Factors influencing hemoglobin levels in pregnant women: a cross-sectional study in Iraq

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Abstract

Background: Anemia remains a significant global health challenge, prompting the need for collaborative interventions.

Objectives: This study aims to evaluate factors associated with anemia among pregnant women in Iraq.

Methods: Conducted from January 1st to March 31st, 2024, a cross-sectional study was conducted at Al-Batool Teaching Hospital's obstetrics and gynecology outpatient clinic in Diyala province, Iraq, using a modified systematic sampling technique. Descriptive statistics and the Chi-square test were employed to discern significant differences between variables, with a P-value < 0.05 indicating significance.

Results: A total of 173 pregnant women, averaging 26.88 years (SD±5.85), participated. Mild to moderate anemia was prevalent in over two-thirds (72.3%), while severe anemia affected 27.7%. Most were in the second trimester (43.4%), with an interpregnancy interval of <2 years (34.7%) and 1-2 children (42.8%). Abortion history was noted in 35.3%, stillbirth in 15.0%, and cesarean section in 61.8%. Furthermore, 81.5% reported nausea and vomiting. Private (ARO) and home-filtered water were primary water sources (34.1% and 31.8%). About 43.4% owned a garden, while 65.9% purchased produce. Most (63.6%) had two daily meals, with 69.9% altering food habits and 59.0% avoiding certain foods, primarily due to maternal obesity. Additionally, 61.3% took iron and folate supplements, and 26.6% consumed coffee. Significant associations were observed, with one daily meal correlating with severe anemia ($\chi 2 = 12.679$, $p = 0.002$), and food avoidance due to maternal obesity linked to severe anemia ($\chi 2 = 9.158$, $p = 0.027$).

Conclusion: Inadequate dietary habits and insufficient nutritional education significantly contribute to severe anemia among pregnant women. Implementing health education and early screening strategies can effectively prevent and control this issue.

Keywords: Anemia, pregnant women, diet, Iraq

Introduction

Anemia occurs when red blood cell count, size, or hemoglobin concentration falls below normal levels, hindering the blood's ability to carry oxygen to tissues and organs [1]. Anemia in pregnancy, defined by the World Health Organization as a hemoglobin level below 11 g/dl, is assessed primarily through hemoglobin concentration measurements [2]. While it doesn't pinpoint the cause, it remains a reliable population-level indicator of anemia [3]. Worldwide, approximately 38% of pregnant women suffer from anemia, with the majority found in developing nations [3]. This condition, characterized by low hemoglobin levels, poses significant risks including premature delivery, low birth weight, and heightened maternal and newborn mortality rates [4,5].

Iron deficiency anemia, constituting over 50% of all anemia cases in women, arises from prolonged negative iron balance due to poor gut absorption or insufficient dietary iron intake. Increased iron demand during pregnancy or growth periods, along with heightened iron loss, further contribute to its prevalence. [Sources: 3, 6]. Iron plays a pivotal role in fundamental cellular and organismal metabolic processes, encompassing respiration, energy production, DNA synthesis, and cell proliferation. [7]

Reduced hemoglobin levels in pregnancy disrupt placental angiogenesis, limiting fetal oxygen supply and leading to fetal growth restriction and low birth weight [8]. Studies indicate a U-shaped relationship between maternal hemoglobin levels and adverse birth outcomes, though the association differs across trimesters [9].

Research suggests that both low and high hemoglobin levels during pregnancy correlate with adverse birth outcomes. Ensuring sufficient iron supply during pregnancy is crucial for mitigating these risks [10].
Research indicates a stronger association between low maternal hemoglobin levels and adverse birth outcomes when measured in the first trimester. Conversely, high hemoglobin levels are linked to adverse outcomes throughout all three trimesters of pregnancy. [9]. To mitigate this risk, WHO advocates for routine antenatal care, including daily oral supplements of 30-60 mg elemental iron and 0.4 mg folic acid throughout pregnancy [11]. Research has shown that enhancing maternal hemoglobin levels during pregnancy can lower the risk of maternal mortality and morbidity due to postpartum hemorrhage [4].

In response to these concerns, the Ethiopian Federal Government introduced national nutrition packages aimed at addressing micronutrient deficiencies among pregnant women. These packages include routine nutritional counseling and supplements such as deworming, insecticide-treated nets, and iron-folic acid supplements during perinatal care [12]

Despite significant efforts to combat anemia, the 2016 Ethiopia Demographic Health Survey revealed that 29% of pregnant women and 24% of women of reproductive age remained anemic [13]. To achieve the second global nutrition target of reducing anemia by 50% among reproductive-age women by 2025, it is essential to implement tailored programs and strategies addressing specific causes and prevalence rates of anemia in different regions and population groups [1, 6].

Limited data exists regarding the hemoglobin levels of pregnant women in low-income nations such as Iraq, particularly in rural areas like Diyala province. This study aims to evaluate hemoglobin levels and related

factors among pregnant women in Diyala's rural communities.

Methods

Study Design

From January 1st to March 31st, 2024, a cross-sectional study took place at the Al-Batool Teaching Hospital's obstetrics and gynaecology outpatient clinic in Diyala province, Iraq. Using a modified systematic sampling technique, pregnant women attending antenatal visits were selected. Data collection involved direct interviews with interviewer-administered structured questionnaire, with each interview lasting approximately 10 minutes. An additional 30 minutes was allocated for the next attending mother to participate in the study, ensuring efficient data collection from consecutive attendees. This approach allowed for a comprehensive understanding of factors related to pregnancy and antenatal care within the hospital setting.

Inclusion and Exclusion Criteria

The study included all confirmed pregnant women regularly attending the outpatient clinic who were willing to participate. Exclusions comprised those unwilling to participate, non-pregnant individuals, and those with urgent medical conditions.

Sample Size

Previous research conducted in Iraq by Hussien et al. [12] indicated that prevalence of anaemia among pregnant women was 48.6%. Utilizing a margin of error of ±6%, a confidence level of 90%, and a non-response correction factor of 10%, the sample size calculator determined that a sample size of 206 (187+10% non-response rate) was necessary, as per the specified formula: N= [Za2 x P XQ/(M.E.)2].

Hemoglobin Level

Hemoglobin Level was obtained from the hemoglobin estimation test, which was frequently done for each pregnant woman to estimate anemia. Hemoglobin levels below 11 g/dL were indicative of anemia. 8 Severity was categorized as mild (10-10.9 g/dL), moderate (8-9.9 g/dL), or severe (less than g/dL). These measurements aided in diagnosing and classifying the severity of anemia among pregnant women. Cases with hemoglobin levels more than 8 g/dL categorized as mild to moderate anemia, while those with hemoglobin level of 8 g/Dl and below were considered as severe anemia.

Study tool

Data was collected using a semi-structured questionnaire comprising three sections. The first section covered sociodemographic variables like age, residence, maternal education, occupation, family size, husband’s occupation, and monthly income. The second section focused on obstetrics and pregnancy-related characteristics, including gestational age, age at first pregnancy, interpregnancy interval, parity, history of abortion, stillbirth, cesarean section, and nausea/vomiting. The third section addressed dietary practices, including fruit/vegetable cultivation, consumption habits, dietary changes during pregnancy, food avoidance, reasons for avoidance, meal frequency, iron-folate supplementation, coffee consumption, and tobacco use. This comprehensive questionnaire facilitated the collection of diverse information related to the study's objectives, encompassing sociodemographic, obstetric, and dietary factors among pregnant women.

Pilot-test
The questionnaire was initially drafted in English and then translated into Arabic by bilingual individuals. To ensure accuracy, it was translated back into English by a third-party expert. A pilot test involving ten women not part of the study was conducted to validate the questionnaire's comprehensibility and clarity.

Ethical Consideration
Ethical clearance was secured from the College of Medicine, University of Diyala, Iraq. Authorization letters were obtained from the Diyala Directorate of Health and Al-Batool Teaching Hospital to access the outpatient clinic consultations in obstetrics and gynecology department.

Statistical analysis
Descriptive statistics, including mean, frequency, percentages, and standard deviations, were utilized to characterize the study subjects. Chi square test was recruited to identify the significant difference between variables. Variables with a P value < 0.05 for significance of variables.

Results
A total of 173 pregnant women participated in the study, yielding an 84.0% response rate. Their mean age was 26.88 years (SD±5.85, range 18-43 years), with over half residing in urban areas (55.5%). Approximately 34.7% had received an elementary education. The majority came from families with less than seven members (96.5%). Most mothers (72.3%) were unemployed, while 57.2% of fathers were employed. Additionally, 54.3% of families had a monthly income of less than 60,000 IQD. More than two-third (125,72.3%) were mild to moderate anemia, compare to 48 (27.7%) were severe anemia.

None of the sociodemographic and economic factors variables have significant association with severity of anemia. These findings are summarized in Table 1.

Table 1: Sociodemographic and economic factors of pregnant women (n=173)

Variable	Categories	Total N (%)	Mild to moderate N (%)	Severe N (%)	Chi	p-value
Age: mean (SD)	26.88 (5.85)	Range 18-43 Years				
Residency	Rural	77 (44.5)	58 (75.3)	19 (24.7)	0.652	0.495
	Urban	96 (55.5)	67 (69.8)	29 (30.2)		
Mother's education	Unable to read and write	22 (12.7)	16 (72.7)	6 (27.3)	1.899	0.594
	Elementary grade	60 (34.7)	47 (78.3)	13 (21.7)		
	High grade	43 (24.9)	29 (67.4)	14 (32.6)		
	College and above	48 (27.7)	33 (68.8)	15 (31.2)		
Family size	7 and more	6 (3.5)	5 (83.3)	1 (16.7)	0.381	0.537
	< 7	167 (96.5)	120 (71.9)	47 (28.1)		
Mother's employment	Unemployed	125 (72.3)	97 (77.6)	28 (22.4)	6.422	0.011
	Employed	48 (27.7)	28 (58.3)	20 (41.7)		

Father's employment	Unemployed	74 (42.8)	59 (79.7)	15 (20.3)	3.605	0.058
	Employed	99 (57.2)	66 (66.7)	33 (33.3)		
Family monthly income	> 600000 IQD	79 (45.7)	52 (65.8)	27 (34.2)	3.000	0.083
	< 599000 IQD	94 (54.3)	73 (77.7)	21 (22.3)		

The majority of pregnant women were in the second trimester (43.4%), with an interpregnancy interval of less than two years (34.7%), and had 1-2 children (42.8%). Abortion history was reported by 35.3%, stillbirth by 15.0%, and cesarean section history by 61.8%. Additionally, 81.5% reported a history of nausea and vomiting. However, none of the obstetrics and pregnancy-related variables showed a significant association with the severity of anemia (Table 2)

Table 2: Obstetrics and pregnancy-related characteristics of pregnant women (n=173)

Variable	Categories	Total N (%)	Mild to moderate N (%)	Severe N (%)	Chi	p-value
Gestational age	First trimester	44 (25.4)	32 (72.7)	12 (27.3)	0.188	0.910
	Second trimester	75 (43.4)	53 (70.7)	22 (29.3)		
	Third trimester	54 (31.2)	40 (74.1)	14 (25.9)		
Inter pregnancy interval	Two years and more	34 (19.7)	26 (76.5)	8 (23.5)	0.375	0.540
	Less than two years	139 (34.7)	99 (71.2)	40 (28.8)		
Parity	Primi para	47 (27.2)	30 (63.8)	17 (36.2)	4.920	0.187
	1-2 children	74 (42.8)	57 (77.0)	17 (23.0)		
	3-4 children	36 (20.8)	24 (66.7)	12 (33.3)		
	5 and more	16 (9.2)	14 (87.5)	2 (12.5)		
History of abortion	No	112 (64.7)	83 (74.1)	29 (25.9)	0.544	0.461
	Yes	61 (35.3)	42 (68.9)	19 (31.1)		
History of stillbirth	No	147 (85.0)	105 (71.4)	42 (28.6)	0.333	0.564
	Yes	26 (15.0)	20 (76.9)	6 (23.1)		
History of cesarean section	No	66 (38.2)	46 (69.7)	20 (30.3)	0.348	0.555
	Yes	107 (61.8)	79 (73.8)	28 (26.2)		
History of nausea and vomiting	No	32(18.5)	22 (68.8)	10 (31.2)	0.241	0.624
	Yes	141 (81.5)	103 (73.0)	38 (27.0)		

The primary sources of drinking water were private (ARO) and filtered water at home, accounting for 34.1% and 31.8%, respectively. While 43.4% reported owning a garden of fruits or vegetables, 65.9% purchased all their produce. Most (63.6%) had two meals daily, with 69.9% altering food habits during pregnancy, and 59.0% avoiding certain foods, mainly due to maternal obesity. Additionally, 61.3% took iron and folate supplements, and 26.6% consumed coffee. Significant associations emerged between specific variables and anaemia severity. Notably, having one meal per day correlated significantly with severe anaemia ($\chi 2$ =

12.679, p = 0.002). Similarly, food avoidance due to maternal obesity was significantly linked to severe anaemia ($\chi 2$ = 9.158, p = 0.027). These findings are summarized in Table 3.

Table 3: The dietary practices of pregnant women (n=173)

Variable	Categories	Total	Mild to moderate	Severe	Chi	p-value
Drinking water	Pipe water	10 (5.8)	5 (50.0)	5 (50.0)	0.188	0.910
	Private (ARO)	59 (34.1)	49 (83.1)	10 (16.9)		
	Filtered water (bottled)	45 (26.0)	24 (53.3)	21 (46.7)		
	Filtered water (at home)	55 (31.8)	44 (80.0)	11 (20.0)		
	River	3 (2.3)	3 (75.0)	1 (25.0)		
Own fruit/vegetable garden	No	98 (56.6)	67 (68.4)	31 (31.6)	1.704	0.192
	Yes	75 (43.4)	3 (75.0)	1 (25.0)		
Used fruit/vegetable	Sell some	24 (13.9)	25 (80.6)	6 (19.4)	2.511	0.463
	Sell all	4 (2.3)	78 (68.4)	36 (31.6)		
	Consumed all	31 (17.9)	24 (66.7)	12 (33.3)		
	Buy all	114 (65.9)	14 (87.5)	2 (12.5)		
Changed food habit during pregnancy	No	52 (30.1)	37 (71.2)	15 (28.8)	0.445	0.832
	Yes	121 (69.9)	88 (72.7)	33 (27.3)		
Avoid food during pregnancy	No	71 (41.0)	51 (71.8)	20 (28.2)	0.011	0.917
	Yes	102 (59.0)	74 (72.5)	28 (27.5)		
How many meals per day	One time	7 (4.0)	1 (14.3)	6 (85.7)	12.679	0.002
	Two times	110 (63.6)	84 (76.4)	26 (23.6)		
	Three times	56 (32.4)	40 (71.4)	16 (28.6)		
Reason for food avoidance	Big baby	35 (20.8)	24 (68.6)	11 (31.4)	9.158	0.027
	Maternal obesity	75 (43.4)	49 (65.3)	26 (34.7)		
	Discolor the fetus	3 (1.7)	1 (33.3)	2 (66.7)		
	Difficult labor	60 (34.7)	51 (85.0)	9 (15.0)		
Iron and folate supplementation	No	67 (38.7)	53 (78.1)	14 (20.9)	2.560	0.110
	Yes	106 (61.3)	72 (67.9)	34 (32.1)		
Coffee consumption	No	127 (73.4)	94 (74.0)	33 (26.0)	0.739	0.390
	Yes	46 (26.6)	31 (67.4)	15 (32.6)		

Discussion

This study found that 72.3% of pregnant women had mild to moderate anemia, while 27.7% had severe anemia. The prevalence of anemia with hemoglobin levels below 8 gm/dl was higher than the WHO estimate [1], indicating a significant health concern. Across Diyala province, anemia prevalence and hemoglobin levels were consistent, highlighting a widespread issue. This high prevalence underscores the severity of the public health problem, emphasizing the urgent need for intervention to mitigate its impact on community health. The study uncovered a higher percentage of mild to moderate anemia (8-10.9 gm/dl) compared to mild cases, possibly indicating chronicity and worsening over time. This finding contrasts with studies from various countries where mild anemia predominated [2,3]. However, it aligns with previous research in Iraq by Khalil [4] and Ashraf et al. [5], suggesting challenges in the healthcare system's ability to effectively diagnose, treat, and monitor anemia. Furthermore, this variation may stem from differences in methodology and sample sizes. Moderate anemia was predominant among the majority of pregnant women, consistent with findings from Pakistan, India, and Algeria (33%, 50.4% and 49.5%), respectively [6,7,8]. Additionally, discrepancies in anemia prevalence might be attributed to variations in the use of hematinic among different populations. This discrepancy underscores the importance of early intervention and highlights potential shortcomings in addressing anemia in the region. The study revealed significant associations between anemia and certain factors. Having only one meal per day was significantly correlated with severe anemia, similar to findings in the Ahmed and Mohammed-Ali study [9]. Additionally, food avoidance due to maternal obesity was linked to severe anemia. Surprisingly, urban residence and higher education level did not improve the condition, contrary to expectations. Unemployment was associated with higher rates of anemia, consistent with previous studies [10,11]. These findings highlight the limited impact of health messages and antenatal care services. Anemia remains a significant public health challenge in Iraq, requiring intensified efforts from the government to address it through targeted health education and improved access to antenatal care services.

This study investigated various sociodemographic, obstetric, and dietary factors potentially linked to women's hemoglobin levels. Further research is recommended to explore the relationships among these variables. Limitations include reliance on self-reported data from mothers, which may be influenced by social desirability and recall biases. Additionally, certain predictors of anemia, such as micronutrient deficiencies and parasitic or malarial infections, were not assessed due to feasibility constraints. These limitations underscore the need for caution when interpreting the study findings and highlight areas for future investigation.

Conclusion and recommendation

Anemia emerged as a moderate public health concern in the study locale. Notably, having just one meal per day was significantly associated with severe anemia, as was food avoidance due to maternal obesity. These findings underscore the importance of nutritional interventions, emphasizing the need for additional meals, encouraging fruit and vegetable intake, maternal health education and enhancing the overall nutritional status of pregnant women through comprehensive care during antenatal follow-up. Such strategies can play a pivotal role in mitigating the prevalence and severity of anemia among pregnant women in the community.