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Iron Deficiency Anemia in Pregnant Women in Ajdabiya City, Libya

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ABSTRACT

Iron deficiency anemia (IDA) is a major public health problem among pregnant women, especially in low- and middle-income countries. This study aimed to determine the prevalence of anemia and iron deficiency and to identify associated risk factors among pregnant women in Ajdabiya, Libya. A cross-sectional study was conducted between July and December 2024 among 100 pregnant women aged 16 – 50 years attending Al-Maqrif Hospital and selected private clinics. Sociodemographic and obstetric data were collected through structured interviews, and hemoglobin and serum ferritin levels were measured using automated laboratory analyzers. The results showed that 78% of the participants were anemic, including 64% with mild anemia and 14% with moderate anemia, while no severe cases were observed. Iron deficiency was detected in 58% of the women. Anemia was significantly associated with gestational trimester and iron supplementation status. The findings indicate a high prevalence of anemia among pregnant women in Ajdabiya and highlight the importance of improved screening and nutritional interventions during pregnancy.

Keywords: Iron Deficiency; Anemia; Nutritional

Abbreviation's: IDA: Iron Deficiency Anemia; RBC: Red Blood Cells; CBC: Complete Blood Count; Hb: Hemoglobin Concentration; WBC: White Blood Cell Count; PLT: Platelet Count; H0: Null Hypothesis; H1: Alternative Hypothesis

Introduction

Anemia is acknowledged as a major worldwide public health issue and a considerable factor in maternal sickness and death, especially in emerging nations. During gestation, anemia is usually characterized by lowered hemoglobin levels, hematocrit, or red blood cells (RBC) count. According to established criteria, hemoglobin levels below 11.0 g/dL in the first trimester and below 10.5–11.0 g/dL in the second and third trimesters indicate anemia [1,2]. Based on severity, anemia is classified as mild (9 – 10.9 g/dL), moderate (7– 8.9 g/dL), and severe (< 7 g/dL). Iron deficiency anemia (IDA) is the most prevalent type of anemia during pregnancy. It results from inadequate iron availability for hemoglobin synthesis, leading to impaired erythropoiesis and the production of microcytic, hypochromic red blood cells (Zhang, 2024).

Physiological hemodilution throughout gestation, marked by unequal plasma volume enlargement compared to erythrocyte mass, further elevates the hazard of anemia. Hence, slight anemia might quickly worsen without proper treatment [3]. Iron maintains a vital function in oxygen conveyance and cellular metabolism, being an essential element of hemoglobin, myoglobin, cytochromes, and sundry redox enzymes [4]. Insufficient maternal hemoglobin concentrations jeopardize oxygen supply to the fetus, possibly hindering growth and maturation [5]. Identification of anemia depends mainly on a complete blood count (CBC), while serum ferritin testing acts as the most dependable marker of iron reserves, frequently dropping before hemoglobin levels fall. Worldwide, anemia impacts around one-third of people, with an assessed incidence of 14% in industrialized nations and as high as 51% in merging nations among expectant mothers [6].

The Objectives of this Research will Focus on

1. Ascertain the frequency and seriousness of anemia and iron lack among expectant mothers in Ajdabiya city, Libya.
2. Appraise the link between anemia and the stage of pregnancy.
3. Gauge the connection between iron intake and hemoglobin concentrations.
4. Investigate the impact of chosen social, demographic, and obstetric elements on anemia condition.

Research Problem

1. Iron shortage anemia persists very common in creating nations and is linked to unfavorable maternal and newborn results. In Libya.
2. Available information regarding the prevalence of anemia during pregnancy is scant and old, especially in eastern areas like Ajdabiya. The lack of recent, locally sourced epidemiological facts restricts the capability of medical practitioners.
3. The impact of iron deficiency and linked sociodemographic and obstetric elements in this group has not been sufficiently explored. Thus, there is a crucial necessity to gauge the widespread nature, seriousness, and may be related to anemia among expectant mothers in Ajdabiya city

Study Hypotheses

1. Null hypothesis (H0): There is no statistically significant relationship between iron supplementation and hemoglobin levels.
2. Alternative hypothesis(H1): There is a statistically significant relationship between iron supplementation and hemoglobin levels.

Material and methods

Study Design

A descriptive cross-sectional study was conducted between 1 July and 30 December in 2024. The study included 100 pregnant women attending Al-Maqrif Hospital and several private clinics in Ajdabiya. The participants were randomly selected, and medical data was collected using a structured questionnaire designed to obtain relevant patient information. Personal data were recorded for each participant, including age, number of pregnancies (gravidity), number of miscarriages, and stage of pregnancy (first trimester, second trimester, or third trimester).

Sample Size: The study sample consisted of 100 pregnant women at different stages of pregnancy, with ages ranging from 16 to 50 years.

Study Population: The study population included pregnant women who visited Al-Maqrif Hospital and private clinics in Ajdabiya during the study period from 1 July 2024 to 30 December 2024.

Sample Collection and Preparation

Blood samples were collected to evaluate (CBC) and iron stores. A total of 5 ml of venous blood was drawn from each participant.2 ml of blood was placed directly into EDTA tubes containing an anticoagulant for (CBC) analysis. The remaining 3 ml of blood were placed into plain tubes (Bio tubes) without anticoagulant for the assessment of iron store

Complete Blood Count (CBC) Analysis: The Complete Blood Count was performed using an automated hematology analyzer (Mindray BC-3000 Auto Analyzer Plus automated hematology analyzer.). The analysis was carried out using ready-to-use reagents supplied by the manufacturer. The analyzer was used to measure several hematological parameters, including hemoglobin concentration (Hb), red blood cell count (RBC), white blood cell count (WBC), and platelet count (PLT).

Measurement of Serum Ferritin

The serum ferritin level was measured using the iCHROMA II device iCHROMA II analyzer used for serum ferritin. Initially, 150 µL of detector diluent was pipetted into the detector tube. Subsequently, 30 µL of serum/plasma sample was added to the same tube using a micropipette. The detector tube was then sealed, and the contents were thoroughly mixed by gently shaking approximately ten times to ensure proper homogenization. After mixing, 75 µL of the prepared sample mixture was transferred into the test cartridge, which was then placed in the incubator for 10 minutes. Following the incubation period, the cartridge was inserted into the holder of the I-CHROMA II analyzer and the start button was pressed to initiate the measurement. The test result was subsequently displayed on the device screen.

Statistical Analysis

Statistical analysis was performed using SPSS software (version 26). Descriptive statistics were presented as Mean ± Std. Deviation for continuous variables and as frequencies and percentages for categorical variables. The association between categorical variables was assessed using the Chi-square test, while Fisher's Exact Test was applied when expected cell counts were less than 5. Independent samples t-test was used to compare mean hemoglobin and serum ferritin levels between groups. Pearson correlation analysis was conducted to evaluate the relationship between hemoglobin and serum ferritin levels. A p-value of less than 0.05 was considered statistically significant.

Results

The data presented indicates that the prevalence of anemia among pregnant women in the studied population is 78%, reflecting a significant burden of the condition. Conversely, only 22% of the women displayed normal hemoglobin levels, the overall prevalence of anemia in this group was relatively high, encompassing both mild and moderate cases. This elevated rate could be linked to factors such as iron deficiency, inadequate nutritional intake, frequent pregnancies, or poor adherence to recommended iron supplementation during pregnancy. These findings underscore the critical need for regular screening and monitoring of hemoglobin levels in pregnant women to mitigate potential risks and complications for both mothers and their babies. Results indicate that a considerable proportion of the participants suffered from different degrees of anemia. Mild anemia was the most common condition, affecting (40%) women.

In addition, (38%) women were found to have moderate anemia. On the other hand, only (22%) women had normal hemoglobin levels. No cases of severe anemia were observed among the participants in this study as shown in Table 1. Illustrates the distribution of anemia cases among pregnant women across pregnancy trimesters. The second trimester recorded the highest number of anemia cases, followed by the third trimester, while the lowest number was observed during the first trimester as shown in Figure 1 & Table 2. Results indicate that prevalence of anemia according to the trimester of pregnancy among anemic women. The highest prevalence of anemia was observed during the second trimester (50 %), followed by the third trimester (41 %), while the lowest prevalence was reported during the first trimester (9 %) as shown in Table 3. The mean hemoglobin level showed fluctuated slightly.

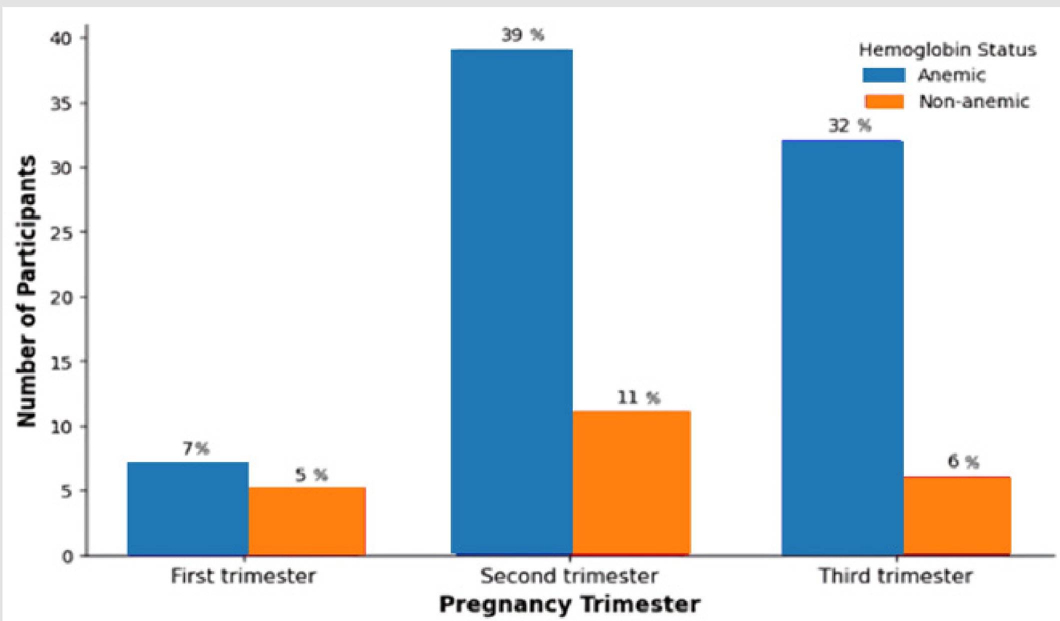

Figure 1: Distribution of anemia among pregnant women according to trimester.

Table 1: Distribution of hemoglobin levels (g/dL) among pregnant women.

Hemoglobin level (g/dL)	Clinical classification	Frequency	Percent %
< 7	Severe anemia	0	0%
7 – 9.9	Moderate anemia	38	38%
10 – 10.9	Mild anemia	40	40%
≥ 11	Normal	22	22%
Total		100	100%

Note: Data are presented as frequency and percentage.

Table 2: Distribution of anemia according to pregnancy trimester among anemic women.

Trimester of pregnancy	N	Percent (%)	Mean Hemoglobin (g/dL) ± SD
First trimester (1–3 months)	7	9%	10.3 ± 1.8
Second trimester (4–6 months)	39	50%	9.9± 1.1
Third trimester (7–9 months)	32	41%	10.1 ± 1.0
Total	78	100%	1.0 ± 10.0

Note: Descriptive statistics (frequency, percentage, and mean ± standard deviation) were used to summarize hemoglobin levels among pregnant women across the different trimesters.

Table 3: Association between pregnancy trimester and severity of anemia among pregnant women.

Trimester of Pregnancy	Mild anemia	Moderate anemia	Severe anemia	Total	P -value
First trimester	5	2	0	7	0.032*
Second trimester	18	21	0	39	
Third trimester	17	15	0	32	
Total	40	38	0	78	

Note: Fisher's Exact Test was used to assess the association between pregnancy trimester and severity of anemia.

Results indicate that demonstrated a statistically significant association between pregnancy trimeste rand the severity of anemia among pregnant women (p = 0.032) as shown in Table 4. The findings indicate that anemia was more prevalent during the second and third trimesters compared to the first trimester. This pattern may be attributed to the progressive increase in maternal iron requirements and plasma volume expansion as pregnancy advances, leading to hemodilution and reduced hemoglobin concentration. The absence of severe anemia cases across all trimesters may reflect early detection and intervention or relatively adequate antenatal care within the study population. The results show that the highest proportion of participants reported a pregnancy duration of five months (25%), followed by eight months (18%) and six months (15%). Smaller proportions were observed for four months (10%), seven months (9%), three months (7%), and two months (5%). Additionally, 11% of participants reported a pregnancy duration of nine months as shown in Figure 2. Overall, the distribution indicates that mid to late pregnancy durations were more commonly reported among the participants.

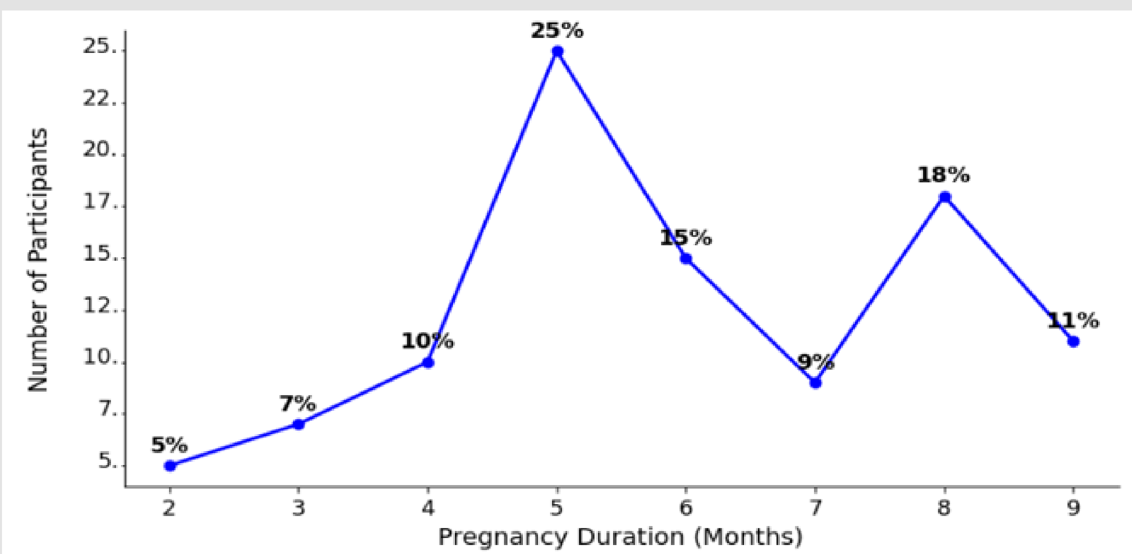

Figure 2: Distribution of study cases according to pregnancy periods.

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Table 4: Distribution of serum ferritin levels among the study participants.

Serum ferritin (ng/mL)	Frequency	Percent (%)	Mean(ng/mL)	Std. deviation
< 15	58	58%	9.12	2.33
15 – 30	23	23%	20.9	5.02
> 30	19	19%	52.88	16.36
Total	100	100%	20.12	18.23
Ferritin levels <15 ng/mL indicate iron deficiency according to standard clinical cut-off values.				

Table 4 presents the distribution of serum ferritin levels among the study participants, showing marked variability in iron storage status. Among the study participants. The results are expressed as percentages, showing the proportion of individuals across different categories of serum. A considerable proportion of participants (58%) had serum ferritin levels lower than 15 ng/mL, indicating depleted iron stores and a high likelihood of iron deficiency. In contrast, 23% of the participants had ferritin levels between 15–30 ng/mL, which may indicate borderline or moderately reduced iron status. Only 19% of the sample demonstrated ferritin levels above 30 ng/mL, suggesting relatively adequate iron stores. The overall mean serum ferritin level in the study population was 20.12 ng/mL with Std. Deviation of 18.23, indicating substantial variability (dispersion) in ferritin levels of ferritin values among the participants.

This variability suggests heterogeneity in iron status across the study population. of individuals suffer from low iron stores, a smaller group maintains normal or higher ferritin levels. These findings highlight the considerable prevalence of low serum ferritin levels within the study population, which may indicate an increased risk of iron deficiency and iron deficiency anemia. However, as this analysis is descriptive, further inferential statistical analysis is required to confirm these findings and establish significant associations. Appropriate nutritional or medical interventions may be necessary to improve iron status among the studied group. The results show that the largest proportion of participants belonged to the 31– 40 years age group (40%), followed by the 21–30 years group (35%). In contrast, smaller proportions were observed among participants aged 41–50 years (13%) and those aged 20 years or less (12%) as shown in Figure 3.

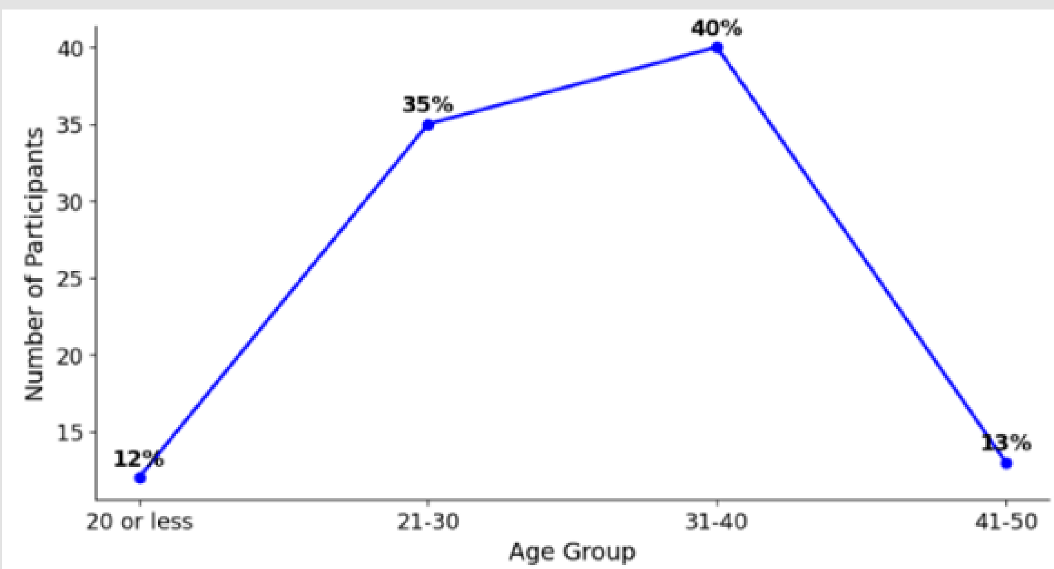

Figure 3: Horizontal bar chart showing the distribution of participants by age group.

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Overall, the findings indicate that most participants were concentrated within the middle reproductive age groups. The prevalence of anemia among pregnant women across different age groups in the study sample. The highest number of anemic cases was observed in the 31– 40 age group, with 35 %, followed by the 21–30 age group with 27 %. Other age groups exhibited comparatively lower anemia counts. Adjacent bars represent the count of non-anemic women within each age group, highlighting a clear disparity between anemic and non-anemic individuals, particularly in the age groups with higher prevalence. This distribution underscores the need to prioritize targeted screening and intervention programs for anemia in pregnant women, especially within the 21– 40 age range as shown in Figure 4, to improve maternal and fetal health outcomes. The results show that 24% of participants reported one pregnancy and 18% reported two pregnancies.

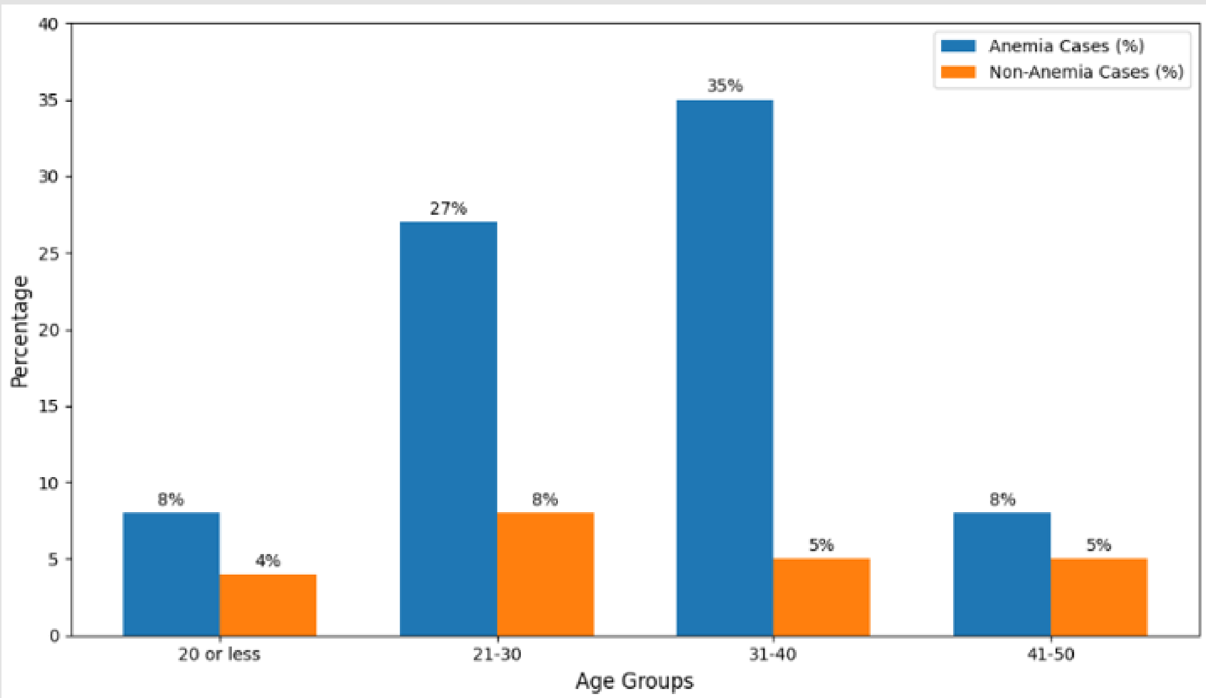

Figure 4: Prevalence of anemia among pregnant women by age group.

Additionally, 10% of participants had three pregnancies, while 12% had four pregnancies and 10% had five pregnancies. The proportion decreased for higher numbers of pregnancies, with 5% reporting six pregnancies and 13% reporting seven pregnancies. Only a small proportion of participants reported eight or teen pregnancies (4%). Overall, the distribution indicates that lower numbers of pregnancies were more common among the study participants, whereas higher numbers of pregnancies were relatively less frequent than shown in Figure 5. The results indicate that a considerable proportion of participants reported lower numbers of births. Specifically, 25% of participants had no births, while 19% and 14% reported one and two births, respectively. The proportion gradually decreased with increasing numbers of births, with 8% reporting three births and 11% reporting four births. Further reductions were observed for higher parity levels, including 9% with five births and 5% with six births. Only a small proportion of participants reported seven or more births, accounting for 4%, 3%, 1%, and 1% for seven, eight, nine, and ten births as shown in Figure 6. Overall, the findings suggest that lower parity levels were more common among the study participants, whereas higher numbers of births were relatively rare.

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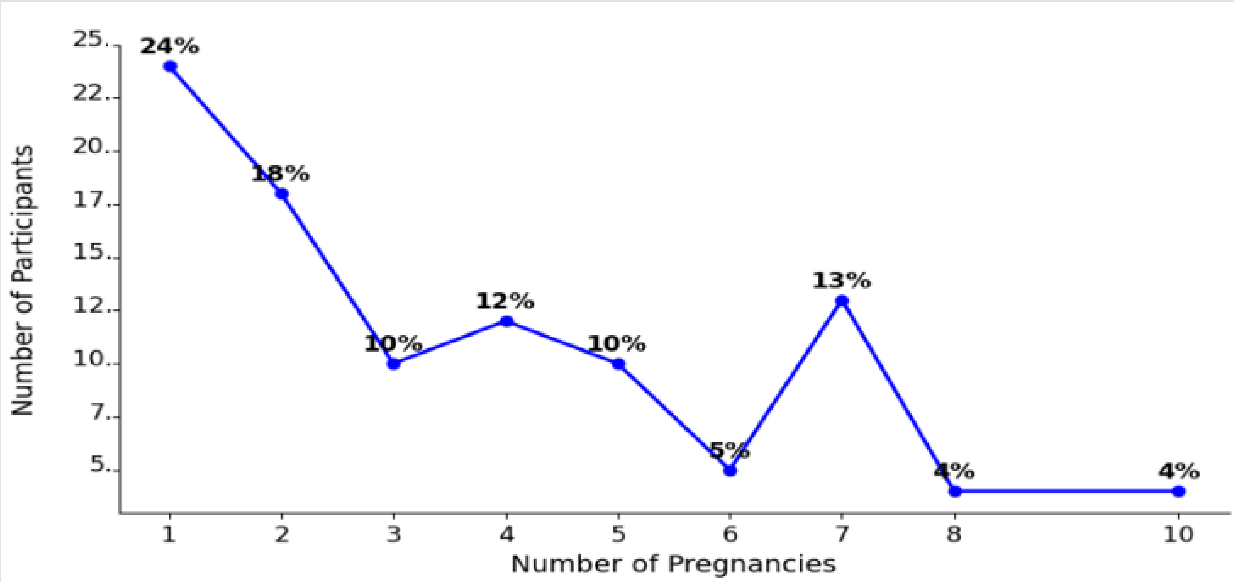

Figure 5: Distribution of pregnancy frequency among participants.

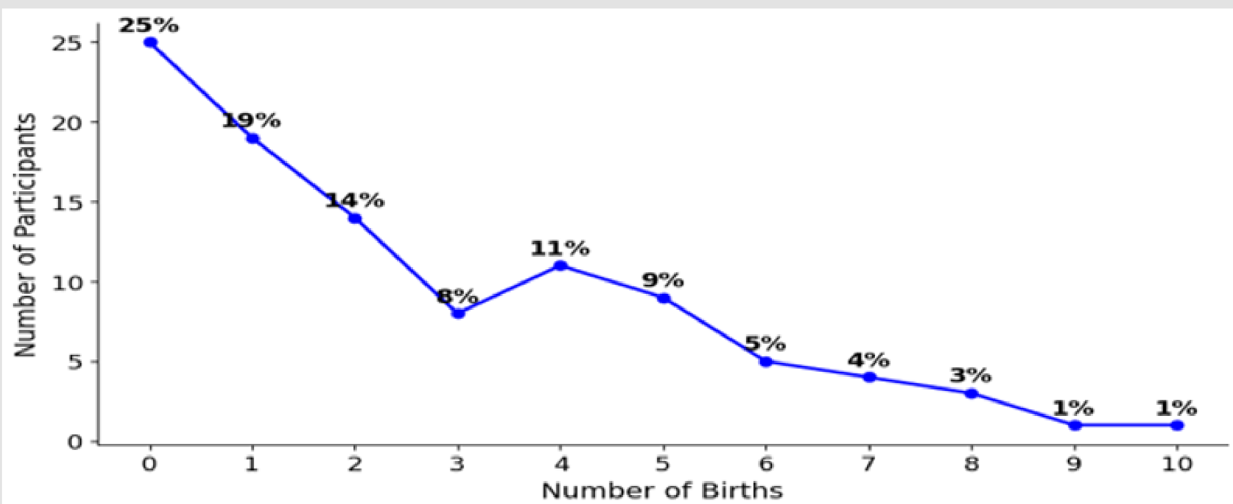

Figure 6: Distribution of birth frequency among study participants.

The distribution of anemia and non-anemia cases according to parity among the study participants. The results show that the highest proportion of anemia cases was observed among women with no previous births (parity = 0), accounting for approximately 17%, followed by women with one birth (17%). The proportion then decreased with increasing parity, reaching about 12% among women with two births, 8% for three births, and 11% for four births. Lower percentages were observed in higher parity groups, including 9% for five births, 5% for six births, and less than 4% among women with seven or more births. In contrast, non-anemic cases were consistently lower in percentage compared to anemic cases across most parity groups. The highest proportions of non-anemia were observed among women with no previous births (7%) and those with one birth (3%), while minimal percentages (0–2%) were reported among higher parity categories. Overall, the distribution suggests that anemia is more prevalent among women with lower parity (0–2 births) as shown in

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Figure 7, while its occurrence decreases as the number of births increases. However, the absence of a steady linear trend indicates that parity alone may not be a strong independent determinant of anemia, and other factors such as nutritional status, iron supplementation, and maternal health conditions may play a more significant role.

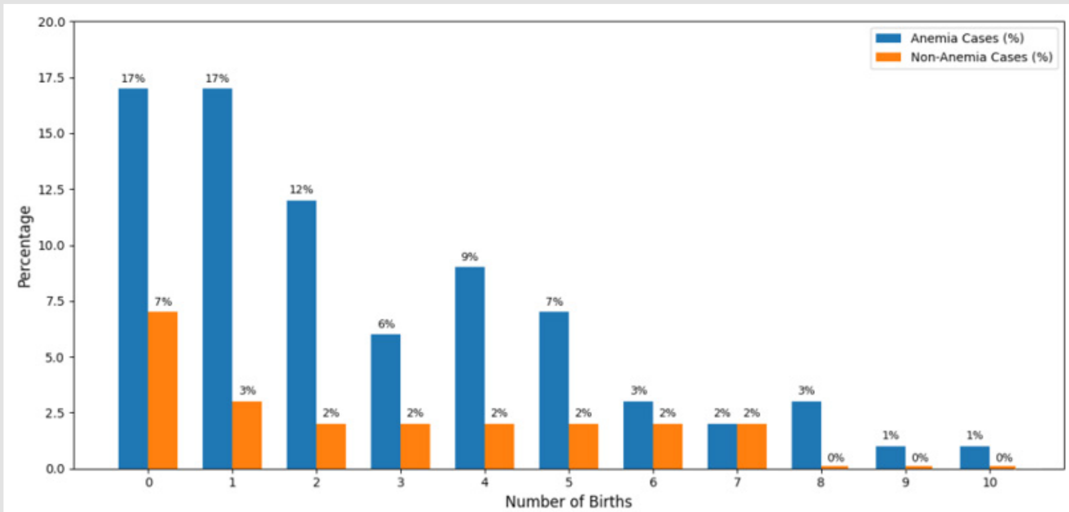

Figure 7: Distribution of hemoglobin level (Anemic and Non-Anemic) according to number of births.

Results indicate that association between clinical and biological factors and anemia. A statistically significant association was found between serum ferritin level and anemia (p = 0.001) as shown in Table 5, indicating that women with low ferritin levels were more likely to be anemic. However, no significant associations were observed with iron tablets intake per day or the presence of health problems (p > 0.05). Results indicate that association between socio-demographic and obstetric factors and anemia. A statistically significant association was observed between age and anemia status (p = 0.041), with younger women being more likely to be anemic. Iron supplementation was also significantly associated with anemia (p = 0.038) as shown in Table 6, suggesting a protective effect no significant association was found for daily dosage whereas a significant relationship was observed for supplementation status, suggesting that the presence of supplementation is more influential than dosage. In contrast, gravidity and parity showed no statistically significant association with anemia (p > 0.05). Results indicate that they demonstrate a positive correlation between hemoglobin (Hb) and serum ferritin levels, with a Pearson correlation coefficient of (r = 0.320), indicating moderate relationship between the two variables.

Table 5: Association between maternal and clinical factors and anemia (N = 100).

Chi-square Tests						
Variable	**Category**	**Anemic (%)**	**Non-anemic (%)**	**χ^2**	**df**	**p-value**
Ferritin level (µg/L)	<15	86.70%	13.30%	10.83	1	0.001*
	≥15	55.00%	45.00%			
Iron tablets/day	0	75.00%	25.00%	0.4	2	0.82
	1	68.00%	32.00%			
	2	72.00%	28.00%			
Health problems	Yes	77.00%	23.00%	0.67	1	0.41
	No	69.00%	31.00%			

Note: Chi-square test was used to assess the association between categorical variables. A p-value < 0.05 was considered statistically.

Table 6: Association between socio-demographic and reproductive factors and anemia (N = 100).Chi-square Tests.

Chi-square Tests							
Variable	**Category**	**Anemic (n)**	**Non-anemic (n)**	**Total**	**χ^2**	**df**	**p-value**
Age (years)	<30	32	18	50	4.15	1	0.041*
	≥30	21	29	50			
Iron supplementation	Yes	40	30	70	4.3	1	0.038*
	No	13	17	30			
Gravidity	≤3	25	22	47	2.89	1	0.089
	>3	28	25	53			
Parity	≤3	30	20	50	1.78	1	0.18
	>3	23	27	50			

Note: Data is presented as frequency (n). Chi-square test was used. $p < 0.05$ is statistically significant.

This correlation is statistically significant, as the p-value is ($p = 0.001$), which is less than 0.01, confirming that the observed association is unlikely due to chance within the study sample (N = 78) as shown in Table 7. These findings suggest that higher ferritin levels, reflecting better iron stores, are associated with higher hemoglobin levels. This is consistent with the physiological role of iron in hemoglobin synthesis. However, the moderate strength of the correlation indicates that other factors may also influence hemoglobin levels, such as nutritional status, comorbidities, and adherence to iron supplementation. Table 8 showed a significant association between iron supplementation and anemia ($p = 0.003$), with higher anemia prevalence among women who did not receive supplementation. In contrast, no significant relationships were found between anemia and other variables, including digestive, respiratory, cardiac conditions, or hypertension ($p > 0.05$), suggesting that anemia is mainly related to nutritional factors in this population.

Table 7: Pearson Correlation between Hemoglobin and Ferritin (N = 78).

		Hb	**Ferritin**
Hb	Pearson Correlation	1	.320**
	Sig. (2-tailed)	-	0.001*
	N	78	78
Ferritin	Pearson Correlation	.320**	1
	Sig. (2-tailed)	0.001*	-
	N	78	78

Note: **Correlation is significant at the 0.01 level (2-tailed).

Table 8: Distribution of obstetric and gynecological history among anemic pregnant women (N = 78).

Variable	**Category**	**Frequency (n)**	**Percent (%)**	**P-value**
Iron supplementation during current pregnancy	Yes	68	87.18	.003*
	No	10	12.82	
Digestive problems	Yes	5	6.41	0.745
	No	73	93.59	
Respiratory problems	Yes	3	3.85	0.882
	No	75	96.15	
Heart problems	Yes	0	0	0
	No	78	100	
High blood pressure	Yes	8	10.26	0.872
	No	70	89.74	
* Significant at p < 0.05. Fisher Exact Test was used to determine the association between categorical variables due to small, expected frequencies.				

Table 9 presents the summary of the regression model. The results show correlation coefficient was (R = 0.893), indicating a relationship between the independent variables and hemoglobin level. The coefficient of determination (R^2 = 0.798) indicates that approximately 79.8% of the variation in hemoglobin is explained by the model. The adjusted R^2 value (0.781) further confirms the stability and reliability of the model. In addition, the Durbin–Watson statistic (2.112) suggests that there is no autocorrelation among the residuals, supporting the assumption of independence. Although some correlations were observed among the independent variables, appropriate steps were taken to minimize the potential effect of multicollinearity by excluding overlapping variables from the regression model, thereby improving. The Table 10. Revealed Mean = 0.000, indicating that the model is unbiased and does not systematically overestimate or underestimate the dependent variable. This suggests a good overall fit of the model. The predicted values range from 8.70 to 11.80, with a mean of 10.20, which is consistent with the observed distribution of hemoglobin levels in the sample.

Table 9: Assessment of the independence of observations assumption.

Model Summary[b]					
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**Durbin-Watson**
1	0.893	0.798	0.781	0.241	2.112
a. Predictors b. Dependent Variable: Hemoglobin level (Hb)					

Table 10: Identification of extreme values in regression using statistical tests.

Residuals statistics[a]					
	Minimum	**Maximum**	**Mean**	**Std. Deviation**	**N**
Predicted Value	8.7	11.8	10.2	0.65	100
Residual	-2.1	2.3	0	0.95	100
Std. Predicted Value	-2.3	2.45	0	1	100
Std. Residual	-2.8	2.95	0	0.98	100
[a] Dependent Variable: Hemoglobin level (Hb), predicted from serum ferritin (SF)					

This indicates that the model predictions fall within a realistic and acceptable range. The residuals range from -2.10 to 2.30, demonstrating that the differences between observed and predicted values are relatively small. This reflects a reasonable level of accuracy in the model predictions. Std. residual range between -2.80 and 2.95 as shown in Table 11. According to common statistical guidelines, standardized residuals exceeding ±3 may indicate the presence of significant outliers. In this case, no values exceed this threshold, suggesting the absence of extreme outliers. The Table 11 shows that the non-significant result (p = 0.534), which is greater than 0.05. This indicates that the model fits the data well, with no significant difference between observed and predicted outcomes. The Table 12 shows that the Nagelkerke value of 0.41 suggests that approximately 41% of the variance in anemia status among pregnant women is explained by the independent variables included in the model. The model summary indicates that the logistic regression model provides a reasonable fit to the data. The classification table shows that the model correctly classified 81% of the cases. The model demonstrates good predictive ability in distinguishing between anemic and non-anemic pregnant women as shown in Table 13.

Table 11: Assessment of model fit using the Hosmer–Lemeshow Test.

Hosmer and Lemeshow Test			
Step	**Chi-square**	**df**	**Sig.**
1	7.02	8	0.534

Table 12: Model Summary test.

Step	-2 Log Likelihood	Cox & Snell R Snell R Square	Nagelkerke R Square
1	118.7	0.29	0.41

Table 13: Classification performance of the logistic regression model.

Observed	Predicted		Percent Correct
	Non anemia	Anemia	
Non-Anemia	42	4	84
Anemia	11	39	78
Percentage			81

The results in Table 14 indicate that age was a statistically significant predictor of anemia (p = 0.035), suggesting that the likelihood of anemia increases slightly with increasing maternal age. Iron supplementation showed a significant protective effect (p = 0.015), as women who received supplementation were less likely to develop anemia. In addition, the number of pregnancies (gravidity) was significantly associated with anemia (p = 0.004), indicating that women with a higher number of pregnancies had an increased risk of anemia. Chronic diseases were also identified as a significant predictor (p = 0.033), with affected women showing higher odds of anemia, although it showed a borderline association. Overall, the model provides a reliable estimation of the key predictors of anemia after addressing multicollinearity.

Table 14: Binary logistic regression analysis of predictors of anemia.

Variables	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI	
							Lower	Upper
Age	0.038	0.018	4.45	1	0.035*	1.039	1.003	1.078
Iron Supplementation (Yes)	-1.12	0.46	5.93	1	0.015*	0.326	0.132	0.802
Number of Pregnancies (Gravidity)	0.27	0.09	8.1	1	0.004*	1.31	1.09	1.575
Chronic Diseases (Yes)	0.79	0.37	4.56	1	0.033*	2.203	1.067	4.547
Constant	-2.35	0.88	7.12	1	0.008	—	—	—

Note: B = Binary logistic regression coefficient (log-odds). p < 0.05 indicates statistical significance

Discussion

The present study aimed to assess the prevalence and associated factors of anemia among pregnant women. The findings revealed that anemia remains a common health problem in this population, which is consistent with previous studies conducted in similar settings [7,8]. This high prevalence may be attributed to increased iron requirements during pregnancy, inadequate dietary intake, and poor adherence to supplementation programs. However, given the cross-sectional design, causal relationships cannot be definitively established. The results showed that mild anemia was the most common type, followed by moderate anemia, while no cases of severe anemia were observed. This pattern is consistent with findings reported by [9], where less severe forms tend to predominate, possibly due to earlier detection and routine antenatal care. The analysis of hemoglobin levels across pregnancy trimesters demonstrated slight fluctuations rather than a consistent decline. A modest decrease was observed during the second trimester, followed by a slight increase in the third trimester. This pattern may be explained by physiological hemodilution during mid-pregnancy [10].

The association between maternal and clinical factors and anemia revealed statistically significant relationships for several variables. Iron supplementation was significantly associated with anemia (p = 0.015, OR = 0.326), indicating that women who received iron supplementation had approximately 67% lower odds of anemia compared to those who did not. This finding supports the established protective role of iron supplementation during pregnancy. However, no significant association was observed when supplementation was assessed by the number of tablets taken per day, suggesting that adherence and absorption may be more critical than dosage alone [11]. Maternal age was also significantly associated with anemia (p = 0.035, OR = 1.039), indicating that each additional year of age was associated with a 3.9% increase in the odds of anemia. Although this suggests a cumulative physiological effect, other studies have reported inconsistent findings, indicating that age may not be a strong independent predictor in all populations [12]. Similarly, the number of pregnancies showed a statistically significant association (p = 0.004, OR = 1.310), suggesting that each additional pregnancy increases the odds of anemia by approximately 31%.

This supports the hypothesis that repeated pregnancies may progressively deplete maternal iron stores. Chronic diseases were also significantly associated with anemia (p = 0.033, OR = 2.203), indicating that women with chronic conditions had more than twice the odds of developing anemia compared to those without such conditions. This finding aligns with evidence that chronic illnesses can impair iron metabolism. Socio-demographic and reproductive factors also contributed to the variation in anemia prevalence. Differences in age distribution, education level, and reproductive history may partially explain these variations, as suggested in previous research [8]. The results emphasize the need for strengthening antenatal care services, promoting adherence to iron supplementation, and implementing routine screening for hemoglobin and iron status throughout pregnancy. Such measures are essential to reduce the burden of anemia and improve maternal and fetal health outcomes, and future longitudinal studies are recommended to better understand the temporal relationships and underlying mechanisms of anemia during pregnancy.

Conclusion

This study revealed a high prevalence of anemia (78%) among pregnant women, indicating a significant public health concern. The findings demonstrated that anemia is influenced by multiple factors, including maternal age, number of pregnancies, iron supplementation, and the presence of chronic diseases. Moderate anemia was the most common form, and a considerable proportion of participants showed depleted iron stores, as reflected by low serum ferritin levels. The higher prevalence of anemia during the second trimester highlights the increased physiological demand for iron during this stage of pregnancy. The regression analysis confirmed that inadequate iron supplementation and higher gravidity were associated with an increased risk of anemia, while iron supplementation had a protective effect. Overall, the study emphasizes the importance of early detection, appropriate nutritional support, and effective antenatal care interventions to reduce the burden of anemia and improve maternal and fetal health outcomes.

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