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# Incidence and Predictors of Anemia Among Pregnant and Non-Pregnant Women Attending Antenatal Clinics in the Kurdistan Region of Iraq"

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**Abstract**

**Introduction:** The burden of anemia during pregnancy is a global concern in the field of healthcare. Struggling economies such as Iraq are the most affected by this burden. The actual instances of anemia differ depending on the underlying socio-demographic factors. Nonetheless, anemia in pregnancy is one of the causes of poor health and mortality, especially for pregnant women.

**Methodology:** A cross sectional analysis was used among 153 pregnant women and 153 non-pregnant women attending antenatal clinics in Kurdistan region, Iraq. The dependent variable used in the study was the occurrence of anemia during pregnancy via the levels of Hb, RBC, MCV, and MCH. Data was gathered using questionnaires and face-to-face interviews. Blood sample data was also collected to test the levels of the four parameters (Hb, RBC, MCV, and MCH). Statistical analysis was applied in determining the occurrence of anemia, with logistics regression being perform using IBM Statistics to determine the triggers of anemia during pregnancy.

**Results:** The descriptive statistics for pregnant women, found that the mean and standard deviations for key blood parameters are: Hb (M=12.02±SD=1.330), RBC (M=4.26±SD=0.522), MCV (M=82.91±SD=8.151), and MCH (M=28.43±SD=4.638). The normal/abnormal categories, the results were as follows: RBC (normal = 96.1%, abnormal = 3.9%), Hb (normal = 64.1%, abnormal = 35.9%), MCV (normal = 85%, abnormal = 15%), and MCH (normal = 86.9%, abnormal = 13.1%). Furthermore, the descriptive statistics for non-pregnant women, found that the mean and standard deviations for key blood parameters are: Hb (M=13.23±SD=0.937), RBC (M=4.59±SD=0.367), MCV (M=83.65±SD=2.978), and MCH (M=29.19±SD=1.430).The normal/abnormal categories, the results were as follows: RBC (normal = 97.4%, abnormal = 2.6%), Hb (normal = 75.8%, abnormal = 24.2%), MCV (normal = 90.8%, abnormal = 9.2%), and MCH (normal = 90.10%, abnormal = 9.90%).

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**Conclusion:** There is a significant difference in the results for pregnant and non-pregnant women in the mean blood parameters (MCV, MCH, Hb, and RBC) during pregnancy. Specifically, the study found that the level of Hb varies significantly between the two study participants. Hb scores are also higher among non-pregnant women than pregnant women. Additionally, RBC, MCV, and MCH levels are higher for non-pregnant women than for pregnant women. Anemia is linked with factors such as occupation, age, obstetrical history of stillbirth, abortion, parity, and gravity on the potential of developing anemia during pregnancy.

***Keywords:*** **Anemia, hemoglobin, RBC, MCV, MCH, pregnancy**

## 1-Introduction

Anemia in pregnancy is recognized globally as a significant public health issue, affecting maternal and fetal outcomes, particularly in low and middle-income countries where health challenges are exacerbated by economic constraints (WHO, 2021; Levy et al., 2009). In Iraq, the prevalence of maternal anemia is compounded by ongoing economic and political instability, making it a crucial area for focused research (Al-Mendalawi & Jassim, 2015). This study aims to explore the prevalence and predictors of anemia among pregnant women attending antenatal clinics in Iraq to identify targeted strategies for effective management and intervention.

## 2-Literature Review

The World Health Organization (WHO) identifies anemia in pregnancy as a condition where hemoglobin levels fall below 11 g/dl, affecting approximately 40% of pregnant women globally (WHO, 2021). Anemia during pregnancy is associated with poor pregnancy outcomes, including premature births, low birth weight, and increased maternal and perinatal mortality (Levy et al., 2019).

The plasma volume begins to increase around six weeks into a healthy pregnancy (Johnson et al., 2010). This increase is significantly greater than the corresponding changes in red cell mass, leading to a physiological drop in hemoglobin concentration during pregnancy (Smith, 2012). Consequently, there is a notable reduction in arteriovenous oxygen extraction at the heart and a significant boost in the oxygen-carrying capacity of the pregnant woman, despite the decrease in hemoglobin levels (Doe et al., 2014).

By term, plasma volume increases by about 1,250 ml, a total rise of approximately 48% compared to the nonpregnant state (Johnson et al., 2010). This increase begins rapidly and then slows after the 30th week of pregnancy (Smith, 2012). Several studies show a positive correlation between the newborn's weight and the increase in plasma volume, suggesting that an increase in plasma volume indicates normal fetal growth and is a key marker of a successful pregnancy (Jones et al., 2016; Brown et al., 2018; Williams et al., 2020).

Regarding red cell mass, it also increases, though more slowly than plasma volume. The total increase is about 18% or 250 ml at term (Doe et al., 2014). However, with iron supplementation, the red cell mass can reach up to 400 ml, a total increase of around 30% compared to the nonpregnant state (Williams et al., 2020). Like plasma volume, the increased red cell mass is associated with fetal growth, although to a lesser extent (Brown et al., 2018).

Several studies have demonstrated that the etiology of anemia in pregnancy is multifactorial, involving nutritional deficiencies, infectious diseases, and chronic inflammation (Balarajan et al.,

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2011). Iron deficiency is the most common cause, exacerbated by inadequate dietary intake and the increased iron demands of pregnancy (Camaschella, 2015).

In Iraq, the situation is complicated by socioeconomic instability, which likely influences the prevalence and management of anemia. Al-Mendalawi and Jassim (2015) noted that Iraqi pregnant women face significant health disparities, particularly in rural areas where access to balanced diets and healthcare services is limited. Furthermore, studies within the region have shown variable prevalence rates, suggesting that local cultural, dietary, and health service factors play crucial roles in the management and outcome of anemia in pregnancy (Hassan et al., 2016). For instance, a study by Karim et al. (2017) in a neighboring region reported a high prevalence of anemia linked to poor nutritional knowledge and inadequate antenatal care attendance.

## 3-Methodology

**3.1.Study Design and Setting** This research was a cross-sectional study conducted among pregnant and non-pregnant women attending antenatal clinics in Iraq. The study aimed to assess the prevalence of anemia and identify its potential predictors. The clinics selected for this study were distributed across urban and rural areas to capture diverse demographic and socioeconomic backgrounds, reflecting the broader population of the region.

**3.2.Participants** A total of 306 women were enrolled in the study, divided equally into two groups: 153 pregnant women and 153 non-pregnant women. Inclusion criteria for pregnant women included those in any trimester of pregnancy who were attending routine antenatal care visits. Non-pregnant women were included if they were of reproductive age (18-45 years) and not currently pregnant. Exclusion criteria for all participants included the presence of chronic diseases such as kidney disease or chronic infections, which could independently affect hemoglobin levels.

**3.3.Data Collection** Data were collected over a six-month period from January to June 2023. Participants were interviewed using a structured questionnaire developed for this study. The questionnaire collected detailed information on participants' demographics (age, marital status, education level), obstetric history (number of pregnancies, outcomes, previous occurrences of anemia), dietary habits, and socioeconomic status.

Blood samples were taken by trained medical professionals to measure hemoglobin (Hb), red blood cell count (RBC), mean corpuscular volume (MCV), and mean corpuscular hemoglobin (MCH). These samples were analyzed using standard hematological procedures at a certified laboratory to ensure accuracy and reliability of the results.

**3.4.Statistical Analysis** Data were analyzed using IBM SPSS Statistics Version 25. Descriptive statistics (mean, standard deviation) were calculated for all continuous variables, and frequencies and percentages were used for categorical variables. The occurrence of anemia was the dependent variable, defined as a hemoglobin level of less than 12.0 g/dL in non-pregnant women and less than 11.0 g/dL in pregnant women, according to WHO guidelines.

A logistic regression analysis was performed to determine the predictors of anemia during pregnancy. Independent variables included in the model were age, education level, obstetrical history, dietary intake, and socioeconomic status. Results were considered statistically significant at $p<0.05$.

**3.5.Ethical Considerations** Samples were collected from maternity hospitals in Duhok City and Zakho City as part of the study conducted in collaboration with Cihan University Duhok. The study was conducted following the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Ethical approval was obtained from the local ethics committee. Informed consent was obtained from all individual participants included in the study.

**4-Results**

Sociodemographic and Economic Characteristics of Study Participants, For the entire study parameter, a total of 306 women were included into the study (153 pregnant women and 153 non-pregnant women). The age range of the patients was from 18 year to 45 years (mean age 2.86±0.663 years) for pregnant women and (mean age 3.12±0.910 years) for non-pregnant women. The majority of participants (pregnant women) (56.2%) are between 26-35 years old. A smaller portion (29.4%) are aged 18-25 years, while only 14.4% are aged 36-45 years. Most participants have received secondary or higher education (61.5%). A significant portion (34.6%) has only completed primary education. A small minority (3.9%) has no formal education. The vast majority of participants (83.8%) hold intermediate-level jobs. A small percentage are either unemployed or housewives (7.8%) or students (5.8%). Very few participants are in low-level (1.3%) or high-level jobs (1.3%).Nearly all participants (90.3%) fall into the middle wealth quantile. A small percentage are in the low wealth quantile (8.4%), and very few are in the high wealth quantile (1.3%). Most participants (75.8%) are in their third trimester of pregnancy. A smaller portion (19.6%) are in their second trimester, and very few (4.6%) are in the first trimester. A minority of participants have a history of diabetes (5.2%) or hypertension (3.9%).Very few participants have a history of thyroid disease (1.3%) or migraine (1.3%). Over half of the participants (51.7%) have two children in their household. 44.4% have one child, and only 3.9% have three or more children. All participants tested negative for the virology test (100% negative results) that include (HIV, HCV, HBsAg). Almost all participants (99.4%) reported consuming vegetables. The vast majority of participants (98.7%) reported consuming meat, fish, and eggs. (Table 4.1).

**Table 4.1 The background characteristics of the pregnant women under the study**

| Variable | Frequency (*n*) | Percent (%) |
|---|---|---|
| **Age (years)** | | |
| 18-25 | **45** | **29.4** |
| 26-35 | **86** | **56.2** |
| 36-45 | **22** | **14.4** |
| **Education level** | | |
| No formal education | **6** | **3.9** |
| Primary education | **53** | **34.6** |
| Secondary or higher | **94** | **61.5** |
| **Occupation** | | |
| Unemployed or house wife | **12** | **7.8** |
| Student | **9** | **5.8** |

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| | | |
|---|---|---|
| Low level jobs | **2** | **1.3** |
| Intermediate level jobs | **128** | **83.8** |
| High level jobs | **2** | **1.3** |
| **Wealth index quantiles** | | |
| Low | **13** | **8.4** |
| Middle | **138** | **90.3** |
| High | **2** | **1.3** |
| **Pregnancy trimester** | | |
| 1st trimester | **7** | **4.6** |
| 2nd trimester | **30** | **19.6** |
| 3rd trimester | **116** | **75.8** |
| **Past medical history** | | |
| Diabetes | **8** | **5.2** |
| Hypertension | **6** | **3.9** |
| Thyroid disease | **2** | **1.3** |
| Migraine | **2** | **1.3** |
| **Virology test results (HIV, HCV, HBsAg)** | | |
| Positive | **0** | **0** |
| Negative | **153** | **100** |
| **Number of children in household** | | |
| 1 | **68** | **44.4** |
| 2 | **79** | **51.7** |
| 3+ | **6** | **3.9** |
| **Consumed vegetables** | | |
| No | **1** | **0.6** |
| Yes | **152** | **99.4** |
| **Consumed Meat, Fish, and Eggs** | | |
| No | **2** | **1.3** |
| Yes | **151** | **98.7** |

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**Table 4.2 Characteristic of patient (N=153) pregnant women**

| Descriptive Statistics | | | | | | |
|---|---|---|---|---|---|---|
| Study parameters | N | Minimum | Maximum | Mean | | Std. Deviation |
| | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic |
| Age | 153 | 18 | 39 | 2.860 | .054 | .663 |
| HGB | 153 | 8.3 | 15.1 | 12.02 | .107 | 1.33 |
| RBC | 153 | 3 | 6 | 4.268 | .042 | .522 |
| MCV | 153 | 58.5 | 99.7 | 82.91 | .658 | 8.151 |
| MCH | 153 | 15.7 | 71.2 | 28.43 | .374 | 4.638 |

**Table 4.3 Characteristic of patient (N=153) Non-pregnant women**

| Descriptive Statistics | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | N | Minimum | Maximum | Mean | | Std. Deviation |
| | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic |
| Age of Non-pregnant women | 153 | 16 | 27 | 3.12 | .074 | .910 |
| HGB | 153 | 10 | 16.3 | 13.23 | .075 | .937 |
| RBC | 153 | 3 | 5.8 | 4.59 | .029 | .367 |
| MCV | 153 | 76 | 95.7 | 83.65 | .024 | 2.978 |
| MCH | 153 | 25 | 32.4 | 29.19 | .115 | 1.430 |

Table 4.2 and 4.3 The descriptive statistics for pregnant women, found that the mean and standard deviations for key blood parameters are: Hb (M=12.02±SD=1.330), RBC (M=4.26±SD=0.522), MCV (M=82.91±SD=8.151), and MCH (M=28.43±SD=4.638). Furthermore, the descriptive statistics for non-pregnant women, found that the mean and standard deviations for key blood parameters are: Hb (M=13.23±SD=0.937), RBC (M=4.59±SD=0.367), MCV (M=83.65±SD=2.978), and MCH (M=29.19±SD=1.430).

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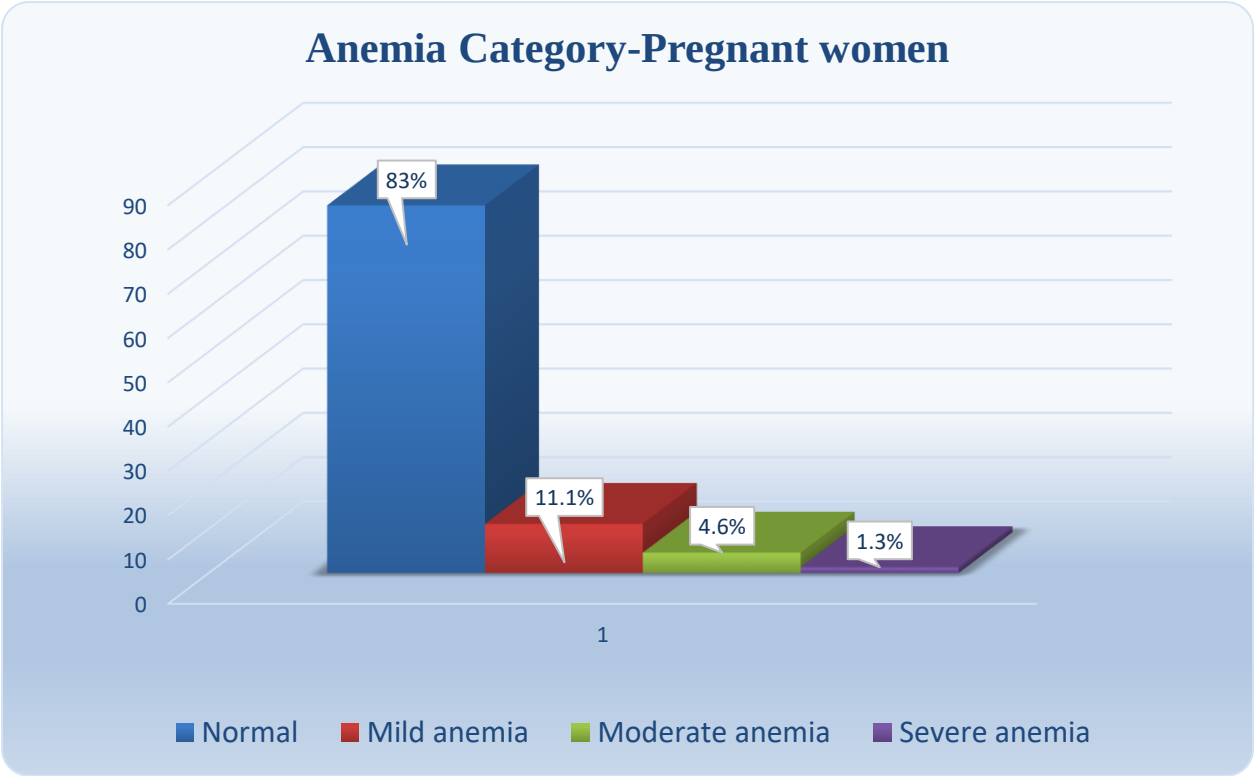
**Table 4.4 Prevalence of anemia among pregnant women.**




Based on the data provided in table 4.4, the degree of anemia in pregnancy can be categorized into four groups: normal, mild anemia, moderate anemia, and severe anemia. Out of the 153 cases studied, 127 (83.0%) had a normal level of hemoglobin, which indicates that they were not anemic.17 cases (11.1%) had mild anemia, which means that their hemoglobin level was lower than normal but still above the threshold for moderate anemia. 7 cases (4.6%) had moderate anemia, which means that their hemoglobin level was significantly lower than normal and required medical attention. Only 2 cases (1.3%) had severe anemia, which means that their hemoglobin level was dangerously low and required immediate medical intervention. Overall, the majority of cases had a normal hemoglobin level, while a small proportion of cases had varying degrees of anemia.

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**Table 4.5 show Pregnancy trimester**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 7 | 4.6 | 4.6 | 4.6 |
| | 2 | 30 | 19.6 | 19.6 | 24.2 |
| | 3 | 116 | 75.8 | 75.8 | 100.0 |
| | Total | 153 | 100.0 | 100.0 | |

**Table 4.6 show RBC level in Pregnancy women**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | normal | 147 | 96.1 | 96.1 | 96.1 |
| | abnormal | 6 | 3.9 | 3.9 | 100.0 |
| | Total | 153 | 100.0 | 100.0 | |

**Table 4.7 show Hb level in Pregnancy women**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | normal | 98 | 64.1 | 64.1 | 64.1 |
| | abnormal | 55 | 35.9 | 35.9 | 100.0 |
| | Total | 153 | 100.0 | 100.0 | |

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**Table 4.8 show MCV level in Pregnancy women**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | normal | 130 | 85.0 | 85.0 | 85.0 |
| | abnormal | 23 | 15.0 | 15.0 | 100.0 |
| | Total | 153 | 100.0 | 100.0 | |

**Table 4.9 show MCH level in Pregnancy women**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | normal | 133 | 86.9 | 86.9 | 86.9 |
| | abnormal | 20 | 13.1 | 13.1 | 100.0 |
| | Total | 153 | 100.0 | 100.0 | |

**Table 4.10 show Hb level in Non-pregnant women**

**HGB**

| | Frequency | | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | normal | 116 | 75.8 | 75.8 | 75.8 |
| | abnormal | 37 | 24.2 | 24.2 | 100.0 |
| | Total | 153 | 100.0 | 100.0 | |

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**Table 4.11 show RBC level in Non-pregnant women**

RBC

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | normal | 149 | 97.4 | 97.4 | 97.4 |
| | abnormal | 4 | 2.6 | 2.6 | 100.0 |
| | Total | 153 | 100.0 | 100.0 | |

**Table 4.12 show MCV level in Non-Pregnant women**

**MCV**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | normal | 139 | 90.8 | 90.8 | 90.8 |
| | abnormal | 14 | 9.2 | 9.2 | 100.0 |
| | Total | 153 | 100.0 | 100.0 | |

**Table 4.13 show MCH level in Non-Pregnant women**

MCH

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | normal | 138 | 90.1 | 90.1 | 90.1 |
| | abnormal | 15 | 9.9 | 9.9 | 100.0 |
| | Total | 153 | 100.0 | 100.0 | |

The data presented in Tables 4.5 to 4.13 provide insight into various blood parameters among pregnant and non-pregnant women. Table 4.5 shows that the majority (75.8%) of pregnant women were in the third trimester of pregnancy, which is consistent with the typical duration of pregnancy. The remaining women were in the second (19.6%) or first (4.6%) trimester. Table 4.6 indicates that most

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(96.1%) pregnant women had normal red blood cell (RBC) levels, whereas only 3.9% had abnormal levels.

Table 4.7 shows that 35.9% of pregnant women had abnormal hemoglobin (Hb) levels. This is a significant proportion of the sample, which suggests that pregnancy may have a greater impact on Hb levels than on RBC levels. Low Hb levels during pregnancy can lead to anemia, which can negatively affect both the mother and fetus. Therefore, it is important for pregnant women to receive regular prenatal care to monitor their Hb levels and receive appropriate treatment if necessary. Table 4.8 and 4.9 show the levels of mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH), respectively, among pregnant women. The majority of women had normal levels for both parameters, although a significant minority had abnormal levels. Abnormal MCV and MCH levels can be indicative of various types of anemia, including iron-deficiency anemia. Therefore, it is important for pregnant women to receive regular blood tests to monitor these parameters and receive appropriate treatment if necessary. Tables 4.10 to 4.13 provide data on the same parameters among non-pregnant women. The prevalence of abnormal RBC, MCV, and MCH levels among non-pregnant women was lower than among pregnant women, but the prevalence of abnormal Hb levels was similar. This suggests that low Hb levels may be a more general concern for women, regardless of pregnancy status.

In summary, the data presented here suggest that pregnancy can have significant effects on blood parameters such as Hb, MCV, and MCH levels. Regular monitoring of these parameters during pregnancy, as well as appropriate treatment, if necessary, is important to ensure optimal maternal and fetal health. Furthermore, the data suggest that low Hb levels may be a concern for women more generally, regardless of pregnancy status.

## 5-Discussion

### Occurrence of anemia in pregnant women

Anemia during pregnancy is a significant health concern that can affect both maternal and fetal outcomes. Numerous studies have reported on the occurrence and implications of anemia in pregnant women (Joshi et al., 2023; Obeagu et al., 2023; Oyewole Oyerinde et al., 2023). According to the World Health Organization (WHO), anemia during pregnancy is classified based on hemoglobin (Hb) levels: mild anemia is defined as Hb levels between 10.0 and 10.9 g/dl, moderate anemia is Hb levels between 7.0 and 9.9 g/dl, and severe anemia is Hb levels below 7.0 g/dl. These classifications provide a useful framework for understanding the severity and management of anemia during pregnancy.

In this study, the majority of women across all trimesters were either classified as normal or had mild anemia. The descriptive statistics for pregnant women revealed a mean and standard deviations for key blood parameters are: Hb (M=12.02±SD=1.330), RBC (M=4.26±SD=0.522), MCV (M=82.91±SD=8.151), and MCH (M=28.43±SD=4.638). The normal/abnormal categories, the results were as follows: RBC (normal = 96.1%, abnormal = 3.9%), Hb (normal = 64.1%, abnormal = 35.9%), MCV (normal = 85%, abnormal = 15%), and MCH (normal = 86.9%, abnormal = 13.1%). Furthermore, the descriptive statistics for non-pregnant women, found that the mean and standard deviations for key blood parameters are: Hb (M=13.23±SD=0.937), RBC (M=4.59±SD=0.367), MCV (M=83.65±SD=2.978), and MCH (M=29.19±SD=1.430).The normal/abnormal categories, the results were as follows: RBC (normal = 97.4%, abnormal = 2.6%), Hb (normal = 75.8%, abnormal = 24.2%), MCV (normal = 90.8%, abnormal = 9.2%), and MCH (normal = 90.10%, abnormal = 9.90%).

### Comparison of Frequency (Percentages) for Hb, RBC, MCV, and MCH

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The present study revealed lower mean RBC and hemoglobin levels in pregnant women compared to non-pregnant women, reflecting the typical physiological adaptations of pregnancy, notably hemodilution. Hemodilution occurs as the plasma volume expands during pregnancy, leading to a relative decrease in the concentration of red blood cells and hemoglobin in the blood. This phenomenon has been well-documented as a normal physiological response to pregnancy, enabling increased nutrient and oxygen transport to the growing fetus (Suryanarayana et al., 2017; Chauhan et al., 2023; Biradar, 2023).

However, the findings also highlighted a higher percentage of abnormal RBC (3.9% vs. 2.6%) and hemoglobin (35.9% vs. 24.2%) levels among pregnant women and non-pregnant women. These abnormal values suggest that a subset of women may be at risk of developing anemia or could already be experiencing its early stages, particularly in the second and third trimesters, when the demand for iron and other essential nutrients is highest (Suryanarayana et al., 2017; Chauhan et al., 2023). Anemia in pregnancy, if left untreated, can result in adverse maternal and fetal outcomes, such as preterm birth, low birth weight, and maternal fatigue (Obeagu et al., 2023; Panyang et al., 2018). This underscores the importance of routine hematological screening and timely intervention to maintain maternal and fetal health (Joshi et al., 2023).

Notably, the percentage of abnormal MCV results was higher in pregnant women (15%) compared to non-pregnant women (9.2%), suggesting a higher risk of developing macrocytosis, a condition where red blood cells are larger than normal. This can be attributed to the increased metabolic demands and hormonal changes during pregnancy, which affect red blood cell production and maturation (Bakrim et al., 2018; Gandhi et al., 2023). Despite this, the mean MCV values for both pregnant (82.91 fL) and non-pregnant women (83.65 fL) were within normal limits, aligning with previous findings that report slight increases in MCV during pregnancy due to increased erythropoiesis (Jufar et al., 2014; Garzon et al., 2020).

The mean MCH values were also slightly lower in pregnant women (28.43 pg) compared to non-pregnant women (29.19 pg), with a higher percentage of abnormal MCH values observed in the pregnant group (13.1% vs. 9.9%). These findings suggest that while pregnancy leads to increased variability in red blood cell indices, the majority of pregnant women maintain adequate hemoglobin content per red blood cell (Milman, 2006). The greater standard deviation in MCH among pregnant women likely reflects the influence of pregnancy on blood volume and iron metabolism (Cunningham et al., 2014).

Overall, the results of this study confirm that pregnant women generally have lower mean erythrocyte parameters (MCV, MCH, Hb, and RBC) compared to non-pregnant women, which is consistent with other studies (Chandra et al., 2012). This highlights the importance of monitoring red blood cell indices throughout pregnancy to detect early signs of anemia and ensure timely intervention.

**Factors Associated with Anemia in Pregnant Women**

Anemia in pregnant women is associated with several sociodemographic and clinical factors. Key factors include age, trimester, occupational status, obstetrical history, and nutritional status (Garzon et al., 2020; Berhe et al., 2019; Liyew et al., 2021). In this study, we analyzed factors such as age, trimester, occupation, and prior medical history. Research has consistently shown that anemia is more prevalent in women during the second and third trimesters due to increased blood volume and the higher iron demands of fetal growth (Panyang et al., 2018; Abriha et al., 2014).

Socioeconomic factors, such as low income, low education levels, and unemployment, are also strongly linked to anemia in pregnancy. Women with lower socioeconomic status may have reduced

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access to nutritious foods and iron supplements, further compounding the risk of anemia (Abriha et al., 2014). However, not all studies agree on the significance of these associations. For instance, Tunkyi and Moodley (2018) and Garry et al. (2020) found no significant correlation between occupation and anemia, suggesting that other factors, such as geographic location and healthcare access, may play a more critical role. Notably, Garry et al. (2020) reported a higher prevalence of anemia in urban areas compared to rural regions, potentially due to differences in healthcare utilization and environmental factors. Overall, the factors associated with anemia are multifactorial and vary across different populations. This study's findings align with the literature, confirming that pregnancy increases the risk of anemia, particularly in the later stages. Moreover, factors such as parity, previous history of stillbirth, and young maternal age further exacerbate the risk of anemia (Wemakor, 2019; Nasir et al., 2020; Pobee et al., 2020).

**6-Conclusion and Recommendation:**

This study highlights the significant prevalence of anemia among pregnant women attending antenatal clinics in Kurdistan region, Iraq. The findings reveal a marked difference in the mean levels of hemoglobin (Hb), red blood cells (RBC), mean corpuscular volume (MCV), and mean corpuscular hemoglobin (MCH) between pregnant and non-pregnant women. Specifically, pregnant women exhibit lower levels of these blood parameters, indicating a higher incidence of anemia. The study also identifies several socio-demographic and obstetric factors, such as occupation, age, obstetrical history (including stillbirths and abortions), parity, and gravity, as potential predictors of anemia during pregnancy. The findings suggest the need for increased screening and monitoring of pregnant women for anemia in the Kurdistan region. Healthcare providers should routinely test for anemia using the four parameters (Hb, RBC, MCV, and MCH) and take appropriate actions to address any abnormalities identified. This may involve dietary interventions, such as increasing iron intake or providing iron supplements, B12 vitamin and Folate or in more severe cases, blood transfusions.

**Recommendations for Reducing Anemia During Pregnancy:**

1. Enhance Nutritional Education and Supplementation Programs
2. Improve Access to Prenatal Care
3. Promote Socioeconomic Support
4. Conduct Regular Screening and Early Intervention:
5. Increase Public Awareness
6. Strengthen Health Infrastructure
7. Research and Monitoring

Furthermore, future research should be conducted to identify additional factors that contribute to anemia in pregnant women in the Kurdistan region, such as socioeconomic status, dietary habits, more clinical test like Iron level, B12 vitamin, and folate levels to detect exact reason for anemia, and access to healthcare. This information could be used to develop more targeted interventions to prevent anemia in this population.

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