

Prevalence and Risk Factors of Iron Deficiency Anemia among Pregnant Women Admitted to Benghazi Medical Center, Benghazi, Libya

Fawzia Elharary^{1,2}, Nagat Beltamer^{1,2,*}, Enas Elsnossy¹, Areg El Fallah³, Abdelmetalab Tarhuni⁴ & Ali Ateia Elmabsout⁵

¹Department of Obstetrics & Gynecology, Al Jamhoria Hospital, Benghazi, Libya.

²Teaching Staff, Faculty of Medicine, University of Benghazi, Benghazi, Libya.

³Department of Obstetrics & Gynecology, Benghazi Medical Center, Benghazi, Libya.

⁴Department of Environmental Health, Faculty of Public Health, University of Benghazi, Benghazi, Libya.

⁵Department of Nutrition, Faculty of Public Health, University of Benghazi, Benghazi, Libya.

Corresponding Author (Nagat Beltamer) Email: nagat.beltamer@uob.edu.ly*



DOI: <https://doi.org/10.38177/ajbsr.2026.8309>

Copyright © 2026 Fawzia Elharary et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Article Received: 24 June 2026

Article Accepted: 27 August 2026

Article Published: 29 August 2026

ABSTRACT

Introduction: Iron deficiency anemia (IDA) is among the most prevalent disorders of nutritional and hematological in nature amongst pregnant women. This study sought to assess the prevalence and associated risk factors of IDA in women pregnant admitted in the Benghazi Medical Center, Libya.

Methodology: A descriptive cross-sectional study was carried out in 210 pregnant women admitted in the Benghazi Medical Center. Data was collected using a structured questionnaire. Lab investigations include complete blood count (CBC), hemoglobin (Hb), serum ferritin, serum iron, peripheral blood film and Vitamin D levels. Findings were analyzed using descriptive statistics.

Results: The prevalence of anemia in pregnant women was 20.5%. Most women were in the third trimester (176, 83.8%) and 194 (92.4%) women had singleton pregnancies. The prevalence of iron deficiency (serum ferritin <30 ng/mL) was 91.4% (192/210). Serum iron <37 µg/dL was found in 134 (63.8%) of women. Hematological indices show that 153 women (72.9%) had mean corpuscle volume (MCV) <80 fL whereas hematocrit (HCT) <33% was present in 206 (98.1%). Based on Hb levels, 176 (83.8%), 30 (14.3%) and 4 (1.9%) had moderate, severe and mild anemia respectively. Peripheral blood film revealed anisopoikilocytosis with microcytic hypochromic changes in 75 (35.7%) and microcytic hypochromic changes in 74 (35.2%) subjects. Potential risk factors for IDA include insufficient preconception care (198, 94.3%), chronic anemia (92, 43.8%), pica (66, 31.4%), improper intake of folic acid with iron (160, 76.2%) and vitamin C with iron (169, 80.5%). Additionally, high prevalence of vitamin D deficiency was detected in 200 (95.2%) participants. Iron supplement intake was 131 (62.4%) whereas iron supplements were not taken by 79 (37.6%).

Conclusion: The study demonstrated a very high prevalence of iron deficiency anemia among pregnant women admitted to Benghazi Medical Center, with low serum ferritin, low serum iron, and microcytic hematological patterns being highly prevalent. The findings highlight the importance of early antenatal screening, preconception care, appropriate iron and folic acid supplementation, nutritional counseling, and regular monitoring of hematological and iron-status indicators among pregnant women in Libya.

Keywords: Iron Deficiency Anemia; Pregnancy; Pregnant Women; Serum Ferritin; Serum Iron; Hemoglobin; MCV; Benghazi; Libya.

1.0. Introduction

Anemia during pregnancy is a major global public health concern that affects both developed and developing countries, leading to important morbidity and mortality for both mothers and their newborns. The World Health Organization (WHO) has identified anemia as one of the major public health problems among women of reproductive age, with particularly important consequences during pregnancy. According to earlier reports, anemia was present in approximately 41.8% of pregnant women worldwide, with prevalence rates significantly higher in developing countries than in developed countries. More recent WHO reports confirm that anemia remains important public health concern, especially in low- and middle-income countries [1,2].

The World Health Organization (WHO) defines anemia in pregnancy based on hemoglobin concentrations. Historically, a hemoglobin concentration of less than 11 g/dL has been considered the threshold for diagnosing anemia in pregnant women [3]. The Centers for Disease Control and Prevention (CDC) defined anemia as hemoglobin levels below 11 g/dL in the first and third trimesters and below 10.5 g/dL in the second trimester [4].

Physiological anemia is a common condition during pregnancy. During pregnancy, the plasma volume of the mother increases significantly (by approximately 50%), which results in a reduction in hemoglobin concentration due to the dilution of the blood. The increase in red blood cell mass is only around 30% of the increase in plasma volume during pregnancy [5].

The cause of pathological anemia during pregnancy is multifactorial. The main causes are nutritional deficiencies, acute or chronic blood loss, hemolytic disorders, hemoglobinopathies such as thalassemia and sickle cell disease, infections and parasitic diseases and chronic medical conditions [5,6]. Anemia can be classified into three types based on the red blood cell morphology: microcytic hypochromic, macrocytic and normocytic normochromic. Among the nutritional deficiencies, iron deficiency is the most common cause of anemia during pregnancy and iron deficiency anemia is the most common type of anemia in pregnant women [6,7].

Iron deficiency is characterized by the depletion of body iron stores. The serum ferritin level is a commonly used indicator of the body's iron stores; however, it should be considered in conjunction with indicators of inflammation as ferritin is an acute-phase reactant [8]. In pregnant women, a ferritin concentration of below approximately 30 µg/L is often used to show iron deficiency [8,9]. So, using ferritin in combination with hemoglobin and other red blood cell indices can help to more accurately diagnose iron deficiency in pregnant women.

The symptoms of iron deficiency anemia (IDA) can be divided based on the severity of the condition. Women with mild cases of anemia may only exhibit symptoms like fatigue, weakness, dizziness, headache, poor concentration and reduced physical ability. People with more severe cases of iron deficiency may display extra symptoms, such as pallor, tachycardia, hypotension and other complications [5,6]. The World Health Organization classifies anemia according to the hemoglobin levels within an individual's blood; people with lower hemoglobin levels are considered to have a higher risk of developing severe symptoms of anemia [2].

For the fetus and the newborn, maternal anemia has been linked to low birth weight, pre-term birth, fetal growth restriction, stillbirth, perinatal mortality, and neonatal morbidity [10-12]. A systematic review and meta-analysis carried out in low- and middle-income countries demonstrated an association between maternal anemia and high risk of low birth weight, preterm birth, perinatal and neonatal mortality [10]. In similar fashion, a systematic review indicated associations between low maternal hemoglobin levels and poor birth outcomes such as low birth weight, preterm births, small-for-gestational-age births, stillbirths, and perinatal/neonatal mortality [11].

In pregnancy, there is a huge increase in the need for iron since iron is needed for the expansion of maternal red blood cells mass, development of placenta and growth of fetus. It has been demonstrated that there is a significant accumulation of iron in the fetus during the third trimester [13]. Therefore, there will be more iron deficiency in pregnancy as the period goes on, especially in case where the iron storage in maternal body before pregnancy is insufficient. Anemia tends to be common in the second and third trimester than early pregnancy [6,14].

Some of the causes of anemia in pregnancy include poor iron nutrition, poor adherence to iron supplements, late antenatal care, adverse effects of iron on the gastrointestinal system, and limited access to healthcare facilities [6,15]. A systematic review and meta-analysis revealed that there are various nutritional and reproductive factors related to anemia in pregnant women. These include poor dietary diversity, lack of meat consumption, consumption

of tea or coffee with food, insufficient antenatal care, multiple pregnancy, multiparity, low family income, and short birth intervals [15].

Age may be another variable factor which can be associated with anemia. Adolescents can have increased susceptibility to anemia because of their own need for growth, apart from the needs of the pregnancy process. Older age may be a risk factor due to the history of repetitive pregnancies, leading to poor nutritional reserves [6,15].

Reproductive factors such as multiparity, multiple pregnancy and short intervals between pregnancies may be risk factors for maternal iron deficiency [15,16]. In addition, dietary habits are important. Low consumption of iron rich foods, low meat consumption and poor dietary diversity can lead to poor iron consumption, while the intake of tea or coffee soon after meals may decrease non-heme iron absorption [15].

Medical and nutritional problems can increase susceptibility to anemia. Some of the factors include gastrointestinal disorders, hyperemesis gravidarum, parasitic infection, chronic illness and pre-pregnancy anemia [6,15,16]. Moreover, infections and inflammation can influence iron metabolism via increased hepcidin levels [17].

IDA diagnosis usually entails performing both hematological and biochemical assessments. The former usually entails having low levels of hemoglobin, MCV, and MCH as well as microcytic and hypochromic erythrocytes seen on peripheral blood film. Common biochemical investigations include assessing serum ferritin and serum iron, with other tests like transferrin saturation or soluble transferrin receptor being helpful in some cases [8,9].

The blood transfusion procedure is usually done only in cases of severe anemia or a considerable amount of clinical deterioration [9,18]. WHO suggests daily intake of iron and folic acid by pregnant women as an important way of preventing and treating maternal anemia [18].

Current literature highlights the significance of timely antenatal care and anemia and iron deficiency screening together with supplementation and monitoring of treatment compliance [15,18,19]. The use of iron supplements helps prevent maternal anemia, iron deficiency and iron deficiency anemia and increases maternal hemoglobin level [19]. Besides iron, there have been new studies conducted on the connection between vitamin D status and anemia. Vitamin D has a role in iron metabolism due to its effect on inflammatory responses and hepcidin; nonetheless, more evidence is needed before vitamin D supplementation could be considered an established treatment for IDA [20,21].

1.1. Study Objective

The present study aimed to estimate the prevalence of iron deficiency anemia among pregnant women admitted to the gynecology and antenatal wards at Benghazi Medical Center and to identify the risk factors associated with an increased risk of anemia among pregnant women.

2.0. Material and Methods

A cross-sectional study was conducted among pregnant women that admitted to gynecological and antenatal ward in Benghazi medical center in duration from 1-8-2021 to 30-4-2022, the data collected by interviewing every patient face to face and used questionnaire collect data about socio demographic profile, Past obstetric history,

gynecological history, past medical history, drug history and nutritional history. Lab investigation involves complete blood count (CBC), iron study, peripheral blood film and Vitamin D.

2.1. Data analysis and statistics

The data was analyzed by using statistical program for social science (SPSS) ver.25. The results presented as means, standards deviation, and ranges for continuous variables, and as frequencies and percentages for categorical data. Figures and tables presented for data summary as needed. Level of significance of less than 5% considered for any statistical relevant results.

3.0. Results

In this study prevalence of anemia (210) from total 1024 (20.5%) that admitted to gynecology and antenatal ward in Benghazi medical center (Table 1).

Table 1. Prevalence of Anemia Among Pregnant Women Admitted to Benghazi Medical Center.

Total number of pregnant women in study period between 1st of August 2021 and 30th of April 2022	Number of anemic pregnant women in study period between 1st of August 2021 and 30th of April 2022	Prevalence of anemic pregnant women
1024	210	20.5%

In Figure 1, majorities of women 96.2% (202) were Libyan and 3.8% (8) non-Libyan anemic pregnant women that admitted to gynecology and obstetrics ward in Benghazi medical center.

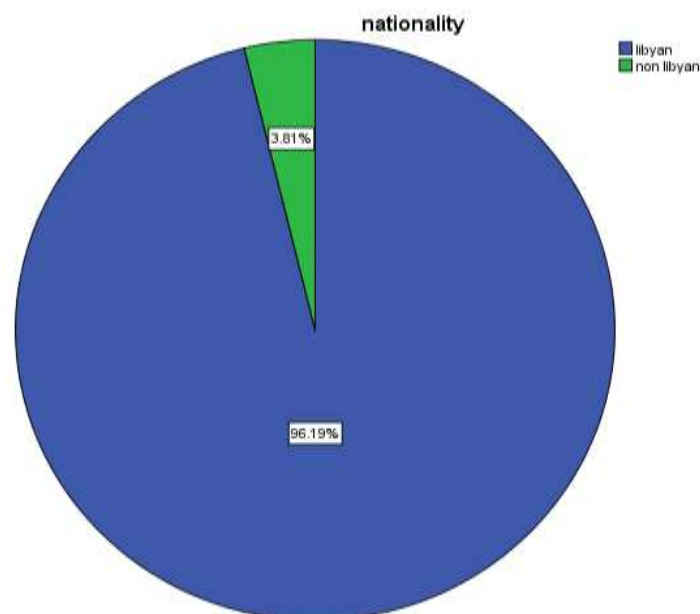


Figure 1. Distribution of Cases According to Nationality.

The largest proportion was aged 26–30 years (29.05%), followed by 31–35 years (21.43%) and 36–40 years (19.52%). Participants aged 21–25 years accounted for 17.62%, while 41–45 years represented 8.10%. The smallest groups were 16–20 years (3.80%) and 46–50 years (0.48%). The most participants were between 26 and 40 years of age (Figure 2).

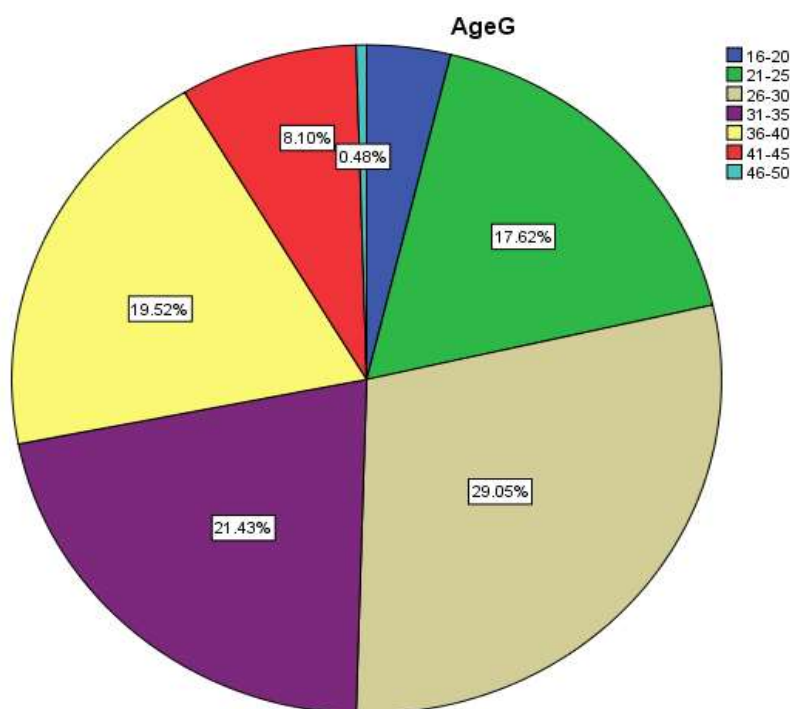


Figure 2. Distribution of Cases According to Age Groups.

The table 2 presented the educational level of 210 participants. The largest proportion had matriculation/high institute education (39.5%, n=83), closely followed by those with university or postgraduate education (38.6%, n=81). Participants with preparatory/intermediate institute education accounted for 16.2% (n=34). Only 3.3% (n=7) were not educated, while 2.4% (n=5) had primary education. Overall, 78.1% of participants had at least matriculation/high institute or university/postgraduate education, indicating that most participants had a relatively high educational level.

Table 2. Distribution of Cases According to Educational Level.

	Frequency	Percent	Valid Percent	Cumulative Percent
Not educated	7	3.3	3.3	3.3
Primary	5	2.4	2.4	5.7
Preparatory - intermediate institute	34	16.2	16.2	21.9
Matriculation -high institute	83	39.5	39.5	61.4
University - post graduate	81	38.6	38.6	100.0
Total	210	100.0	100.0	

The table 3 showed the income level of the 210 participants. The majority had a medium income level (75.2%, n=158). Participants with a poor income level accounted for 21.0% (n=44), while only 3.8% (n=8) reported a high-income level. Overall, most participants were in the medium-income category, with relatively few reporting high income.

Table 3. Distribution of Cases According to Income.

	Frequency	Percent	Valid Percent	Cumulative Percent
Poor	44	21.0	21.0	21.0
Medium	158	75.2	75.2	96.2
High income	8	3.8	3.8	100.0
Total	210	100.0	100.0	

The majority of cases were housewives (81.0%, n=170), while 19.0% (n=40) were workers. Thus, the study population was predominantly composed of housewives (Table 4).

Table 4. Distribution of Cases According to Employ State.

	Frequency	Percent	Valid Percent	Cumulative Percent
house wife	170	81.0	81.0	81.0
worker	40	19.0	19.0	100.0
Total	210	100.0	100.0	

The table 5 shown that, the distribution of participants according to the duration of the measured characteristic (10–40 units, depending on the variable). The largest proportion was in the 21–30 category (50.5%, n=106), followed by the 10–20 category (39.0%, n=82). Only 10.5% (n=22) were in the 31–40 category.

Table 5. Distribution of Cases According to Age of Marriage.

	Frequency	Percent	Valid Percent	Cumulative Percent
10-20	82	39.0	39.0	39.0
21-30	106	50.5	50.5	89.5
31-40	22	10.5	10.5	100.0
Total	210	100.0	100.0	

The majority of cases were in the third trimester (176, 83.8%), followed by the second trimester (24, 11.4%). Only 10 cases (4.8%) were in the first trimester. Thus, most participants were in the third trimester (Table 6).

Table 6. Distribution of Cases According to Gestational Age.

	Frequency	Percent
First trimester	10	4.8%
Second trimester	24	11.4%
Third trimester	176	83.8%
Total	210	

Most cases had a single pregnancy (194, 92.4%), whereas 16 cases (7.6%) had a multiple pregnancy. Therefore, singleton pregnancies predominated in the study population (Table 7).

Table 7. Distribution of Cases According to Number of Baby in this Pregnancy.

	Frequency	Percent	Valid Percent	Cumulative Percent
Single	194	92.4	92.4	92.4
Multiple	16	7.6	7.6	100.0
Total	210	100.0	100.0	

The majority of cases did not receive preconception care (198, 94.3%), while only 12 cases (5.7%) reported receiving preconception care (Table 8).

Table 8. Distribution of Cases According to Pre Conception Care.

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	12	5.7	5.7	5.7
No	198	94.3	94.3	100.0
Total	210	100.0	100.0	

Most cases did not report blood loss during pregnancy (148, 70.5%), whereas 62 cases (29.5%) reported experiencing blood loss (Table 9).

Table 9. Distribution of Cases According to Blood Loss in this Pregnancy.

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	62	29.5	29.5	29.5
No	148	70.5	70.5	100.0
Total	210	100.0	100.0	

A total of 163 cases (77.6%) received a blood transfusion during pregnancy, while 47 cases (22.4%) did not receive a transfusion. Thus, blood transfusion was reported in more than three-quarters of the cases (Table 10).

Table 10. Distribution of Cases According to Blood Transfusion in Pregnancy.

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	163	77.6	77.6	77.6
No	47	22.4	22.4	100.0
Total	210	100.0	100.0	

The most common interpregnancy interval was 2 years (52, 24.8%), followed by more than 3 years (44, 21.0%) and less than 1 year (41, 19.5%). An interval of 1 year was reported by 30 cases (14.3%), while 3 years was reported by 21 cases (10.0%). Twenty-two cases (10.5%) had no interpregnancy interval (Table 11).

Table 11. Distribution of Cases According to Inter Pregnancy Interval.

	Frequency	Percent	Valid Percent	Cumulative Percent
.00	22	10.5	10.5	10.5
<1	41	19.5	19.5	30.0

1	30	14.3	14.3	44.3
2	52	24.8	24.8	69.0
3	21	10.0	10.0	79.0
>3	44	21.0	21.0	100.0
Total	210	100.0	100.0	

Most participants reported average menstrual blood loss (157, 74.76%). Heavy blood loss was reported by 38 participants (18.10%), while 15 participants (7.14%) reported heavy blood loss accompanied by blood clots (Table 12).

Table 12. Amount of Blood Loss in Menstrual Cycle.

Amount of blood loss	Frequency	Percent
within average	157	74.76
heavy blood loss	38	18.10
heavy with blood clots	15	7.14
Total	210	100.0

A history of chronic anemia was reported by 92 cases (43.8%), whereas 118 cases (56.2%) had no history of chronic anemia. Therefore, more than two-fifths of the participants reported previous chronic anemia (Table 13).

Table 13. History of Chronic Anemia.

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	92	43.8	43.8	43.8
No	118	56.2	56.2	100.0
Total	210	100.0	100.0	

Among the cases, 91 (43.3%) reported no recurrent infection. Vaginitis was the most common infection, affecting 53 cases (25.2%), followed by vaginitis combined with UTI in 39 cases (18.6%) and UTI in 26 cases (12.4%). Only 1 case (0.5%) reported an upper respiratory tract infection (URTI) (Table 14).

Table 14. History of Recurrent Infection in this Pregnancy.

	Frequency	Percent	Valid Percent	Cumulative Percent
Non	91	43.3	43.3	43.3
URTI	1	.5	.5	43.8
Vaginitis	53	25.2	25.2	69.0
UTI	26	12.4	12.4	81.4
Vaginitis	39	18.6	18.6	100.0
Total	210	100.0	100.0	

A history of chronic illness was reported by 30 cases (14.3%), while 180 cases (85.7%) reported no chronic illness. Thus, most participants had no history of chronic illness (Table 15).

Table 15. History of Chronic Illness.

Chronic illness	Frequency	Percent
Yes	30	14.3%
No	180	85.7%

More than half of the participants, 118 (56.2%), reported consuming no coffee per day. Thirty participants (14.3%) consumed 2 cups, 27 (12.9%) consumed 1 cup, and 17 (8.1%) consumed 3 cups per day. Smaller proportions consumed 4 cups (7, 3.3%), 5 cups (5, 2.4%), 6 cups (5, 2.4%), and 7 cups (1, 0.5%) (Table 16).

Table 16. Numbers of Cup of Coffee Consumption Per Day.

	Frequency	Percent	Valid Percent	Cumulative Percent
.00	118	56.2	56.2	56.2
1.00	27	12.9	12.9	69.0
2.00	30	14.3	14.3	83.3
3.00	17	8.1	8.1	91.4
4.00	7	3.3	3.3	94.8
5.00	5	2.4	2.4	97.1
6.00	5	2.4	2.4	99.5
7.00	1	.5	.5	100.0
Total	210	100.0	100.0	

The majority of participants, 158 (75.2%), reported consuming no tea per day. Twenty-nine participants (13.8%) consumed 1 cup, 10 (4.8%) consumed 2 cups, and 7 (3.3%) consumed 3 cups. Smaller proportions consumed 4 cups (5, 2.4%) and 6 cups (1, 0.5%) per day (Table 17).

Table 17. Numbers of Cup of Tea Consumption Per Day.

	Frequency	Percent	Valid Percent	Cumulative Percent
.00	158	75.2	75.2	75.2
1.00	29	13.8	13.8	89.0
2.00	10	4.8	4.8	93.8
3.00	7	3.3	3.3	97.1
4.00	5	2.4	2.4	99.5
6.00	1	.5	.5	100.0
Total	210	100.0	100.0	

More than half of the participants, 121 (57.6%), reported consuming no milk per day. Thirty-seven (17.6%) consumed 1 cup, 24 (11.4%) consumed 2 cups, and 20 (9.5%) consumed 3 cups per day. Smaller proportions consumed 4 cups (4, 1.9%), 5 cups (3, 1.4%), and 10 cups (1, 0.5%) (Table 18).

Table 18. Numbers of Cup of Milk Consumption Per Day.

	Frequency	Percent	Valid Percent	Cumulative Percent
.00	121	57.6	57.6	57.6
1.00	37	17.6	17.6	75.2
2.00	24	11.4	11.4	86.7
3.00	20	9.5	9.5	96.2
4.00	4	1.9	1.9	98.1
5.00	3	1.4	1.4	99.5
10.00	1	.5	.5	100.0
Total	210	100.0	100.0	

A history of pica was reported by 66 participants (31.4%), whereas 144 participants (68.6%) reported no history of pica (Table 19).

Table 19. History of Pica.

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	66	31.4	31.4	31.4
No	144	68.6	68.6	100.0
Total	210	100.0	100.0	

The majority of cases, 131 (62.4%), reported taking iron supplements during pregnancy, while 79 cases (37.6%) did not take iron supplements (Table 20)

Table 20. Prevalence of Cases that take Iron Supplement During this Pregnancy.

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	131	62.4	62.4	62.4
No	79	37.6	37.6	100.0
Total	210	100.0	100.0	

Only 50 cases (23.8%) reported taking folic acid together with iron supplements, whereas 160 cases (76.2%) did not. Thus, combined folic acid and iron supplementation was relatively uncommon (Table 21).

Table 21. Prevalence of Cases that take Folic Acid with Iron Supplement.

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	50	23.8	23.8	23.8
No	160	76.2	76.2	100.0
Total	210	100.0	100.0	

Forty-one cases (19.5%) reported taking vitamin C with iron supplements, while 169 cases (80.5%) did not. Therefore, most participants did not combine vitamin C with their iron supplementation (Table 22).

Table 22. Prevalence of Cases that take Vitamin C with Iron Supplement.

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	41	19.5	19.5	19.5
No	169	80.5	80.5	100.0
Total	210	100.0	100.0	

The majority of participants, 138 (65.7%), reported taking multivitamins during pregnancy, while 72 (34.3%) did not take multivitamins (Table 23).

Table 23. Taken Multivitamin During Pregnancy.

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	138	65.7	65.7	65.7
No	72	34.3	34.3	100.0
Total	210	100.0	100.0	

The majority of cases had moderate anemia (176, 83.8%) based on the reported Hb categories. Thirty cases (14.3%) had severe anemia with Hb below 7 g/dL, while 4 cases (1.9%) had mild anemia. the findings indicate that moderate anemia was the predominant Hb category in the study population (Table 24).

Table 24. CBC (HB) Levels.

CBC1.HB	N	Percentage
Sever (< 7)	30	14.3
Moderate (9.9 - 7)	176	83.8
Mild (10.9 - 10)	4	1.9
Total	210	100.0

The majority of participants had MCV levels below 80 fL (153, 72.9%), indicating a predominantly microcytic pattern. The remaining 57 participants (27.1%) had MCV levels within the normal range of 80–100 fL (Table 25).

Table 25. MCV Levels.

	Frequency	Percent
<80 FL	153	72.9%
80-100 FL	57	27.1%

Almost all participants had HCT levels below 33% (206, 98.1%), while only 4 participants (1.9%) had HCT levels between 33–52%. This indicates that reduced hematocrit was highly prevalent in the study population (Table 26).

Table 26. HCT Levels.

	Frequency	Percent
<33%	206	98.1%
33-52%	4	1.9%

Most participants had serum ferritin levels below 30 ng/mL (192, 91.4%), while 18 participants (8.6%) had levels above 30 ng/mL. Thus, iron deficiency was highly prevalent, affecting 192 participants (91.4%) (Table 27).

Table 27. Serum Ferritin Levels.

Serum ferritin	Frequency	Percent
<30 ng/ml	192	91.4%
>30 ng/ml	18	8.6%
Total	210	

The prevalence of iron deficiency anemia (192) 91.4%. Serum iron levels were below 37 µg/dL in 134 participants (63.8%), whereas 76 participants (36.2%) had levels between 37–150 µg/dL. Therefore, approximately two-thirds of the participants had low serum iron levels (Table 28).

Table 28. Serum Iron Levels.

	Frequency	Percent
<37 ug/dl	134	63.8%
37-150 ug/dl	76	36.2%

The most common peripheral blood film finding was anisopoikilocytosis with microcytic hypochromic changes in 75 participants (35.7%), followed closely by microcytic hypochromic changes in 74 participants (35.2%). Normocytic normochromic findings were observed in 50 participants (23.8%). Less frequent findings included normocytic hypochromic changes (6, 2.9%) and microcytic normochromic changes (4, 1.9%). One case showed anisopoikilocytosis with normocytic normochromic cells, spherocytes, polychromasia, and fragmented cells (Table 29).

Table 29. Peripheral Blood Film.

	Frequency	Percent
Anisopikilocytosis microcytic hypochromic	75	35.7%
Microcytic hypochromic	74	35.2%
Microcytic normochromic	4	1.9%
Normocytic hypochromic	6	2.9%
Normocytic normochromic	50	23.8%

N: B 1 case anisopikilocytosis normocytic normochromic + spherocyte polychromasia and fragment.

Vitamin D deficiency was highly prevalent among the participants. Two hundred participants (95.2%) had serum vitamin D levels below 30 ng/mL, while only 10 participants (4.8%) had levels above 30 ng/mL. Thus, the vast majority of participants had low vitamin D levels (Table 30).

Table 30. Vitamin D Status.

Vitamin D	Frequency	Percent
<30 ng/ml	200	95.2%
>30 ng/ml	10	4.8%
Total	210	%100

4.0. Discussion

Pregnancy anemia is one of the serious public health problems of today that occurs not only in developed but also in developing countries causing poor maternal and child outcomes and negatively influencing economic development of these countries. Prevalence of anemia in pregnant women in our study was found to be 20.5% and that is significantly lower than the prevalence observed in Bathinda, Punjab (India 81.8%) [12], Sudan (53%) [23], northwest Libya (72%) [14], and Bangladesh (62.5%) [45], while it is significantly higher than Chinese (13.9%) [46] but similar to prevalence observed in Qatar (27.1%) [47] and Sana'a, Yemen (25%) [18].

As concerns severity of anemia, the most prevalent category was moderate anemia (83.81%), followed by severe (14.29%) and mild (1.9%). Iron deficiency was highly prevalent, as it affected 91.4% of patients suffering from anemia, and it highlights iron deficiency as the main cause of anemia in our case.

The current study showed a very high prevalence of iron deficiency in pregnant women hospitalized in Benghazi Medical Center. Of 210 participants, 192 (91.4%) had ferritin level of less than 30 ng/mL, thus showing low level of stored iron according to the criterion of the study. Besides, 176 (83.8%) had moderate anemia, 30 (14.3%) had severe anemia and 4 (1.9%) had mild anemia. Prevalence obtained in our study is considerably higher than the global burden of anemia observed in pregnant women and is higher even than the estimates obtained in many low- and middle-income countries [1,3,10]. It may be partly explained by the nature of the current study (hospital based), as women who are admitted to the medical center may have a high prevalence of anemia and pregnancy complications.

The laboratory findings provide further evidence of a predominantly iron-deficient pattern. Low MCV (<80 fL) was observed in 153 women (72.9%), while 206 (98.1%) had HCT below 33% and 134 (63.8%) had serum iron below 37 µg/dL. Peripheral blood film examination demonstrated anisopoikilocytosis with microcytic hypochromic changes in 75 (35.7%) and microcytic hypochromic changes in 74 (35.2%). These findings are compatible with iron-restricted erythropoiesis and support the high prevalence of iron deficiency identified by serum ferritin [8,9].

The finding that 91.4% of participants had ferritin below 30 ng/mL is particularly important. Ferritin is a useful marker of body iron stores, although it may increase during infection or inflammation [8]. In the current study, the combination of low ferritin, low serum iron, low MCV and predominantly microcytic hypochromic blood films provides stronger evidence that iron deficiency was an important contributor to the anemia observed. Nevertheless, because the study used ferritin <30 ng/mL as its criterion for iron deficiency, this threshold should be clearly stated in the methodology, and the results should distinguish between iron deficiency and iron deficiency anemia, which requires evidence of both iron deficiency and anemia [8,9].

An important finding was the predominance of women in the third trimester (176, 83.8%), compared with 24 (11.4%) in the second trimester and 10 (4.8%) in the first trimester. The predominance of anemia in late pregnancy is biologically plausible because maternal iron requirements increase progressively during pregnancy, particularly as fetal iron accumulation and maternal erythrocyte expansion increase [13]. Previous systematic evidence has also identified second- and third-trimester pregnancy as risk periods for anemia [15].

The present study identified several potentially important obstetric risk factors. A total of 198 women (94.3%) had not received preconception care, while 92 (43.8%) reported a history of chronic anemia and 62 (29.5%) reported blood loss during pregnancy. Lack of preconception care may represent a missed opportunity to identify and correct iron deficiency before pregnancy. Similarly, a history of chronic anemia suggests that some women may have entered pregnancy with already depleted iron stores. Previous research has consistently identified inadequate antenatal care, previous anemia and blood loss as important contributors to maternal anemia [6,15,16].

The interpregnancy interval may also have contributed to the high prevalence of iron deficiency. In this study, 41 women (19.5%) had an interval of less than one year, while 22 (10.5%) had no previous interpregnancy interval. Short birth intervals have been identified as a risk factor for maternal anemia, potentially because maternal iron stores may not be completely replenished before the subsequent pregnancy [15,16]. The present findings therefore suggest that reproductive history should be considered when assessing pregnant women at risk of iron deficiency.

Dietary and behavioral characteristics may also have contributed. Although 118 participants (56.2%) reported no coffee consumption and 158 (75.2%) reported no tea consumption, a proportion consumed these beverages daily. Tea and coffee consumption after meals has been identified as a risk factor for anemia because certain compounds can inhibit non-heme iron absorption [15]. In addition, 66 women (31.4%) reported a history of pica. Pica is commonly associated with iron deficiency and may represent a clinical marker of depleted iron stores.

Iron supplementation was reported by 131 women (62.4%), while 79 (37.6%) did not take iron supplements. Despite relatively widespread use of iron, the prevalence of iron deficiency remained extremely high. This may indicate late initiation of supplementation, inadequate adherence, insufficient dosage, poor absorption, or pre-existing iron deficiency before pregnancy. Evidence from systematic reviews demonstrates that antenatal iron supplementation reduces maternal anemia, iron deficiency and iron deficiency anemia [19]. Therefore, improving early initiation and adherence to iron supplementation may be particularly important in this population.

The present study also identified a substantial burden of recurrent infection. Vaginitis was reported in 53 women (25.2%), UTI in 26 (12.4%), and vaginitis combined with UTI in 39 (18.6%). Infection and inflammation can influence iron metabolism through hepcidin-mediated sequestration of iron and can complicate the interpretation of ferritin [17]. However, the simultaneous presence of low ferritin, low serum iron, microcytosis and hypochromia in the present study supports iron deficiency as an important component of the anemia burden.

Another notable finding was the high prevalence of low vitamin D status. Two hundred women (95.2%) had vitamin D levels below 30 ng/mL. Previous research has reported an association between vitamin D deficiency and anemia, potentially involving inflammatory pathways and regulation of hepcidin [20,21]. However, the relationship remains incompletely understood, and vitamin D deficiency should not be interpreted as a direct cause of iron deficiency anemia based on the current evidence.

Overall, the findings demonstrate a substantial burden of iron deficiency anemia among pregnant women admitted to Benghazi Medical Center. The combination of low ferritin (91.4%), low MCV (72.9%), low serum iron (63.8%), low HCT (98.1%), and predominantly microcytic hypochromic blood films indicates widespread iron depletion. The high prevalence is likely multifactorial and may be related to advanced gestational age, previous anemia,

inadequate preconception care, blood loss, short interpregnancy intervals, nutritional practices, infection and inadequate or late supplementation. These findings emphasize the importance of early antenatal screening, assessment of iron status, appropriate iron–folic acid supplementation, dietary counseling and monitoring of adherence [15,18,19].

5.0. Conclusion

This study demonstrated a high prevalence of iron deficiency anemia among pregnant women admitted to Benghazi Medical Center. The findings showed that 91.4% of participants had serum ferritin levels below 30 ng/mL, while 83.8% had moderate anemia and 14.3% had severe anemia. In addition, 72.9% had microcytic MCV values, 98.1% had HCT below 33%, and 63.8% had low serum iron levels. Peripheral blood films predominantly demonstrated microcytic and hypochromic changes.

Several potential risk factors were also identified, including limited preconception care, a history of chronic anemia, pica, and inadequate use of folic acid with iron and vitamin C with iron. Although most of women reported taking iron supplements during pregnancy, iron deficiency remained very common. The high prevalence of anemia and iron deficiency highlights the need for early screening, appropriate iron and folic acid supplementation, nutritional education, and regular monitoring of hematological and iron-status indicators throughout pregnancy. These measures may help reduce the burden of maternal anemia and its potential adverse consequences for mothers and their babies.

5.1. Future perspective

Future studies should include larger, multicenter and prospective cohorts to better determine the prevalence and determinants of iron deficiency anemia among pregnant women in Libya. Further research should assess the effectiveness of early preconception and antenatal screening, iron–folic acid supplementation, nutritional counseling, and adherence-monitoring interventions. Longitudinal studies should also evaluate the relationship between maternal iron status and pregnancy and neonatal outcomes. In addition, the potential relationship between vitamin D deficiency and iron status warrants further investigation.

Declarations

Source of Funding

This study did not receive any grant from funding agencies in the public or not-for-profit sectors.

Conflict of Interest

The authors declare that they have no conflict of interest.

Consent for Publication

The authors declare that they consented to the publication of this study.

Ethical Approval

The ethical statement was obtained from ethical committee of Benghazi University, Benghazi. Libya.

Informed Consent

All participants provided written informed consent before commencement.

Acknowledgement

The authors would like to thank all participants in this study.

References

- [1] World Health Organization (2025). Anaemia in women and children. Global Health Observatory.
- [2] World Health Organization (2024). Guideline on haemoglobin cutoffs to define anaemia in individuals and populations. World Health Organization.
- [3] World Health Organization (2015). The global prevalence of anaemia in 2011. World Health Organization.
- [4] Centers for Disease Control and Prevention (n.d.). CDC criteria for anemia in pregnancy. Centers for Disease Control and Prevention.
- [5] Cunningham, F.G., Leveno, K.J., Bloom, S.L., Dashe, J.S., Hoffman, B.L., Casey, B.M., et al. (2022). William's obstetrics (26th Ed.). McGraw Hill.
- [6] Pavord, S., Daru, J., Prasannan, N., Robinson, S., Stanworth, S., & Girling, J. (2020). UK guidelines on the management of iron deficiency in pregnancy. *British Journal of Haematology*, 188(6): 819–830. <https://doi.org/10.1111/bjh.16221>.
- [7] World Health Organization (n.d.). Anaemia in women and children. World Health Organization.
- [8] Daru, J., Colman, K., Stanworth, S.J., De La Salle, B., Wood, E.M., & Pasricha, S.R. (2017). Serum ferritin as an indicator of iron status: What do we need to know? *The American Journal of Clinical Nutrition*, 106(s6): 1634s–1639s. <https://doi.org/10.3945/ajcn.117.155960>.
- [9] World Health Organization (2020). WHO guideline on use of ferritin concentrations to assess iron status in individuals and populations. World Health Organization.
- [10] Rahman, M.M., Abe, S.K., Rahman, M.S., Kanda, M., Narita, S., Bilano, V., et al. (2016). Maternal anemia and risk of adverse birth and health outcomes in low- and middle-income countries: Systematic review and meta-analysis. *The American Journal of Clinical Nutrition*, 103(2): 495–504. <https://doi.org/10.3945/ajcn.115.107896>.
- [11] Young, M.F., Oaks, B.M., Tandon, S., Martorell, R., Dewey, K.G., & Wendt, A.S. (2019). Maternal hemoglobin concentrations across pregnancy and maternal and child health: A systematic review and meta-analysis. *Annals of the New York Academy of Sciences*, 1450(1): 47–68. <https://doi.org/10.1111/nyas.14093>.
- [12] Haider, B.A., Olofin, I., Wang, M., Spiegelman, D., Ezzati, M., & Fawzi, W.W. (2013). Anaemia, prenatal iron use, and risk of adverse pregnancy outcomes: Systematic review and meta-analysis. *BMJ*, 346: f3443. <https://doi.org/10.1136/bmj.f3443>.

- [13] Young, M.F., Griffin, I., Pressman, E., McIntyre, A.W., Cooper, E., McNanley, T., Harris, Z.L., Westerman, M., & O'Brien, K.O. (2012). Maternal hepcidin is associated with placental transfer of iron derived from dietary heme and nonheme sources. *The Journal of Nutrition*, 142(1): 33–39. <https://doi.org/10.3945/jn.111.145961>.
- [14] Stevens, G.A., Paciorek, C.J., Flores-Urrutia, M.C., Borghi, E., Namaste, S., Wirth, J.P., Suchdev, P.S., Ezzati, M., Rohner, F., Flaxman, S.R., & Rogers, L.M. (2022). National, regional, and global estimates of anaemia by severity in women and children for 2000–19: A pooled analysis of population-representative data. *The Lancet Global Health*, 10(5): e627–e639. [https://doi.org/10.1016/s2214-109x\(22\)00084-5](https://doi.org/10.1016/s2214-109x(22)00084-5).
- [15] Zhang, J., Li, Q., Song, Y., Fang, L., Huang, L., & Sun, Y. (2022). Nutritional factors for anemia in pregnancy: A systematic review with meta-analysis. *Frontiers in Public Health*, 10: 1041136. <https://doi.org/10.3389/fpubh.2022.1041136>.
- [16] World Health Organization (2016). WHO recommendations on antenatal care for a positive pregnancy experience. World Health Organization.
- [17] Ganz, T., & Nemeth, E. (2011). Hepcidin and disorders of iron metabolism. *Annual Review of Medicine*, 62: 347–360. <https://doi.org/10.1146/annurev-med-050109-142444>.
- [18] World Health Organization (2012). Guideline: Daily iron and folic acid supplementation in pregnant women. World Health Organization.
- [19] Cantor, A.G., Holmes, R., Bougatsos, C., Atchison, C., DeLoughery, T., & Chou, R. (2024). Screening and supplementation for iron deficiency and iron deficiency anemia during pregnancy: Updated evidence report and systematic review for the US Preventive Services Task Force. *JAMA*, 332(11): 914–928. <https://doi.org/10.1001/jama.2024.13546>.
- [20] Smith, E.M., & Tangpricha, V. (2015). Vitamin D and anemia: Insights into an emerging association. *Current Opinion in Endocrinology, Diabetes and Obesity*, 22(6): 432–438. <https://doi.org/10.1097/med.00000000000000199>.
- [21] Harvey, N.C., Holroyd, C., Ntani, G., Javaid, K., Cooper, P., Moon, R., et al. (2019). The effect of maternal vitamin D supplementation on hepcidin, iron status, and inflammation in pregnant women. *The Journal of Nutrition*, 149(6): 1050–1058.