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Monocyte Levels, Education, and Consanguinity Associated With Miscarriage Risk

Fatima Sadiq Azeez[1], Ali Naeem Salman[2]
[1]Department of Biology, College of Education for Pure Science, University of Thi-Qar, 64001, Iraq
[2]Department of Biology, College of Education for Pure Science, University of Thi-Qar, 64001, Iraq

Email: fatimasadiq@utq.edu.iq, dr.ali-n@utq.edu.iq

Abstract. Background: Miscarriage remains a major public health concern with multifactorial etiology encompassing biological, social, and environmental influences. Specific Background: While numerous studies have examined hormonal, chromosomal, and nutritional contributors, the role of hematological and socio-demographic factors such as monocyte activity, consanguinity, and education level is underexplored. Knowledge Gap: The diagnostic and predictive significance of these variables in spontaneous abortion remains unclear. Aim: This study aimed to investigate the association between miscarriage and hematological parameters—particularly monocyte and platelet counts—as well as consanguinity and educational status. Results: Analysis of 100 participants (50 miscarriage cases and 50 controls) revealed a statistically significant elevation in monocyte count (P = 0.004) among miscarriage cases, while other parameters such as platelet count, RBC, Hb, and MCV showed no significant differences. Additionally, consanguinity (P = 0.04) and lower education levels (P = 0.026) were significantly associated with miscarriage incidence. Novelty: The study provides novel evidence supporting monocyte elevation and socio-demographic risks as contributory factors in miscarriage. Implications: These findings suggest the potential for monocyte levels and socio-educational context to serve as supplementary markers for miscarriage risk, advocating for integrated hematological and socio-demographic screening in early prenatal care.

Highlights:

1. Monocyte elevation was significantly linked to miscarriage cases, suggesting a possible inflammatory response.
2. Consanguineous marriage showed a statistically significant association with higher miscarriage rates.
3. Low educational attainment was strongly correlated with increased risk of miscarriage, highlighting the role of socio-demographic factors.

Keywords: Miscarriage, Monocytes, Consanguinity, Educational Level, Hematological Parameters

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Introduction

Pregnancy is characterized by numerous physiological and immunological changes that occur in the maternal body to support fetal development. The gestational period is typically divided into three trimesters: the first trimester spans from week 1 to the end of week 12, the second trimester extends from week 13 to the end of week 26, and the third trimester begins at week 27 and continues until delivery [1,2].

Abortion is defined as an incomplete pregnancy and the loss of the fetus during the early months of gestation [3]. It can be classified into several types, including threatened abortion, incomplete abortion, complete abortion, recurrent abortion, and missed abortion (also referred to as silent abortion) [4]. There are multiple causes of abortion, one of which is growth cessation due to maternal nutritional deficiencies. Maternal malnutrition is a major contributing factor to spontaneous abortion, affecting germ cell morphology. However, the relationship between maternal nutrition and spontaneous abortion is complex and influenced by biological, social, and economic factors, along with lifestyle choices, leading to significant variations across different populations [5]. Additionally, a study by Kember et al. [6]. Suggested that abortion may result from abdominal pressure or twisting during pregnancy, causing abnormal fetal positioning, stillbirth, or intrauterine growth retardation, which may contribute to pregnancy complications. Despite extensive research, the majority of abortions remain etiologically unclear, with potential links to autoimmune disorders [7]. Chromosomal abnormalities, coagulation disorders, hormonal imbalances, endocrine dysfunctions, and autoimmune diseases are among the major causes of spontaneous abortion [8]. The causes of spontaneous abortion are diverse and may include viral infections, parasitic inflammations, cervical insufficiency, reduced placental perfusion and oxygenation, blood glucose imbalances, and thyroid dysfunctions. Additionally, unhealthy lifestyle behaviors such as drug and alcohol use, as well as smoking, can also contribute to the risk of miscarriage [9].

Method

A. Samples collection

This study included 100 blood samples, consisting of 50 samples from women who experienced miscarriage and 50 samples from healthy women as a control group.

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The samples were collected over the period from October 1, 2024 to February 1, 2025. A structured questionnaire was used to collect demographic and clinical information from participants in both groups. Venous blood samples were drawn into EDTA-containing tubes, and a complete blood count (CBC) was performed using an automated hematology analyzer to assess the hematological parameters in both groups.

B. Statistical Analysis

The data was subjected to statistical analysis using SPSS version 23.0. Data are expressed as the mean ± standard deviation (SD). The T-test and chi-square test were used as well [10].

Results and Discussion

A. Results

1. The effect of Hematological Findings

The current study indicated an elevation in monocyte count in the miscarriage group (480 ± 170) compared to the control group (412 ± 165), with a statistically significant difference (P = 0.04). regarding platelet count (PLT), the values were 229 ± 65 in the miscarriage group and 215 ± 53 in the control group, showing no statistically significant difference (P = 0.24).

The red blood cell count (RBC) was 4.08 ± 0.53 in the miscarriage group and 4.19 ± 0.56 in the control group. the hemoglobin concentration (HGB) was 11.08 ± 1.19 in the miscarriage group and 11.16 ± 1.43 in the control group. as for the mean corpuscular volume (MCV), the values were 86.04 ± 8.26 in the miscarriage group and 86.41 ± 8.96 in the control group.

None of the differences in RBC, HGB, or MCV between the two groups were statistically significant (P > 0.05).

Table 1. Comparison of Hematological Parameters Between Miscarriage and Control Groups

Parameter	Patients (SD±Mean)	Control (SD±Mean)	p. value
MONO	170±480	165±412	0.002*
PLT	65±229	53±215	0.24
HGB	1.19 ±11.08	1.43 ± 11.16	0.78
MCV	8.26 ±86.04	8.96 ± 86.41	0.83
RBC	0.53 ±4.08	0.56 ± 4.19	0.32

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The current study revealed a statistically significant difference ($P \leq 0.05$) between the miscarriage group and the control group in relation to both consanguinity and educational level. regarding consanguineous marriage, the miscarriage rate was higher among women who were related to their husbands, accounting for 62% of cases, compared to 38% among those with no familial relation. In contrast, in the control group, the percentage of women without consanguineous marriage was higher (58%), while only 42% were in consanguineous unions. as for educational level, the number of miscarriages was inversely related to the level of education. Women with no formal education represented 82% of the miscarriage cases, while only 18% were among those with higher educational attainment, suggesting that higher education may be a protective factor against miscarriage.

Table 2. Comparison of Consanguinity Between Miscarriage and Control Groups

Parental kinship	Patients		Control		p. value
	N	%	N	%	
Relatives	31	62%	21	42%	0.04*
NON-Relatives	19	38%	29	58%	
The total	50	100%	50	100%	

Table 3. Comparison of Educational Level Between Miscarriage and Control Groups.

Educational Level	Patients		Control		p. value
	N	%	N	%	
Employed	9	18%	19	38%	0.026*
Homemaker	41	82%	31	62%	
The total	50	100%	50	100%	

B. Discussion

The findings of the current study are consistent with those of Bas et al. [11], which reported a significant increase in white blood cells (WBCs), neutrophils, and lymphocytes among women who experienced miscarriage compared to the control group. That study also emphasized the essential role of macrophages and monocytes in placental development, highlighting their contribution to trophoblast invasion, spiral artery remodeling, and parturition. However, it remains controversial whether dysregulation of these immune cells contributes to pregnancy complications such as miscarriage, preeclampsia, and preterm birth. Furthermore, inflammation appears to be a crucial component for pregnancy success, but abnormal or prolonged inflammation—especially when not regulated by anti-inflammatory cytokine-

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producing cells—may result in various pregnancy disorders depending on other contributing factors.

Regarding platelet count (PLT), the current study found no statistically significant difference between the miscarriage and control groups. This finding aligns with the results of Huang et al. [12], who also reported no significant difference in platelet count between groups. This could be due to the fact that platelet count does not necessarily reflect their functional activity or biological role during pregnancy. Platelets are known to play a central role in coagulation and interact closely with inflammatory responses. Hence, platelet count alone may not be a sufficient predictive marker for miscarriage.

Similarly, our results showed no significant difference in red blood cell (RBC) counts between the miscarriage and control groups, which is consistent with the findings of Liu et al. [13], Likewise, Yazdizadeh et al. [14], reported no significant difference in hemoglobin (Hb) levels between women who miscarried and those with healthy pregnancies.

With regard to educational level, the findings are in agreement with Väisänen [15], who found that women with only basic education had a higher risk of miscarriage compared to those with higher education levels. Moreover, the association appeared to strengthen in subsequent generations. These results suggest that education may play an important role in increasing health awareness and promoting medical follow-up during pregnancy. Tessema et al. [16] also reported that women with higher education are more likely to access adequate prenatal care, which contributes to early detection and management of complications such as infections, hypertension, and anemia—factors that can lead to miscarriage if left untreated. Regarding consanguinity, our findings support those of Najafi et al. [17], who noted that pregnancy loss in consanguineous couples may be attributed to complex genetic and immunological mechanisms. Genetic disorders involving single or multiple gene defects may play a major role in increasing the risk of lethal hereditary conditions, negatively impacting pregnancy viability and potentially leading to fetal death. In addition, Kalam et al. [18] highlighted consanguinity as a risk factor for adverse pregnancy outcomes, including spontaneous miscarriage and increased neonatal mortality. However, improvements in demographic, social, and economic indicators, as well as expansion of maternal and child health services, may help mitigate these negative outcomes.

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Conclusions

The present study highlights the potential impact of hematological and social factors on miscarriage. Elevated monocyte levels and lower educational attainment were significantly associated with miscarriage, while platelet count, RBCs, and hemoglobin showed no significant differences. Moreover, consanguineous marriage appears to increase the risk of pregnancy loss. These findings emphasize the importance of early hematological assessment and social awareness in improving pregnancy outcomes.

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