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Prevalence of iron deficiency anemia and associated factors among pregnant women attending health centers in Torbat Heydariyeh City: Relationship with pregnancy outcomes

Mobina Mahdizade[1], Mahdi Bakhtiyari-dovvombaygi[1], Mahin Kiyani-Mask[2], Somaye Barzanouni[3], Faeze Khodadadi[4*]

[1] Student Research Committee, Torbat Heydariyeh University of Medical Sciences, Torbat Heydariyeh, Iran
[2] Department of Midwifery, Torbat Jam Faculty of Medical Sciences, Torbat Jam, Iran
[3] Vice Chancellery of Education and Research, Torbat Heydariyeh University of Medical Sciences, Torbat Heydariyeh, Iran
[4] Imam Hossein Educational Hospital, Torbat Heydariyeh University of Medical Sciences, Torbat Heydariyeh, Iran

***Corresponding Author Email: faeze_khodadadi@yahoo.com**
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Abstract

Iron deficiency anemia (IDA) remains a major public health concern during pregnancy and is associated with adverse maternal and neonatal outcomes. The prevalence and determinants of IDA vary across regions due to socioeconomic and nutritional differences. This study aimed to determine the prevalence of IDA and its associated factors among pregnant women and to assess its relationship with pregnancy outcomes in Torbat Heydariyeh, Iran.

This descriptive–analytical cross-sectional study was conducted between 2020 and 2021 among 189 pregnant women attending health centers for routine antenatal care. Data were collected using a structured questionnaire including demographic, obstetric, and nutritional variables. Hematological parameters (hemoglobin and serum ferritin) were measured using standard laboratory methods. Anemia was defined according to World Health Organization criteria, and iron deficiency anemia was diagnosed based on reduced hemoglobin and serum ferritin levels. Statistical analysis was performed using SPSS version 21, applying independent t-tests, chi-square tests, and correlation analyses. A p-value <0.05 was considered statistically significant.

The prevalence of iron deficiency anemia among participants was 15%. A significant inverse association was observed between maternal body mass index (BMI) and weight with the prevalence of anemia ($p < 0.05$), indicating that women with lower BMI and body weight were at higher risk. No statistically significant relationships were found between anemia and maternal age, parity, history of miscarriage, or educational level ($p > 0.05$). Nutritional status emerged as a stronger determinant of anemia than demographic characteristics.

Iron deficiency anemia affected a considerable proportion of pregnant women in the study population. Low maternal weight and BMI were the primary factors associated with anemia, whereas demographic variables showed no significant influence. These findings highlight the importance of targeted screening and nutritional counseling for underweight pregnant women. Future longitudinal studies incorporating dietary patterns and socioeconomic factors are recommended to improve preventive strategies against anemia during pregnancy.

Keywords: Iron deficiency anemia; Pregnancy; Anemia

Introduction

Anemia during pregnancy is a major global health concern affecting a substantial proportion of women worldwide, with a reported prevalence of 30% among women of reproductive age (1). Iron is an essential micronutrient during pregnancy because of its critical role in supporting blood volume expansion and oxygen transport required for both the mother and the developing fetus (2). During pregnancy and lactation, women require approximately 1,000 mg of additional iron. The recommended daily intake increases from 8 mg in non-pregnant women to 27 mg during pregnancy (3).

The World Health Organization (WHO) classifies anemia in pregnant women into four categories based on prevalence and its impact on public health: a prevalence below 5% is considered of no public health significance; 5–19% indicates a mild public health problem; 20–39% reflects a moderate concern; and 40% or higher represents a severe public health crisis (4). Iron deficiency anemia (IDA) is the most common type of anemia during pregnancy and is associated with numerous adverse maternal and neonatal outcomes (5). The WHO estimates that 50% of anemia cases observed during pregnancy are attributable to iron deficiency. It defines anemia in pregnancy as a condition characterized by a reduced number of red blood cells (RBCs) or low hemoglobin concentration. Hemoglobin levels below 11 g/dL in the first trimester, below 10.5 g/dL in the second trimester, and below 11 g/dL in the third trimester are considered diagnostic. The WHO further categorizes anemia by severity into mild anemia (hemoglobin 9–10.9 g/dL), moderate anemia (hemoglobin 7–8.9 g/dL), and severe anemia (hemoglobin <7 g/dL) (6).

Evidence indicates that anemia during pregnancy increases the risk of complications such as hypertension, preeclampsia, premature rupture of membranes, postpartum hemorrhage, and postpartum infection (7). Also, infants born to anemic mothers are up to 50% more likely to develop anemia during childhood (8), which may increase the risk of preterm birth, low birth weight, and perinatal mortality (9,10). These associations may vary according to the severity of anemia; however, they remain highly relevant for the design of preventive interventions.

The etiology of anemia during pregnancy is multifactorial, with iron deficiency representing the most prevalent cause globally (11). Deficiencies of vitamin A, folate, vitamin B12, and riboflavin may also contribute because of their roles in hemoglobin synthesis and erythropoiesis (6). Exposure to heavy metals such as lead through contaminated water is another risk factor for IDA (12). Other important causes include chronic and parasitic infections, acute or chronic blood loss, and inherited hemoglobin disorders such as thalassemia and sickle cell anemia, all of which are associated with increased maternal and fetal complications (13).

Anemia in pregnancy results from a combination of nutritional, infectious, and social determinants. Iron and folate deficiencies, low dietary diversity, young maternal age, limited education, short interpregnancy intervals, and inadequate access to antenatal care all increase the risk of anemia and underscore the importance of nutritional and health interventions (14). Despite the implementation of antenatal care programs in Iran, the prevalence of IDA remains considerable, and studies conducted in different regions of the country demonstrate substantial variation. Research in Iran has identified several risk factors, including low socioeconomic status, limited educational attainment, short birth intervals, multiparity, low body mass index (BMI), inappropriate maternal age, and insufficient intake of iron and folic acid supplements (15).

Although this issue is of significant importance, the prevalence and underlying factors of anemia vary across regions due to cultural and geographical differences. Torbat Heydariyeh, one of the major population centers in Razavi Khorasan Province, lacks sufficient and reliable data regarding the prevalence and determinants of anemia among pregnan t women. Updated and region-specific evidence is therefore essential to inform localized health planning. Accordingly, this

study was conducted to determine the prevalence of IDA and its associated factors among pregnant women attending health centers in Torbat Heydariyeh during 2020–2021 and to evaluate its relationship with pregnancy outcomes.

Methods

This descriptive–analytical cross-sectional study was conducted to determine the prevalence of IDA, its associated factors, and its relationship with pregnancy outcomes. The study population consisted of pregnant women who attended the laboratory of the Torbat Heydariyeh Health Center, Razavi Khorasan Province, Iran, for routine third-trimester testing during 2020–2021.

Based on statistical sample size calculation using a 95% confidence level ($\alpha = 0.05$), 90% statistical power ($\beta = 0.2$), and an estimated prevalence of 18.9% derived from previous studies, the final sample size was determined to be 200 participants (16). Participants were recruited through convenience sampling after providing informed consent.

Inclusion criteria comprised pregnant women aged 20–40 years who attended the health center laboratory for routine antenatal tests. Exclusion criteria included blood donation within the previous three months; history of chronic liver or kidney disease; presence of anemia types other than iron deficiency anemia, such as thalassemia or sickle cell anemia; acute or chronic infections; and multiple pregnancies.

Data were collected using a researcher-designed questionnaire containing demographic and obstetric information. Variables included maternal age, height, weight, BMI, educational level, gestational age, parity, history of miscarriage, and neonatal characteristics (birth length, birth weight, and gestational age at delivery).

Venous blood samples were obtained from all participants to assess hematological parameters. Complete blood count (CBC) and hemoglobin (Hb) concentration were measured using an automated cell counter. Serum samples were then separated to determine ferritin concentration using specific assay kits.

According to established standards, anemia was defined as hemoglobin levels <11 g/dL in the first and third trimesters and <10.5 g/dL in the second trimester. Anemia severity was classified into three categories: mild (10–11 g/dL), moderate (7–10 g/dL), and severe (<7 g/dL). Iron deficiency anemia was defined as the presence of anemia accompanied by reduced serum ferritin levels below the standard threshold.

All identified cases of anemia were referred to a physician at the health center for appropriate clinical management.

After data extraction, statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 21. Quantitative variables were described using mean ± standard deviation (Mean ± SD), and qualitative variables were presented as frequency and percentage distributions. The independent samples t-test, chi-square (χ^2) test, and Pearson or Spearman correlation coefficients were applied to assess associations between background variables and anemia prevalence, depending on data distribution normality. A p-value <0.05 was considered statistically significant in all analyses. This article was derived from a research project approved by the Student Research Committee of Torbat Heydariyeh University of Medical Sciences, with the ethics code IR.THUMS.REC.1398.041

Results

This study was conducted during 2020–2021 to determine the prevalence of IDA and its associated factors among 189 pregnant women attending health centers in Torbat Heydariyeh.

Most participants were aged 21–30 years (41.6%). Regarding educational level, the highest proportion had a high school diploma (32.1%), whereas the lowest proportion was illiterate (1.6%). The majority were housewives (85.7%) and resided in rural areas (73.8%) (Table 1).

The mean maternal height and weight were 161.17 ± 7.4 cm and 68.79 ± 12.4 kg, respectively. Approximately 31.1% of participants were experiencing their first

pregnancy. Among women with a previous pregnancy, the interval between the current and prior pregnancy was most commonly 2–5 years (35.7%). A history of miscarriage was reported by 22.7% of participants. Most women (68.5%) reported regular iron supplement intake, whereas 1.6% had never used iron supplements. Regarding tea consumption, 65.1% reported drinking tea one to three times daily, and 85.7% did not consume tea immediately after meals. A history of hypothyroidism was reported in 15.59% of participants (Table 1).

Overall, 27 women (15%) were diagnosed with anemia. Statistical analysis demonstrated a significant association between body mass index (BMI) and maternal weight with anemia prevalence ($P < 0.05$). The mean maternal weight was higher among women without anemia compared with those with mild anemia.

No statistically significant associations were observed between anemia prevalence and maternal age ($P = 0.310$), parity ($P = 0.631$), number of miscarriages ($P = 0.638$), or educational level ($P > 0.05$) (Table 2).

Table 1. Frequency distribution of demographic variables, demographic information, nutritional variables, and history of hypothyroidism in pregnant women participating in the study

Variable		Number (Percentage)
Age	Less than 23 years	51 (27.0)
	24-28 years	50 (26.5)
	29-31 years	37 (19.6)
	Older than 31	51 (27.0)
Education level	Illiterate	3 (1.6)
	Primary school	26 (13.8)
	Guidance school	48 (25.5)
	High school diploma	79 (42.0)
	University degree	32 (17.04)
occupation	Housewife	179 (95.7)
	Self-employed	1 (0.5)
	Employee	7 (3.7)
Monthly household income	Less than 1 million Toman	74 (42.3)
	1–2 million Toman	60 (31.7)
	2–3 million Toman	29 (15.3)
	More than 3 million Toman	12 (6.3)
Place of residence	City	49 (26.2)
	Rural	138 (73.8)
Number of children	First pregnancy	75 (40.1)
	1	67 (35.8)
	2-4	44 (23.5)
	More than 4	1 (0.5)
Interval between previous and current pregnancy	First pregnancy	59 (31.9)
	Less than 1 year	8 (4.3)
	Between 3-4 years	29 (15.7)
	More than 3 years	89 (48.1)
History of miscarriage	Yes	42 (22.7)
	No	143 (77.3)
Parity (number of pregnancy)	1	57 (30.6)
	2	70 (37.6)
	3 and more	59 (31.7)
Type of previous delivery	First pregnancy	66 (35.5)
	Vaginal delivery	74 (39.8)
	Cesarean section	46 (24.7)
Meat consumption	Once daily	10 (5.5)
	Every other day	79 (43.6)
	Once weekly	92 (50.8)
Daily tea consumption	Do not consume	18 (9.7)
	1-3 times	121 (65.4)

	More 3 times	46 (24.9)
Tea consumption immediately after meals	Yes	8 (4.3)
	No	178 (95.7)
Iron supplement intake	Never used	3 (1.6)
	Rarely use	25 (13.4)
	Sometimes use, irregularly	29 (15.5)
	Always use, regularly	130 (69.5)
History of hypothyroidism	Yes	25 (15.53)
	No	136 (84.5)

Table 2. Determining the relationship between BMI, weight, age, number of children, number of miscarriages, and level of education with the prevalence of anemia

Variable	**Mild anemia**	**Normal**	**Significance level**
	Standard deviation ± Mean	**Standard deviation ± Mean**	
BMI	24.9±4.5	37.3±4.8	P= 0.038
Weight	63.48±11.8	70.66±2.3	P= 0.014
Age group	**Number (percentage)**	**Number (percentage)**	
Less than 23 years	8 (29.6)	43 (26.7)	P= 0.394
24-28 years	10 (37.0)	39 (24.2)	
29-31 years	3 (11.1)	34 (21.1)	
Older than 31 years	6 (22.2)	45 (28.0)	
Number of children	**Number (percentage)**	**Number (percentage)**	
First pregnancy	9 (33.3)	66 (41.5)	P= 0.639
1 child	12 (44.4)	55 (34.6)	
2-4 children	6 (22.2)	37 (23.3)	
More than 4 children	0 (0.0)	1 (0.6)	
Number of miscarriages	**Number (percentage)**	**Number (percentage)**	
0	20 (74.1)	123 (78.8)	P= 0.638
1	5 (18.5)	26 (16.7)	
2	2 (7.4)	4 (2.6)	
3	0 (0.0)	2 (1.3)	
6	0 (0.0)	1 (0.6)	
Education level	**Mild anemia**	**Normal**	
University degree	0 (0.0)	3 (1.9)	p>0.99
Illiterate	2 (7.4)	24 (15.0)	
Primary school	11 (40.7)	37 (23.1)	
Guidance school	13 (48.1)	65 (40.6)	
High school diploma	1 (3.7)	31 (19.4)	

Discussion

The present study was conducted to determine the prevalence of IDA and selected associated factors among pregnant women attending healthcare centers in Torbat Heydariyeh. The principal finding indicated a statistically significant association between BMI and maternal weight with the prevalence of IDA. In contrast, variables such as maternal age, parity, and educational level were not significantly associated with anemia.

The prevalence of IDA in the study population was 15%. This rate warrants consideration in comparison with national and regional estimates. A recent comprehensive review in Iran reported a mean prevalence of 15.7% among pregnant women, with a higher rate of 17.8% in eastern regions of the country (17). Another study conducted in Shirvan, located in northeastern Iran, reported a prevalence of 16% during the third trimester (18). These comparisons indicate that the prevalence observed in our study is largely consistent with both national and regional

averages, which may reflect the specific health and nutritional conditions of the area under investigation.

One of the most important findings of this study was the significant inverse association between maternal weight and BMI with anemia, indicating that women with lower body weight experienced a higher prevalence of anemia. This observation is consistent with physiological principles linking inadequate nutritional reserves to an increased risk of anemia. In contrast, the absence of a significant association between educational level and anemia in our study is in agreement with findings reported in other regions of Iran, including Mashhad (19) and Hormozgan (20). This consistency may suggest the relative effectiveness of antenatal care programs in providing health education and supplement distribution across different educational levels.

Another notable finding was the lack of a statistically significant association between parity and anemia. This result differs from several earlier studies that identified high parity as a risk factor for anemia (21).

The findings of this study have important clinical implications. Emphasizing maternal nutritional status, particularly BMI and weight, as key risk indicators highlights the importance of targeted screening and nutritional counseling for women who begin pregnancy with low body weight. Healthcare providers may use these simple indicators to identify high-risk individuals and implement more effective preventive strategies.

Despite these findings, certain limitations should be acknowledged. The cross-sectional design does not permit causal inference between the studied variables. In addition, convenience sampling may limit the generalizability of the results to the broader population of pregnant women in the region. Some variables, including regular supplement intake, were collected through self-report and may therefore be subject to recall bias. Furthermore, potential confounding factors such as detailed socioeconomic status, specific dietary patterns, and parasitic infections, which may influence iron status (19), were not assessed in this study.

Conclusion

Overall, this study demonstrated that among pregnant women in Torbat Heydariyeh, nutritional indicators such as low maternal weight and low BMI were more strongly associated with the risk of IDA than demographic factors.

In light of these findings and the stated limitations, longitudinal studies are recommended to clarify potential causal relationships between risk factors and the development of anemia throughout pregnancy. Future research should incorporate additional variables, including dietary patterns, socioeconomic status, and underlying infections, into analytical models. Furthermore, investigations evaluating actual adherence to supplement intake and the effectiveness of current educational programs are warranted, as available evidence suggests that routine supplement use may not always be sufficient for the prevention of anemia.

Acknowledgments

This article was derived from a research project approved by the Student Research Committee of Torbat Heydariyeh University of Medical Sciences, with the ethics code IR.THUMS.REC.1398.041.

Declaration

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