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Assessment of Hematological Profile and Blood Group Patterns in Pregnant Women

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ABSTRACT

Background: Hematological changes are crucial for meeting the increased requirements of the developing fetus and placenta, leading to significant changes in blood volume and composition. Monitoring these hematological variations helps identify potential maternal-fetal complications and assess overall pregnancy outcomes. **Objective:** To evaluate the hematological parameters among pregnant women and assess the correlation with different blood groups. **Study Design:** Cross-sectional study. **Settings:** Hayatabad Medical Complex, Peshawar Pakistan. **Duration:** Eight months, from January to August 2024. **Methods:** The study involved 374 pregnant women. Participants aged 18 and older were selected using non-probability sampling and included if they provided informed consent. Data was collected through a structured questionnaire, and blood samples were assayed for Complete Blood Count and blood group determination by forward agglutination. SPSS version 26 was used for statistical analysis, with a p-value <0.05 deemed significant. **Results:** Among the 374 participants, blood type B was the most prevalent (32.9%). The mean hemoglobin (Hb) level was 11.32 g/dL (±1.86), while the mean TLC was 9,666 cells/µL (±4,668). The average platelet (PLT) count was 274,360 cells/µL (±77,754). No significant correlation was found between blood groups and Hb (p=0.162), and WBC (p=0.316), while significant association with PLT levels (p=0.007). **Conclusion:** The present study investigation revealed a notable association was observed between blood groups and platelet counts. These findings contribute to our comprehension of the interrelationship between blood group polymorphisms and hematological parameters, underscoring the necessity for further research in genetically diverse populations.

Keywords: *TLC, Anemia, Hemoglobin, Pregnancy, Hematology.*

INTRODUCTION

The hematological profile gives essential insights into the physiological changes as pregnancy progresses, influencing outcomes and highlighting potential maternal-fetal complications.[1] Hematological changes during pregnancy are essential to support the growing needs of the fetus and placenta, resulting in notable increases in blood volume.[2] RBC indices, such as Mean cell volume (MCV), MCH, and MCHC, provide evidence to support pathologies in RBCs.[3] These indices give an overview of anemia and polycythemia while also helping differentiate conditions such as alcohol use, liver problems, thalassemia, kidney issues, and sickle cell disease.[4] Among the common hematological abnormalities in pregnancy is anemia, defined by the World Health Organization (WHO) as a hemoglobin concentration below 11.0 g/dL or a hematocrit concentration below 33%.[1] Blood volume increases by over 50% during pregnancy, leading to hemodilution.[4] This increase surpasses the associated rise in red blood cell mass, resulting in physiological anemia characterized by low RBC, Hb, HCT, MCH, and MCHC levels.[5]

During pregnancy, the increase in blood volume is linked to decreased levels of atrial-natriuretic peptide and heightened plasma renin activity.[4] The normal hemoglobin (Hb) range for pregnant women is 11-12 g/dL, with critical values being Hb < 5 g/dL and Hb > 20 g/dL, which may lead to heart failure and hemoconcentration-related clotting. Starting at the 16th week of gestation, Hb levels, RBC count, and HCT typically decline due to increased plasma volume.[4,6] The World Health Organization estimates that 51% of pregnant women in developing countries, particularly in sub-Saharan Africa, are affected by anemia, with the global prevalence in pregnant women being 41.8%.[2] In Ethiopia, anemia is a significant public health issue, affecting approximately 62.7% of pregnant women.[7] Additionally, a study in Ethiopia found that 11.62% experienced anemia, while 7.7% were diagnosed with thrombocytopenia.[2]

Leukocytosis is also present in normal pregnancy, driven by physiological stress, due to a complex process involving the endocrine system, metabolic processes, and the genital system, leading to increased leukocyte counts during pregnancy.[4] Gestational thrombocytopenia, second only to anemia among hematological abnormalities, occurs in 7-8% of pregnancies and is typically a mild condition requiring no clinical intervention.[1] There is a massive decrease in platelet count with advancing gestational age, likely due to the continuous expansion of the uterine wall, causing lacerations and subsequent hemorrhage and platelet consumption.[4] Kadas *et al.*, reported that hematological profiles and trimester stages significantly correlate with white and mixed cell counts.[1]

Since the discovery of the ABO blood group system by Karl Landsteiner in 1900, which plays a vital role in transfusion and transplantation, numerous studies have investigated its relationship with various diseases.[8,9] Some studies have reported an increased risk of preeclampsia in women with A or AB blood groups. In contrast, others have found a higher percentage of the O blood group among women with gestational diabetes mellitus (GDM).[9]

Despite the changes in hematological values during pregnancy, few laboratories provide specific reference ranges for pregnant women.[10] Most laboratory information systems report reference values based on samples from non-pregnant women, which may not apply to clinical decisions during pregnancy. This discrepancy increases the risk of misinterpreting regular physiological changes as pathological events or overlooking significant alterations due to pathological conditions.[4,11] The WHO recommends eight antenatal visits throughout pregnancy, including complete blood count and fasting blood sugar tests, along with other recommendations.[12]

Understanding the hematological changes during pregnancy is crucial for accurate clinical assessment of pregnant women. This study seeks to clarify these changes to comprehend better how pregnancy impacts blood parameters, thereby aiding in identifying potential maternal-fetal complications and enhancing overall pregnancy care. The study aimed to evaluate the hematological profile and blood group patterns in pregnant women in Peshawar, identifying common hematological abnormalities to strengthen maternal and fetal health outcomes in the region.

METHODS

A cross-sectional design study was conducted in the Gynecology Department of Hayatabad Medical Complex Peshawar over eight months, from January to August 2024. A sample size of 374 pregnant women was calculated as per the WHO Sample Size Calculator using a 41.8% anticipated frequency of anemia in pregnancy based on a population size of 2,049,157 with a 95% confidence interval and a 5% margin of error,[2,13] Study participants were selected by a non-probability sampling technique. The study included pregnant women aged 18 years and above, in any trimester of pregnancy, who provided informed consent. Exclusion criteria were women with known hematological disorders, those with a history of chronic diseases such as diabetes, hypertension, or cardiovascular disorders, and those who refused to give consent after the approval of the Ethical Review Committee of the Hayatabad Medical Complex Hospital (Ref No. 1022/HEC/B&PSC/2023).

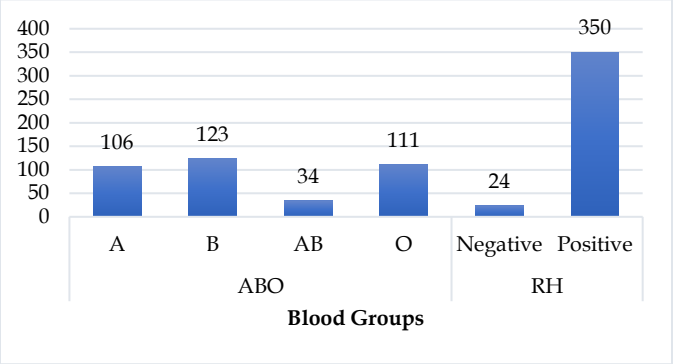
Data collection was initiated through a structured questionnaire regarding the demographic information and relevant medical history. Blood samples were collected and assayed for Complete Blood Count (CBC) using the Mindray Hematology Analyzer BC-20s was performed, while blood group determination was performed using the forward agglutination method.

Data analysis was conducted using SPSS version 26. Categorical variables such as blood group types and anemia status were expressed in frequencies and percentages. Descriptive analysis was performed for continuous variables such as Hb levels, TLC and Platelets counts to express the mean and SD. ANOVA was applied to compare mean differences in HB levels, TLC, and Platelet count across different blood group groups. The chi-square test was employed with a p-value <0.05, deemed significant for any association between blood groups and anemia, TLC, and Platelets count.

RESULTS

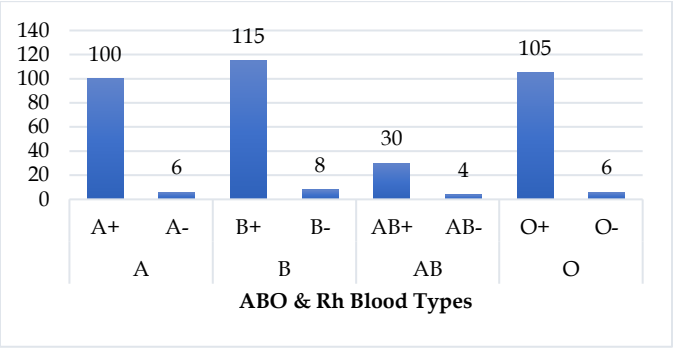
The analysis of blood group distributions among the 374 participants showed that group B was the most prevalent, comprising 32.9% of the sample population, followed by group O at 29.7% and group A at 28.3%. Group AB was the least common, with only 9.1% of individuals falling into this category. The cumulative percentage shows that the majority of the population, 61.2%, belongs to either group A or B, with the remaining portion mainly distributed between groups O and AB. Regarding Rh factor, the majority of individuals, 93.6%, were Rh-positive, while only 6.4% were Rh-negative, as shown in Figure 1.

Figure 1: Frequency of Blood Groups Patterns among Pregnant Women



When considering the ABO and Rh factors combined, illustrated in Figure 2, B+ emerged as the most frequent blood group (30.7%), followed by O+ (28.1%) and A+ (26.7%). The AB+ blood group accounted for 8.0% of the population, while the less common negative blood groups, O-, A-, B-, and AB-, comprised less than 10% of the sample.

Figure 2: Frequency of ABO & RH blood types among pregnant women



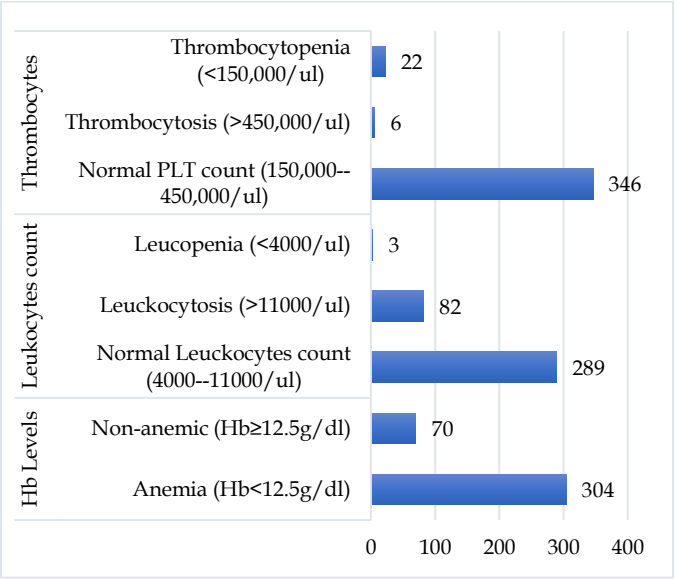
The descriptive statistics for the hematological parameters in the study population are described in Table 1. Hemoglobin (HB) levels had a mean of 11.32 g/dL (±1.86), White Blood Cell (WBC) count averaged 9,666 cells/µL (±4,668), and Platelet count (PLT) was 274,360 cells/µL (±77,754). The Neutrophil (NEU) percentage had a mean of 70.21% (±9.19), while Lymphocytes (LYMPH) averaged 24.72% (±8.51), and Mid-range cells (MID) were 5.07% (±2.73).

Table 1: Descriptive statistics of hematological profile

Hematological Parameters	Minimum	Maximum	Mean	Std. Deviation
Hb	6.2	20.1	11.317	1.8599
TLC	1100	80000	9666.31	4668.506
PLT#	39000	590000	274360	77754
Neutrophils (%)	17	91	70.21	9.193
Lymphocytes (%)	5	76	24.72	8.508
Mid Range (%)	0	27	5.07	2.729

The anemia, leukocyte count, and platelet count results underscore notable patterns in the population, presented in Figure 3. Most of the population (81.3%, n=304) was anemic, with hemoglobin levels below 12.5 g/dL, while only 18.7% (n=70) were non-anemic, indicating a high prevalence of anemia. Regarding total leukocyte count (TLC), 77.3% (n=289) of individuals had normal levels (4,000–11,000 cells/µL), but 21.9% (n=82) exhibited leukocytosis (TLC >11,000/µL). A small fraction (0.8%, n=3) had leukopenia (TLC <4,000/µL), reflecting standard immune system variations. In terms of platelet counts, 92.5% (n=346) of participants had normal thrombocyte levels, while thrombocytopenia (platelet count <150,000/µL) was observed in 5.9% (n=22) and thrombocytosis (platelet count >450,000/µL) in 1.6% (n=6).

Figure 3: Prevalence of Anemia, Leukocytosis, and Thrombocytosis among the pregnant females



ANOVA was used to compare mean differences in hematological parameters across different blood groups.

The analysis of hemoglobin (Hb) revealed no significant differences between groups (F = 1.440, p = 0.188). Similarly, no significant differences were found for white blood cell count (WBC) (F = 1.472, p = 0.176) and platelet count (PLT) (F = 1.557, p = 0.147). These results suggest that blood groups do not significantly impact the mean levels of these hematological parameters in the study population. The crosstabs analysis of anemia, total leukocyte count (TLC), and thrombocyte count against ABO/RH blood groups, as shown in Table 2, reveals the following: Among the 304 individuals with anemia (Hb <12.5 g/dL), the distribution across ABO/RH groups showed no significant association, with a Pearson Chi-Square value of 10.501 and a p-value of 0.162, suggesting that the blood group does not significantly influence anemia in the sample. For total leukocyte count, 289 individuals had an average count (4,000–11,000 cells/µL), while 82 had leukocytosis (TLC >11,000/µL), and 3 had leukopenia (TLC <4,000/µL). The Pearson Chi-Square test value was 15.950 with a p-value of 0.316, indicating no significant association between ABO/RH groups and leukocyte count. However, the linear-by-linear association showed a borderline significance (p = 0.012), suggesting a potential trend. Among the 374 participants, 346 had a normal platelet count, 6 had thrombocytosis, and 22 had thrombocytopenia. The Chi-Square value of 30.352 and a p-value of 0.007 indicate a statistically significant association between ABO/RH groups and platelet count. This suggests that the blood group may influence platelet abnormalities in the population. Overall, while there was no correlation statistically between ABO/RH and anemia or TLC, there is a notable association with thrombocyte count.

Table 2: Comparison of anemia, leukocytes count, and platelets count with ABO & RH blood groups

Variables		ABO & Rh Blood Groups								p-value
		A+	A-	B+	B-	AB+	AB-	O+	O-	
Hb Levels	Anemic	79	6	86	8	24	4	92	5	0.162
	Non-anemic	21	0	29	0	6	0	13	1	
TLC	Normal	71	3	90	4	22	4	89	6	0.316
	Leukocytosis	28	3	24	4	8	0	15	0	
	Leukopenia	1	0	1	0	0	0	1	0	
Platelets Count	Normal PLT count	88	4	108	8	30	3	99	6	0.007
	Thrombocytosis	2	0	1	0	0	1	2	0	
	Thrombocytopenia	10	2	6	0	0	0	4	0	

DISCUSSION

This present study explored the relationship between ABO/RH blood groups and key hematological parameters in a sample of 374 participants. The findings revealed that blood type B was the most common among the participants. The mean levels of hemoglobin (11.32 g/dL), white blood cells (9,666 cells/µL), and platelets (274,360 cells/µL) were within the expected ranges for a generally healthy population. The blood group distribution in our study shows notable differences compared to the findings of Mahapatra *et al.,* reported that blood group A constituted 18.06%, blood group B was about 27.75%, blood group AB 6.60%, and blood group O was 47.58% among healthy students. Our study identified blood group B as the most prevalent, indicating a higher proportion of this blood group than the 27.75% reported by Mahapatra *et al.,* Additionally, blood group O was found to be less prevalent in our sample compared to the 47.58% observed.[14]

In comparison to the findings of Geetanjli *et al.*, the mean hemoglobin level was 10.48 g/dL, which is higher than the 10.03 g/dL reported by Geetanjli *et al.,* Our study's mean total leukocyte count was 10,666.31 cells/µL, which is higher than Geetanjli *et al.,*'s 9,469 cells/µL value. Our average platelet count was 274,360.96 cells/µL, closely aligning with the 276,000 cells/µL reported by Geetanjli *et al.,* Regarding differential counts, our study found a mean neutrophil percentage of 70.21% and a mean lymphocyte percentage of 24.72%, consistent with the 70% neutrophils and 22% lymphocytes reported by Geetanjli *et al.,* Overall, our findings are comparable to those of Geetanjli *et al.,*, with minor differences in the exact values of hemoglobin, total leukocyte count, and platelet count, reflecting typical variations in hematological parameters.[15] Jassal *et al.,* reported that 58.2% of pregnant women had leukocytosis with a mean TLC of 12,060 cells/µL. Our study presents slightly different findings, with about 21.9% of participants exhibiting leukocytosis, and the mean TLC was 9,666 cells/µL. This is lower than the 12,060 cells/µL reported by Jassal *et al.,* and indicates a lower prevalence of leukocytosis in our participants. Jassal *et al.,* reported an average platelet count of 281,250 cells/µL and found a significant correlation with pregnancy. Our study found an average platelet count of 274,360 cells/µL, slightly lower than Jassal *et al.,* reported. However, the difference is relatively minor.[16]

Elsyed *et al.,* reported a prevalence of 10% thrombocytopenia in their study. In comparison, our study found that 5.9% of participants had thrombocytopenia.[17] However, there was a significant association between blood groups and Platelet count (p=0.007) in our study. Okoroiwu *et al.,* reported mean hemoglobin (Hb) levels of 10.96 g/dL during the third trimester of pregnancy. In comparison, our study found a mean hemoglobin level of 10.48 g/dL. This suggests that our participant's average Hb level is slightly lower than that reported by Okoroiwu *et al.,* The difference could be attributed to variations in the gestational age of the participants in their study.[18] Our analysis indicated a

significant correlation between ABO&RH blood groups and platelet count, suggesting that blood groups may influence platelet abnormalities. However, no significant correlations were observed between blood groups and hemoglobin or white blood cell levels. These results imply that while the blood group might play a role in platelet variations, it does not substantially impact other hematological parameters.

CONCLUSION

Our study provided valuable insights into the distribution of blood groups and associated hematological parameters in our study population. We observed that blood group B was the most prevalent among participants. No significant correlations between blood groups and hemoglobin or white blood cell counts, there was a notable association with platelet counts. These findings contribute to the understanding of blood group-related variations in hematological parameters and highlight the need for further research to explore these associations in broader and more diverse populations.

LIMITATIONS

Limitations of present study include a potentially non-representative sample, as the findings may not generalize beyond the specific population studied. The cross-sectional nature of the research provides only a snapshot in time, limiting insights into temporal changes. Additionally, the study lacked detailed clinical histories, which could have influenced hematological values.

SUGGESTIONS / RECOMMENDATIONS

Future research recommendations include expanding the sample size to include diverse populations to improve generalizability. Longitudinal studies would provide a better understanding of changes over time, and incorporating detailed clinical information could offer more comprehensive insights into factors affecting hematological parameters.

CONFLICT OF INTEREST / DISCLOSURE

None.

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