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Original article

Prevalence and Associated Risk Factors for Anaemia amongst Pregnant Women Attending Gynecology and Obstetrics Department in Tobruk Medical Center, Tobruk, Libya

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Anemia during pregnancy is a major public health issue, particularly in developing countries, with significant health, social, and economic consequences. This study aimed to assess the prevalence of anemia among pregnant women attending the Tobruk Medical Center and identify associated factors. A cross-sectional analytical study was conducted from January 2024 to June 2024 on 2187 pregnant women attending the Gynecology Department at Tobruk Medical Center in Tobruk, Libya, to gather data on social and demographic characteristics, reproductive health status, and the prevalence of anemia. Logistic regression was used for statistical analysis. The overall prevalence of anemia among pregnant women was 49.7%, with 42.9% experiencing mild anemia. Parity and gravidity were significantly associated with anemia. The anemia prevalence was higher among multiparous women (51.4%). Other factors, such as age, employment status, and abortion history, did not show a strong association. The prevalence of anemia among pregnant women in Tobruk is high and coincides with WHO's definition of a severe public health problem. This highlights the need for greater awareness of balanced diets, regular antenatal checkups, and the consistent use of iron and folic acid supplements to address anemia in pregnancy in Libya. Future research should explore these additional factors to better address maternal anemia.

Introduction

Anemia in pregnancy is a major global public health concern, particularly in low- and middle-income countries where it significantly contributes to maternal and perinatal morbidity and mortality [1]. During pregnancy, a woman's body requires higher levels of iron and folate to support both maternal health and fetal development [2]. Moreover, several factors have been identified as contributing factors to anaemia amongst pregnant women. Iron deficiency is the most common cause; it is usually accompanied by a deficiency of other nutrients.8,13 Around 40% of women begin their pregnancy with decreased iron stores, which become insufficient to meet the increased iron needs during pregnancy [2]. In developing countries, the main cause of anemia during pregnancy is nutritional deficiencies of iron, folate, and vitamin B12 and also parasitic diseases, such as malaria and hookworm [2]. Other factors include physiological haemodilution, underlying inflammatory conditions and malnutrition, leading to insufficient vitamins, proteins, iron and iodine [3].

The World Health Organization (WHO) estimates that approximately 38% of pregnant women globally are anaemic, with the highest rates reported in sub-Saharan Africa and South-East Asia [3]. Anemia during pregnancy not only compromises maternal health but also affects the fetus by reducing oxygen supply, increasing the risks of intrauterine growth retardation, preterm birth, low birth weight, stillbirth, and neonatal death. Additionally, it weakens the mother's resistance to infections and her ability to withstand blood loss during childbirth [2,4,5]. Despite ongoing efforts to improve maternal health, anemia remains a persistent problem with serious health implications. In many developing regions, including sub-Saharan Africa and the Middle East, the condition remains widespread, with prevalence rates often exceeding 50%[6]. Poor nutritional intake, frequent pregnancies, inadequate prenatal care, and the prevalence of parasitic infections contribute to this high burden [6].

Women suffering from moderate to severe anemia face increased risks of complications such as postpartum hemorrhage, heart failure, and poor wound healing [7]. Furthermore, infants born to anemic mothers are at greater risk of developing iron deficiency in infancy, which can impair their cognitive and physical development [8]. These outcomes highlight the urgent need for prioritizing anemia screening, prevention, and treatment as part of routine antenatal care. Addressing anemia in pregnancy is a vital component of

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safe motherhood and improving child survival. Early detection and effective management of anemia in pregnancy can significantly reduce the risks associated with childbirth and improve long-term health outcomes for both mother and child [9,10].
While global data are available, there remains Limited data are available in several regions, including Libya. In addition, there has been limited research on the epidemiology of anemia in pregnancy in Arab countries, with reported prevalence at 25% in Kuwait, 40% in Saudi Arabia, 28% in Qatar, 29% in Tunisia, 30% in Egypt, 31% in Iraq, 32% in Morocco, and 26% in the United Arab Emirates [6]. The WHO reported that 28% of pregnant women in Libya were anaemic as of 2011, a figure lower than previously estimated in 2005(34%)[6]. Anemia in Africa has shown different prevalence figures of anemia. For example, in Nigeria 54.5%, in Ethiopia 56.8% and in Kenya 57% [11-12]. However, these estimates do not reflect variations across different cities and regions. Inadequate surveillance and limited research hinder the development of targeted interventions. Given the severe health consequences of anemia and its preventability, it is crucial to understand the local epidemiology of this condition. Therefore, this study aims to estimate the prevalence of anemia and identify its associated risk factors among pregnant women in Tobruk city, Libya, to inform evidence-based strategies for improving maternal and neonatal health.

Methods

Study Design and Setting

This study was a cross-sectional analytical study conducted to collect data on the social and demographic characteristics, reproductive and sexual health status, and prevalence of anemia (measured by hemoglobin levels at a single point in time). Moreover, the risk factors among pregnant women attending the Obstetrics and Gynecology Department for antenatal care at Tobruk Medical Center.

Study Sample

The study included pregnant women aged between 16 and 48 years who were receiving antenatal care in the department during the period from January 2024 to June 2024. All pregnant women attending antenatal care at Tobruk Medical Center who met the inclusion criteria were eligible. Women who were not pregnant, were beyond childbearing age, or had received a blood transfusion within the past six months were excluded.

Sample Size

To estimate the prevalence of anemia with a 95% confidence level and a 5% margin of error, and assuming a maximum variability (prevalence rate of 50% in the absence of prior data), the final sample size was calculated to be 2,178 pregnant women.

Sampling Strategy

Participants were selected using sampling procedures covering the first half of 2024, which included all attendees from January to June 2024.

Data Collection

Data were collected from the Statistics and Documentation Office at Tobruk Medical Center using a structured questionnaire administered in a consultation room with full respect for privacy. Before data collection, research assistants received brief training on how to use the tool, maintain confidentiality, and adhere to collection procedures. The questionnaire gathered information on socio-demographic characteristics, obstetric history, and relevant medical background.
Data were entered and stored using the Statistical Package for the Social Sciences (SPSS) software. The hemoglobin test samples were processed in the center's laboratories. Blood samples were drawn via venipuncture by laboratory staff as part of routine antenatal care, using EDTA tubes and analyzed on a Sysmex instrument following standard operating procedures.
Hemoglobin levels were used to determine whether a patient was anemic based on World Health Organization (WHO) criteria, which define anemia in pregnant women as hemoglobin concentrations below 11 g/dL. The severity of anemia was categorized as follows: Mild anemia: 9.0 – 10.9 g/Dl; Moderate anemia: 7.0 – 9.8 g/Dl; Severe anemia: Less than 7.0 g/dL.

Statistical Analysis

Data were analyzed using frequencies, percentages, one-sample t-tests, mean comparisons, chi-square tests, and logistic regression analysis.

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Ethical Considerations

All procedures involving human participants were conducted in accordance with the ethical standards of the research committee.

Results

Sociodemographic characteristics of the study participants

Table 1 presents the sociodemographic characteristics of the 2,178 study participants. The age distribution indicates that the majority of participants were between 25 and 34 years old, accounting for 55.4% of the sample. Participants aged 35–44 years, who represented 24.6%, followed this. The younger age group of 14–24 years comprised 19.3%, while only a small proportion of the sample 0.8 percentage were above 45 years of age, reflecting a predominantly young to middle-aged cohort. With regard to employment status, the majority of study participants were housewives, accounting for 69.1% of the total sample. While the students comprised the smallest proportion, with only 1.8% of the sample. In addition. The majority of pregnant women (75.9%) lived in urban areas, while 24.1% resided in rural areas.

Table 1. Sociodemographic characteristics of the study participants

Sociodemographic characteristics	Frequency	Percentage
Age (years)		
14 – 24 years	420	19.3%
25 – 34 years	1206	55.4%
35 – 44 years	535	24.6%
Above 45 years	17	0.8%
Employment status		
Student	40	1.8%
Self-employed	634	29.1%
Housewife	1504	69.1%
Location of residence		
Urban	1654	75.9%
Rural	524	24.1%

The obstetric characteristics of the study participants

Table 2 summarizes the obstetric history of the 2,178 study participants. In terms of parity, the majority of women were multiparous, constituting 84.4% of the sample, while 15.6% were primiparous, indicating that most participants had experienced more than one previous delivery. Regarding gravidity, women who had been pregnant 2–4 times represented the largest group; accounting for 44.6%. This was followed by 30.3% who had experienced 5–7 pregnancies, and 15.6% who were in their first pregnancy. Notably, 9.6% (n = 208) of participants had a gravidity of 7 or more. Regarding gestational age, the large majority of participants (98.7%, n = 2,150) were in their third trimester of pregnancy. In contrast, only 0.9% (n = 20) were in the first trimester, and 0.4% (n = 8) were in the second trimester. Regarding gestational age, the large majority of participants (98.7%, n = 2,150) were in their third trimester of pregnancy. In contrast, only 0.9% (n = 20) were in the first trimester, and 0.4% (n = 8) were in the second trimester.

In terms of abortion history, the majority of participants (65.6%, n = 1,428) reported no history of abortion, while 29.5% (n = 642) had experienced 1–2 abortions. A smaller proportion of women reported higher numbers of abortions: 3.9% (n = 84) had 3–4 abortions and 1.1% (n = 24) had experienced five or more.

Table 2. The obstetric characteristics of the study participants

Obstetric characteristics	Frequency	Percentage
Parity		
Primiparous	339	15.6%
Multiparous	1839	84.4%
Gravidity		
1	339	15.6%
2-4	971	44.6%
5-7	660	30.3%
≥ 7	208	9.6%

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Gestational Trimester		
First	20	0.9%
Second	8	0.4%
Trimester	2150	98.7%
History of Abortion		
0	1428	65.6%
1-2	642	29.5%
3-4	84	3.9%
≥ 5	24	1.1%

The Prevalence of Anemia in Pregnancy

Table 3 presents the overall prevalence of anemia among pregnant women in the study population. The mean hemoglobin (Hb) level for the entire sample (N = 2,178) was 10.9895 g/dL, with a standard deviation of 1.38108 and a standard error of 0.02959. This mean value was statistically significant compared to the World Health Organization's (WHO) threshold for anemia in pregnancy, which is 11.0 g/dL

Table 3. Overall prevalence of anemia in pregnancy

Anemia	N	Mean	Std. Deviation	Std. Error Mean	P-value
Hemoglobin (Hb) (g/dL) [2]	2178	10.9895	1.38108	0.02959	0.742

The mean hemoglobin level falls marginally below the standard threshold, suggesting that, on average, the population may be classified as mildly anemic. According to hematological criteria specific to pregnancy, anemia is defined as hemoglobin levels less than 11.0 g/dL, with severity categorized as follows: mild anemia (9.0–10.9 g/dL), moderate anemia (7.0–8.9 g/dL), and severe anemia (<7.0 g/dL).

The Distribution of Anemia in the Pregnancy Population

Table 4 illustrates the distribution of anemia among pregnant women based on its severity. The data show that 50.3% of the participants had normal hemoglobin levels (≥11.0 g/dL), indicating that just over half of the study population was not anemic. The remaining 49.7% (n = 1,082) of the women were found to be anemic to varying degrees, highlighting a substantial burden of anemia in this population. Among the anemic group, mild anemia (Hb 9.0–10.9 g/dL) was the most prevalent, affecting 42.9% of the total sample. Moderate anemia (Hb 7.0–8.9 g/dL) was reported in 6.5% of participants. Notably, severe anemia (Hb <7.0 g/dL) was present in only 0.3% of participants, making it the least common category.

Table 4. Distribution of Anemia in Pregnancy According to Severity

Category of Anemia	Frequency	Percentage	Mean Hb (g/dL)	Std. Deviation
Non-anemia: ≥11.0 g/dL	1096	50.3%	12.086	0.82983
Mild anemia: 9.0–10.9 g/dL	935	42.9%	10.127	0.53427
Moderate anemia: 7.0–8.9 g/dL	141	6.5%	8.379	0.45771
Severe anemia: <7.0 g/dL	6	0.3%	6.400	0.58992
Total	2178	100%	---	---

Risk factors associated with anemia in the study population

Table 5 presents the results of the chi-square tests examining the association between several sociodemographic and obstetric variables and the prevalence of anemia among pregnant women in the study population (N = 2,178). Overall, 49.7% (n = 1,082) of the participants were classified as anemic, while 50.3% (n = 1,096) were non-anemic. There were varying degrees of the prevalence of anemic pregnancy among the different study variables. Age, employment status, location of residence and history of abortion were not significantly associated with anemia status. In contrast, parity and Gravidity showed a strong and statistically significant association with anemia p < 0.001). Moreover, women with only one pregnancy had the lowest anemia rate (40.1%), whereas those with seven or more pregnancies exhibited the highest rate of anemia (56.3%).

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Table 5. Correlation Analysis for Risk Factors of Anemia

Age/Anemia			**Anemia Category**		**Total**	**Chi-Square Test**
			Non-Anemia	**Anemia**		
Age	14 – 24 years	Frequency	205	215	420	0.796
		Percentage	48.8%	51.2%	100.0%	
	25 – 34 years	Frequency	613	593	1206	
		Percentage	50.8%	49.2%	100.0%	
	35 – 44 years	Frequency	268	267	535	
		Percentage	50.1%	49.9%	100.0%	
	Above 45 years	Frequency	10	7	17	
		Percentage	58.8%	41.2%	100.0%	
Total		Frequency	1096	1082	2178	
		Percentage	50.3%	49.7%	100.0%	
Employment Status/Anemia			**Anemia Category**		**Total**	**Chi-Square Test**
			Non-Anemia	**Anemia**		
Employment Status	Student	Frequency	17	23	40	0.37
		Percentage	42.5%	57.5%	100.0%	
	Self-employed	Frequency	332	302	634	
		Percentage	52.4%	47.6%	100.0%	
	Housewife	Frequency	747	757	1504	
		Percentage	49.7%	50.3%	100.0%	
Total		Frequency	1096	1082	2178	
		Percentage	50.3%	49.7%	100.0%	
Location of Residence/Anemia			**Anemia Category**		**Total**	**Chi-Square Tests**
			Non-Anemia	**Anemia**		
Location of Residence	Urban	Frequency	836	818	1654	0.712
		Percentage	50.5%	49.5%	100.0%	
	Rural	Frequency	260	264	524	
		Percentage	49.6%	50.4%	100.0%	
Total		Frequency	1096	1082	2178	
		Percentage	50.3%	49.7%	100.0%	
Parity/Anemia			**Anemia Category**		**Total**	**Chi-Square Tests**
			Non-Anemia	**Anemia**		
Parity	Primiparous	Frequency	203	136	339	0.000
		Percentage	59.9%	40.1%	100.0%	
	Multiparous	Frequency	893	946	1839	
		Percentage	48.6%	51.4%	100.0%	
Total		Frequency	1096	1082	2178	
		Percentage	50.3%	49.7%	100.0%	
Gravidity/Anemia			**Anemia Category**		**Total**	**Chi-Square Test**
			Non-Anemia	**Anemia**		
Gravidity	1	Frequency	203	136	339	0.0001
		Percentage	59.9%	40.1%	100.0%	
	2-4	Frequency	474	497	971	
		Percentage	48.8%	51.2%	100.0%	
	5-7	Frequency	328	332	660	
		Percentage	49.7%	50.3%	100.0%	
	Above 7	Frequency	91	117	208	
		Percentage	43.8%	56.3%	100.0%	
Total		Frequency	1096	1082	2178	
		Percentage	50.3%	49.7%	100.0%	

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History of Abortion/Anemia			Anemia Category		Total	Chi-Square Test
			Non-Anemia	Anemia		
History of Abortion	0	Frequency	742	686	1428	0.18
		Percentage	52.0%	48.0%	100.0%	
	1-2	Frequency	305	337	642	
		Percentage	47.5%	52.5%	100.0%	
	3-4	Frequency	37	47	84	
		Percentage	44.0%	56.0%	100.0%	
	≥ 5	Frequency	12	12	24	
		Percentage	50.0%	50.0%	100.0%	
Total		Frequency	1096	1082	2178	
		Percentage	50.3%	49.7%	100.0%	

Logistic Regression Analysis for Risk Factors of Anemia

Table 6 presents the logistic regression analysis identifies variables such as age, employment status, residence, and abortion history that do not significantly influence anemia risk in this sample. Gravidity, specifically being in the first pregnancy, is the only statistically significant protective factor against anemia. Moreover, women in their first pregnancy had a statistically significantly lower risk of anemia. The 2–4 and 5–7 pregnancy groups were not statistically significant.

Table 6. Logistic Regression Analysis for Risk Factors of Anemia

Variable	Category	B(Coefficient)	SE	Wald x^2	p-value	Odds Ratio (Exp(B))	95% CI for Exp(B)
Age (Ref: >45 years)	14–24 years	0.523	0.517	1.024	0.311	1.688	0.613 – 4.650
	25–34 years	0.333	0.506	0.431	0.511	1.394	0.517 – 3.762
	35–44 years	0.276	0.508	0.296	0.587	1.318	0.487 – 3.565
Employment (Ref: Housewife)	Student	0.377	0.330	1.307	0.253	1.458	0.764 – 2.782
	Self-employed	-0.111	0.099	1.248	0.264	0.895	0.736 – 1.087
Location (Ref: Rural)	Urban	-0.038	0.101	0.139	0.710	0.963	0.790 – 1.174
Gravidity (Ref: >7)	1 pregnancy	-0.780	0.220	12.553	<0.001	0.458	0.298 – 0.706
	2–4 pregnancies	-0.285	0.187	2.325	0.127	0.752	0.521 – 1.085
	5–7 pregnancies	-0.274	0.177	2.386	0.122	0.761	0.538 – 1.076
Abortion History (Ref: ≥5)	0 abortions	0.181	0.440	0.170	0.681	1.199	0.506 – 2.842
	1–2 abortions	0.259	0.438	0.348	0.555	1.295	0.549 – 3.056
	3–4 abortions	0.312	0.470	0.440	0.507	1.366	0.544 – 3.432

Discussion

Anemia during pregnancy remains a significant public health issue globally, particularly in developing countries, with profound health, social, and economic consequences. Despite various health initiatives aimed at improving maternal health, anemia continues to affect pregnant women, especially in low-resource settings. This study aimed to assess the prevalence of anemia among antenatal attendees at the Tobruk Medical Center and identify associated factors. The overall prevalence of anemia was found to be 49.7%, which is considered a severe public health problem by the World Health Organization (WHO) when the prevalence exceeds 40% [14]. This rate is higher than a previous study in the same region (40.3%) and aligns with findings from other studies in Libya, where anemia prevalence among pregnant women ranged from 25% to 81% [15,16]. The prevalence is also comparable to rates found in West Algeria and some African countries show similar prevalence and indicating that anemia is a widespread issue in these regions, highlighting the need for continued anemia control programs [17,18].

The mean hemoglobin (Hb) level for the entire sample (N = 2,178) was 10.9895 g/dL, with a standard deviation of 1.38108 and a standard error of 0.02959. It resembles results found in other research, though the exact figures are typically not accessible for developing nations; the reported rates are relevant to specific urban populations of women [18]. The mean hemoglobin (Hb) level among the 2,178 participants was 10.9895 g/dL (SD = 1.38108; SE = 0.02959), similar to findings from other developing regions [19]. About 50.3% (n = 1,096) had normal Hb levels (≥11.0 g/dL), while 49.7% (n = 1,082) were anemic. Mild anemia (Hb 9.0–10.9 g/dL) was the most common, affecting 42.9% (n = 935). Moderate anemia (Hb 7.0–8.9 g/dL)

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was observed in 6.5%. In contrast to other studies, where mild and moderate anemia have a similar proportion [20, 21]. Whereas most cases of anemia were mild, some women still presented with severe anemia. The proportion of severe anemia (Hb <7.0 g/dL) was only 0.3%, a rate consistent with similar studies in Nigeria [22]. Despite being rare, severe anemia remains a critical maternal health concern.

Regarding demographic factors, the study found no significant association between age, employment status, or residence and anemia prevalence. This agrees with another study [23]. The age distribution indicates that the majority of participants were between 25 and 34 years old, accounting for 55.4% of the sample. While only a small proportion of the sample 0.8 percent, were above 45 years of age, reflecting a predominantly young to middle-aged cohort. The majority of study participants were housewives, accounting for 69.1% (n = 1,504) of the total sample. The employment status shows slightly less likelihood to be anemic than housewives, but again, not significant. Most women lived in urban areas (75.9%, n = 1,654), while 24.1% (n = 524) were from rural settings. Anemia prevalence was nearly equal across both groups, with no significant difference based on residence ($x^2 = 0.712$, $p > 0.05$; OR = 0.963, p = 0.710).

In terms of parity, the majority of women were multiparous, constituting 84.4% (n = 1,839) of the sample, while 15.6% (n = 339) were primiparous, indicating that most participants had experienced more than one previous delivery. The results of this study do not coincide with another study done in Ethiopia and sub-Saharan Africa [24, 25]. Where primigravida were more anemic than multigravida females. Whereas another study conducted in Qatar and Pakistan [26,27] shows that the incidence of anemia is abundant in multiparous women, the results coincide with this study.

There is a good association of parity (number of previous births) and anemia. The parity showed a strong and statistically significant association with anemia status ($x^2 = 0.000$, $p < 0.001$). Among primiparous women, only 40.1% were anemic, compared to 51.4% among multiparous women. Possibly due to cumulative nutritional depletion or iron deficiency not fully recovered between pregnancies. Research conducted in Kairatu Health Center also found a correlation between the parity of pregnant women and the incidence of anemia [28].

Anemia was 2.2 (OR) times more prevalent in women with four or living children than in women with fewer children. Multiparity may induce anemia by reducing maternal iron reserves at every pregnancy and by causing blood loss at each delivery. The mean number of living children was 1.2 in our study. Regarding gravidity, Women who had been pregnant 2–4 times represented the largest group, accounting for 44.6% (n = 971). Gravidity (total number of pregnancies) was also significantly associated with anemia ($x^2 = 0.0001$, $p < 0.001$). Women with only one pregnancy had the lowest anemia rate (40.1%), whereas those with seven or more pregnancies exhibited the highest rate of anemia (56.3%). This trend shows a clear dose-response relationship between increasing gravidity and higher anemia prevalence, reinforcing the physiological burden that repeated pregnancies may impose on maternal iron stores. Gravidity emerged as the strongest predictor in the study. In terms of abortion history, the majority of participants (65.6%, n = 1,428) reported no history of abortion, while 34.4% (n 750) reported history of abortion.

In the current study, history of abortion did not show a significant association with anemia status ($x^2 = 0.18$, $p > 0.05$). Although anemia was slightly more prevalent among women with 1–2 or 3–4 abortions, the differences were not statistically meaningful. This may suggest that previous abortions alone, in the absence of other risk factors, do not substantially increase anemia risk in this population. These findings of abortion history did not significantly affect anemia status in this model, although biologically, repeated abortions may affect iron status due to blood loss. Our finding is also consistent with reports from the Trinidad and Tobago study [29]. Overall, the study analysis identifies gravidity, specifically being in the first pregnancy, as the only statistically significant protective factor against anemia. Other variables such as age, employment status, residence, and abortion history did not significantly influence anemia risk in this sample. From a medical standpoint, these findings underscore the importance of reproductive history—especially repeated pregnancies—in understanding and addressing anemia in pregnancy

Conclusion

The results of this study highlight prevalence and associated risk factors for anemia amongst pregnant women attending. Important details regarding anemia and relate risk factors of anemia have been supplied by the study, which might aid in the formulation of prevention plans and policy. Lastly, the results offer epidemiological insight into the range of anemia. This is essential for directing ongoing health education and awareness campaigns about the consequences of anemia and the significance of preventing and lowering the risk of anemia during pregnancy. Overall, these findings emphasize that anemia in pregnancy is a common concern, particularly in its mild form, and underline the need for effective screening, nutritional support, and antenatal care strategies to mitigate its impact

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Strengths and limitations of the study

The study's strengths were that the diagnosis of anemia was based on the clinical diagnosis of anemia in pregnant women in a hospital setting involves a combination of patient history, physical examination, and laboratory investigations. This study serves as a benchmark for further research into the role of other factors that may contribute to understanding anemia in pregnancy. The study's explanatory power was limited, suggesting that other unmeasured factors, such as diet, socioeconomic status, and iron supplementation, may play a more significant role. In addition, the study was a hospital-based study, so results could only be generalized to Tobruk city and not all pregnant women in the population and the study design was cross-sectional, so it was impossible to identify and establish cause and effect relationships. Further research is needed to explore these additional factors and their impact on maternal anemia.

Conflict of Interests

Authors declare no conflict of interests.

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