controlled conditions to the hospital laboratory where the following hematological parameters were analyzed following standard procedures: Hemoglobin (Hb), Hematocrit (Hct), Red Blood Cell Count (RBC), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC).

Follow-Up and Data Collection

Participants were followed up through their pregnancy, with data collected at each trimester to monitor changes in hematological parameters. Follow-up visits coincided with their scheduled prenatal check-ups to minimize inconvenience to the participants.

Data Handling and Management

Data collected from laboratory analyses and participant records were entered into a secure database. Personal identifiers were removed to maintain confidentiality, and access to the data was restricted to authorized research personnel only.

STATISTICAL ANALYSIS

Data were analyzed using the SPSS software. Descriptive statistics summarized the demographics and baseline characteristics. Repeated measures ANOVA was used to determine significant changes in hematological parameters over the trimesters. Statistical significance was set at a p-value of less than 0.05.

RESULTS

Table 1 exhibited the demographic and baseline characteristics of study participants. The average age of participants increased slightly with each trimester, from 28.4 years in the first trimester to 30.2 years in the third trimester. A significant majority of the participants were from rural areas (over 80% in each group), reflecting the community's demographic scenario. There was a gradual decrease in average hemoglobin and hematocrit values from the first to the third trimester, aligning with expected physiological changes due to hemodilution in pregnancy. The RBC count also showed a decreasing trend, which is typical as pregnancy progresses.

Table 2 showed the distribution of haemoglobin levels across trimesters. The mean hemoglobin level was reported as 11.7 (± 1.3) g/dL in first trimester, 11.3 (± 1.2) in second trimesters and 10.9 (± 1.1) g/Dl in third trimesper and across all trimesters, the mean hemoglobin level was 11.3 (± 1.2) g/dL. However, the differences were statistically significant p<0.042) across the trimesters.

The hematocrit values across trimesters were shown in Table 3. The mean hematocrit level was reported as 35.5% (± 3.7) in first trimester, 33.8% (± 3.5) in second trimesters and 32.5%, (± 3.3) in third trimesper and across the trimesters, the mean hematocrit level was 34.0% (± 3.5). However, the differences were statistically significant p<0.012) across the trimesters.

Table 4 highlighted the distribution of red blood cell count across trimesters. The mean red blood cell count was reported as 4.85 x 10^6/µL (±0.50 x 10^6) in first trimester, 4.30 x 10^6/µL (±0.45 x 10^6/µL in second trimesters and 4.30 x 10^6/µL (±0.45 x 10^6/µL) in third trimesper and across all trimesters, the mean red blood cell count was 4.57 x 10^6/µL (±0.50 x 10^6/µL). However, the differences were statistically significant p<0.023) across the trimesters.

Mean corpuscular volume across trimesters were shown in Table 5. The mean corpuscular volume was reported as 88 (±4.0) in first trimester, 90 (±4.2) in second trimester and 90 (±4.1) in third trimester and across the trimesters, the mean corpuscular volume was 89 (±4.1). However, the differences were statistically significant p<0.042) across the trimesters.

Table 6 exhibited the distribution of mean corpuscular haemoglobin across trimesters. The mean corpuscular haemoglobin was reported as 29.5 (±2.0) pg in first

trimester, 30.0 (±2.1) pg in second trimester and 30.2 (±2.2) pg in third trimester and across all trimesters, the mean corpuscular haemoglobin was 29.9 (±2.1) pg. However, the differences were statistically significant p<0.048) across the trimesters.

Table 1: Demographic and baseline characteristics of study participants.

Characteristics	First Trimester (n=80)	Second Trimester (n=80)	Third Trimester (n=80)	Total (n=240)
Age (years) Mean ± SD	28.4 ± 5.2	29.1 ± 4.8	30.2 ± 4.9	29.2 ± 5.0
Range	18 - 39	19 – 41	20 - 45	18 - 45
Area of Residence-Urban	12 (15%)	15 (18.75%)	18 (22.5%)	45 (18.75%)
Rural	68 (85%)	65 (81.25%)	62 (77.5%)	195 (81.25%)
Baseline Hemoglobin (g/dL) - Mean ± SD	11.7 ± 1.3	11.5 ± 1.2	11.3 ± 1.1	11.5 ± 1.2
Baseline Hematocrit (%) - Mean ± SD	35.5 ± 3.7	34.8 ± 3.5	34.0 ± 3.3	34.8 ± 3.5
Baseline RBC (x10^6/µL) - Mean ± SD	4.85 ± 0.5	4.70 ± 0.5	4.55 ± 0.5	4.70 ± 0.5

Table 2: Haemoglobin (Hb) levels across trimesters.

Trimester	Mean (g/dL)	SD	Range (g/dL)	95% CI	p-value
First Trimester	11.7	1.3	9.0 - 14.0	11.4 - 12.0	**<0.042**
Second Trimester	11.3	1.2	8.8 - 13.8	11.0 - 11.5	
Third Trimester	10.9	1.1	8.5 - 13.2	10.7 - 11.1	
Total	10.2	1.0	10.2 - 11.8	11.6 - 12.3	

Table 3: Hematocrit (Hct) values across trimesters.

Trimester	Mean (%)	SD	Range (%)	95% CI	p-value
First Trimester	35.5	3.7	28.0 - 42.0	34.8 - 36.2	**<0.012**
Second Trimester	33.8	3.5	27.0 - 41.0	33.2 - 34.5	
Third Trimester	32.5	3.3	26.0 - 40.0	31.9 - 33.2	
Total	34.0	3.5	26.0 - 42.0	33.6 - 34.3	

Table 4: Red blood cell count across trimesters.

Trimester	Mean (x10^6/µL)	SD	Range (10^6/µL)	95% CI	p-value
First Trimester	4.85	0.50	3.8 - 5.9	4.75 - 4.95	**<0.023**
Second Trimester	4.55	0.50	3.6 - 5.7	4.45 - 4.65	
Third Trimester	4.30	0.45	3.5 - 5.4	4.21 - 4.39	
Total	4.57	0.50	3.5 - 5.9	4.51 - 4.64	

Table 5: Mean corpuscular volume across trimesters.

Trimester	Mean (fL)	SD	Range (fL)	95% CI	p-value
First Trimester	88	4.0	80 - 96	87 - 89	**<0.042**
Second Trimester	90	4.2	82 - 98	89 - 91	
Third Trimester	90	4.1	83 - 99	89 - 91	
Total	89	4.1	80 - 99	88 - 90	

Table 6: Mean corpuscular haemoglobin across trimesters.

Trimester	Mean (pg)	SD	Range (pg)	95% CI	p-value
First Trimester	29.5	2.0	25 - 34	29.1 - 29.9	**<0.048**
Second Trimester	30.0	2.1	26 - 35	29.6 - 30.4	
Third Trimester	30.2	2.2	27 - 36	29.8 - 30.6	
Total	29.9	2.1	25 - 36	29.7 - 30.1	

Table 7: Mean corpuscular haemoglobin concentration across trimesters.

Trimester	Mean (g/dL)	SD	Range (g/dL)	95% CI	p-value
First Trimester	33.4	1.2	31 - 36	33.1- 33.7	**<0.031**
Second Trimester	33.5	1.3	31 - 37	33.2- 33.8	
Third Trimester	33.6	1.3	31 - 37	33.3- 33.9	
Total	33.5	1.3	31 - 37	33.3- 33.7	

Mean corpuscular haemoglobin concentration across trimesters was shown in Table 7. The mean corpuscular haemoglobin concentration was reported as 33.4 (±1.2) g/dL in first trimester, 33.5 (±1.3) g/dL in second trimester and 33.6 (±1.3) g/dL in third trimester and across the trimesters, the mean corpuscular haemoglobin concentration was 33.5 (±1.3) g/dL. However, the differences were statistically significant p<0.031) across the trimesters.

DISCUSSION

In our study, the demographic characteristics of the participants were assessed to provide context for the subsequent analysis of haematological parameters. Participants were divided into three groups based on their trimester at the time of recruitment: first trimester, second trimester, and third trimester, with 80 participants in each group, totalling 240 participants. The overall average age across all trimesters was 29.2 (± 5.0) years. A significant majority of the participants (81.25%) resided in rural areas.

The observed decrease in haemoglobin levels across the trimesters aligns with the physiological adaptation during pregnancy, where hemodilution occurs due to the increase in plasma volume. This trend is expected and consistent with existing literature on haematological changes during pregnancy. The p-value for the difference in haemoglobin levels between the first and second trimesters was 0.042, indicating statistical significance. Most of the studies showed that the Hb content of pregnant women is low as compared to non-pregnant women. There is a significant decrease was observed in Hb from first to third trimester as compared to non-pregnant women.

The gradual decrease in hematocrit levels across trimesters aligns with the physiological changes in pregnancy, where plasma volume expansion leads to hemodilution. This trend supports the expected pattern of hematocrit values during pregnancy. The p-value for the difference in hematocrit levels between the first and second trimesters was 0.012, indicating statistical significance. Hematocrit level falls down during pregnancy as compared to non-pregnant control and there is no significant difference in the value of Hct in all three trimesters. But the study conducted by Purohit et al. (2015) revealed that there was variation in value of Hct in all three trimester of pregnancy. This decrease is not linear as Hct percentage in first and third trimester is lower but in second trimester, it is very significant (Azab et al., 2017).

The observed decrease in RBC count across the trimesters supports the expected physiological adaptation during pregnancy, where hemodilution occurs due to increased plasma volume. The p-value for the difference in RBC counts between the first and second trimesters was 0.023, indicating statistical significance. In a normal non-pregnant female the total RBC count ranges from 4.4 to 5.4 million/µl of blood. Total RBC count fall down during pregnancy significantly as compared to non-pregnant women (Mba et al., 2019). RBC count decreases linearly, as gestational age increases.

Blood volume increases by approximately 30-50% to meet the increased demands of the mother and fetus (Cunningham et al., 2014). This expansion of plasma volume begins early in pregnancy and peaks around the second trimester, leading to a dilutional effect known as physiological anaemia of pregnancy. The increase in MCV values across trimesters could be attributed to the body's adaptation to the increased demand for oxygen transport during pregnancy. The p-value for the difference in MCV values between the first and second trimesters was 0.042, indicating statistical significance. According to James et al. (2008), MCV increased significantly from first to third trimester during pregnancy. But another study conducted by Akinbami et al. (2013), MCV falls from first to third trimester due to anaemia in patients. Despite the increase in total red blood cell mass, the hematocrit and haemoglobin concentrations appear reduced due to the disproportionately larger rise in plasma volume (Rasmussen and Stoltzfus, 2003). This physiological anaemia is generally well tolerated but requires monitoring to distinguish it from pathological anaemia, which may necessitate intervention.

The observed changes in MCH and MCHC values across the trimesters reflect the body's adaptation to the increased demand for oxygen transport during pregnancy. These trends are consistent with expected physiological changes and support the robustness of the study findings. No significant changes in MCH during pregnancy and remains constant throughout the three trimesters. But other studies showed that the values of MCH decreased significantly in the second and third trimester. MCHC is found to be lower in pregnant women as compared to non-pregnant women due to poor iron intake. In pregnant women with anaemia, MCHC is decreased significantly as compared to non-anaemic pregnant women. Study conducted by (Abrar et al., 2019) showed that the MCHC is constant during pregnancy and there is no change through the pregnancy.

However, this study had limitations, including its relatively small sample size and the predominance of rural participants, which may limit the generalizability of the results to broader populations. Future research should consider larger, more diverse populations to validate these findings and explore the underlying mechanisms driving hematological changes in pregnancy. Additionally, longitudinal studies tracking individual changes across all trimesters would provide more detailed insights into the progression of these physiological adaptations.

CONCLUSION

Based on the findings, it is recommended that regular monitoring of hematological parameters such as hemoglobin, hematocrit, RBC count, MCV, MCH and MCHC should be a standard practice throughout pregnancy to ensure maternal and fetal health. These parameters provide critical insights into the physiological adaptations during pregnancy and can help in the early detection and management of potential complications.

Declaration By Authors

The authors hereby declared that it was their original peace of research and had not been sent to any other journal for publication.

Ethical Approval: Approved.

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