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Prevalence and Risk Factors of Anemia, Iron Deficiency in Pregnant Women Seeking Care at The Center for Disease Control in Dong Nai Province, Vietnam

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ABSTRACT

Background: Iron-deficiency anemia (IDA) remains a significant public health issue among pregnant women, contributing to adverse maternal and neonatal outcomes. Despite national iron supplementation programs, anemia persists as a prevalent condition in Vietnam, particularly in underserved areas. This study aims to assess the prevalence and associated risk factors of anemia and iron deficiency among pregnant women attending the Center for Disease Control in Dong Nai Province, Vietnam.

Methods: A crosssectional descriptive study was conducted on 320 pregnant women in their first trimester attending prenatal care at the Dong Nai Center for Disease Control.

Result: The findings revealed that the prevalence of anemia, iron deficiency, and iron-deficiency anemia were 18.12%, 13.44%, and 11.25%, respectively. Significant risk factors for anemia included severe pregnancy nausea ($p < 0.001$), inadequate dietary diversity ($p < 0.001$), and lack of early iron supplementation ($p = 0.038$). However, no statistically significant correlation was found between anemia and BMI, educational level, socioeconomic status, or maternal age.

Conclusion: Anemia and iron deficiency remain prevalent in early pregnancy. Early prenatal screening and nutritional interventions, including iron supplementation and dietary modifications, are essential to reduce the burden of IDA.

Keywords: *Iron-deficiency anemia, pregnancy, hemoglobin, ferritin*

1. INTRODUCTION

Anemia is a condition characterized by reduced hemoglobin concentration and red blood cell count, leading to oxygen deficiency in body tissues. Iron-deficiency anemia (IDA) occurs when red blood cell production is impaired due to insufficient iron levels [1].

Iron-deficiency anemia is one of the most prevalent health issues worldwide, particularly among women of reproductive age, pregnant women, and young children [2]. It is a major global public health concern, influenced by nutritional deficiencies, chronic infections, and blood loss [3], [4]. Alarmingly, at least half of all pregnant women in middle and low-income countries suffer from this condition. Contributing to this high prevalence are various factors such as inadequate dietary intake, hemoglobin disorders, and infections like HIV, malaria, and parasitic infestations [4], [5]. Postpartum fatigue

is a prevalent issue among new mothers, with research indicating that hormonal changes, nutritional deficiencies, and physical stress contribute to increased exhaustion in the postpartum period [6]. Given that iron plays a crucial role in oxygen transport and energy metabolism, iron-deficiency anemia during pregnancy may further exacerbate postpartum fatigue, delaying maternal recovery and impairing overall well-being [6].

According to statistics from the World Health Organization, Vietnam ranks among countries with a high prevalence of anemia in pregnant women, particularly severe anemia, with iron-deficiency anemia being a significant contributing factor [5]. Despite the nationwide implementation of iron supplementation programs during pregnancy, data from 2008 from the Institute of Nutrition revealed a persistently high prevalence of iron-deficiency anemia in pregnant women, accounting for 31.4%. Notably, the mountainous regions in the North, Northwest, and Coastal provinces in Central Vietnam reported severe anemia rates of 45.7% and 44.1%, respectively, while the Southeast region had the lowest rate at 24% [7].

To improve maternal and infant health and achieve the goals of the Safe Motherhood Initiative, we conducted this study to assess iron-deficiency anemia prevalence and risk factors in pregnant women in Dong Nai province.

2. MATERIALS AND METHODS

2.1. Study Design and Population

Study design: Cross-sectional descriptive study.

Study population: All pregnant women in their first trimester attending prenatal care at the Dong Nai Center for Disease Control between July 2022 and April 2023.

2.2. Methods

Inclusion Criteria:

Pregnant women with a gestational age less than 14 weeks, calculated from the last menstrual period with a regular menstrual cycle of 28-30 days or determined by ultrasound, and who consent to participate in the study.

Exclusion Criteria:

Pre-existing chronic conditions (e.g., heart disease, liver disease, kidney disease, diabetes, cancer, tuberculosis).

Acute infections (e.g., malaria, HIV, severe bacterial infections).

Genetic hemolytic disorders (e.g., thalassemia).

Pregnancy complications (e.g., vaginal bleeding, ruptured membranes, fetal abnormalities). ***Diagnostic Criteria***

Anemia: Hb < 11 g/dL

Iron deficiency: Serum ferritin < 12 ng/mL Anemia severity:

Mild: Hb 10-10.9 g/dL Moderate: Hb 7-9.9 g/dL Severe: Hb < 7 g/dL.

Sample Size Calculation: Estimated prevalence of IDA: 17.6% (based on a 2012 study in Thai Nguyen, Vietnam) [8].

Sample size: 320 pregnant women.

Sampling Methodology: Convenience sampling will be employed, selecting all pregnant women attending antenatal care who meet the sampling criteria from July 2022 to April 2023.

Data collection was conducted utilizing an interviewer-administered structured questionnaire, complemented by physical examinations and laboratory investigations. The questionnaire, derived from previous similar studies, was tailored to suit the local context. Initially prepared in English, it was then translated into the local language (Vietnamese) and subsequently back-translated to English to ensure consistency.

The questionnaire encompassed various domains, including socio-demographic factors, obstetricrelated variables, and factors pertinent to anemia. Four diploma nurses were tasked with data collection, under the supervision of two designated supervisors. Interviews were conducted upon the participants' exit from the service.

The subjects underwent prenatal examinations and ultrasounds to record the pregnancy status and gestational age. Additionally, the obstetric history of the pregnant women was documented, including the number of pregnancies, deliveries, miscarriages, current living children, the time interval between the most recent delivery and the current pregnancy, and iron supplementation practices.

A 2 ml venous blood sample was collected for a complete blood count test and quantification of serum ferritin levels. Diagnosis of anemia and iron deficiency was made based on the criteria set by the World Health Organization and the American College of Obstetricians and Gynecologists. Anemia was diagnosed when the Hb concentration was <11 g/dL, and iron deficiency was diagnosed when the Ferritin concentration was <12 ng/mL.

Stringent measures were implemented to ensure data quality, including a two-day training session for both data collectors and supervisors, pretesting of data collection tools on a subset comprising 5% of the sample, and meticulous supervision throughout the data collection process.

Methods of Data Processing and Analysis:

The collected data were coded and entered EpiData version 3.1, subsequently exported to SPSS version 20.0 for analysis. Descriptive statistics were computed to determine frequencies and percentages. Binary logistic regression analysis was performed, and crude odds ratios (COR) with 95% confidence intervals (CI) were calculated to identify candidate variables for inclusion in the final model.

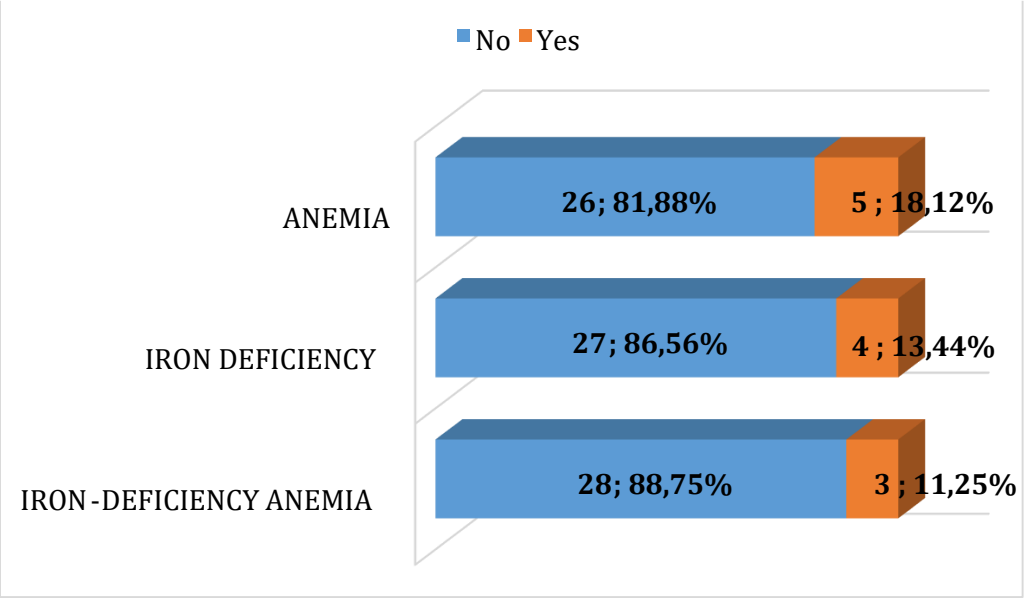
Variables with a p-value of < 0.25 in the binary logistic regression analysis were selected for inclusion in the multivariable logistic regression model to control for potential confounders. Adjusted odds ratios (AOR) with 95% CI were then estimated to assess the presence of associations in the multivariable logistic regression analysis.

Finally, variables with a p-value of < 0.05 in the multivariable logistic regression analysis were deemed statistically significant predictors of maternal anemia.

3. RESULTS

3.1. Prevalence of Iron-Deficiency Anemia in Pregnancy

Graph 1. Prevalence of Anemia and Iron-Deficiency Anemia



In the first trimester of pregnancy: the anemia rate is 18.12%, the iron deficiency rate is 13.44%, and the combined rate of anemia and iron deficiency is 11.25%. Of these, 79.31% have mild anemia, 20.31% have moderate anemia, with no cases of severe anemia as discuss on Graph 1 and Table 1.

Table 1. Distribution of anemia rates based on Hemoglobin concentration

Hemoglobin (g/dl)	**n**	**%**
Mild anemia	46	79,31
Moderate anemia	12	20,69
Server anemia	0	0,00
Total	**58**	**100,00**

3.2. Analysis of Correlated Factors

We did not find a correlation between sociodemographic characteristics and iron-deficiency anemia in the study. In Table 2, several risk factors have been included in the analysis, including: age, educational level, occupation, residential area and financial situation.

Table 2. The association between iron-deficiency anemia and certain demographic factors

Related Factors	**Iron-deficiency anemia**				**p**
	Yes		**None**		
	n	**%**	**n**	**%**	
Age	32,44 ± 6,20		30,72 ± 6,16		0,114
< 20	1	16,67	5	83,33	0,735
20 – 34 □ 35	24	10,43	206	89,57	
	11	13,10	73	86,90	
Educational level					0,866
□ Primary Education	7	12,50	49	87,50	
Secondary Education	26	11,30	204	88,70	
College-University-Postgraduate Education	3	8,82	31	91,18	
Occupation					0,154
Household	7	7,07	92	92,93	
Manual Labor Intellectual Labor	22	14,77	127	85,23	
	7	9,72	65	90,28	
Residential Area					0,595
Rural Area Urban Area	32	10,96	260	89,04	
	4	14,29	24	85,71	
Financial Situation					0,965
Poverty	5	12,50	35	87,50	
Adequate Nutrition Moderate	29	11,07	233	88,93	
	2	11,11	16	88,89	

In Table 3, some pregnancy factors included in the analysis are gestational age, number of deliveries, number of miscariages abortions,multiple pregnancy, abnormal uterine bleeding before pregnancy, however, we did not find a correlation between these factors and iron-deficiency anemia.

Table 3. The correlation between overall iron-deficiency anemia and obstetric characteristics

Related Factors	**Iron-deficiency anemia**				**p**
	Yes		**None**		
	n	**%**	**n**	**%**	
Gestation age	8,51 ± 2,94		7,90 ± 2,72		0,209

< 8 weeks 8 – < 12 weeks □ 12 weeks	18 9 9	9,63 13,04 14,06	169 60 55	90,37 86,96 85,94	0,542
Number of deliveries □ 1 □ 2	 20 16	 9,13 15,84	 199 85	 90,87 84,16	0,078
Number of miscarriages, abortions None □ 1	 26 10	 10,74 12,82	 216 68	 89,26 87,18	0,614
Multiple pregnancies None Yes	 35 1	 11,44 7,14	 271 13	 88,56 92,86	0,619
Abnormal uterine bleeding before pregnancy None Yes	 31 5	 10,76 15,62	 257 27	 89,24 84,38	0,409

The rate of non-nausea pregnant women is 7.83%, while those experiencing nausea is 15.58%, indicating a significant difference in iron-deficiency anemia status (Table 4.). The data also reveals that 13.88% of pregnant women who consume tea have a significantly lower prevalence of iron-deficiency anemia compared to those who do not consume tea. Furthermore, 8.19% of pregnant women who consume all four food groups exhibit a significantly lower prevalence of iron-deficiency anemia. Lastly, 5.88% of pregnant women who have been taking iron supplements since pregnancy detection show a significantly lower prevalence of iron-deficiency anemia.

Table 4. The correlation between iron-deficiency anemia and nutritional status during pregnancy

Dietary habits	**Iron-deficiency anemia**				**p**
	Yes		**None**		
	n	**%**	**n**	**%**	
Tea None	 7	 6,31	 104	 86,12	0,041
Yes	29	13,88	180	93,69	
Prenatal milk supplement None Yes	 13 23	 11,93 10,90	 216 68	 88,07 89,10	0,783
Iron supplementation None Yes	 30 6	 13,76 5,88	 188 96	 86,24 94,12	0,038

BMI before pregnancy					0,294
< 18,5	6	11,76	45	88,24	
18,5 – 25 ≥ 25	28	12,50	196	87,50	
	2	4,44	43	95,56	
Dietary status					0,556
Less	9	9,09	90	90,91	
Similarly More	16	11,11	128	88,89	
	11	14,29	66	85,71	
Nausea					0,000
Yes	18	20,00	72	80,00	
None	18	7,83	212	92,17	
Nutritional status					0,000
Adequate intake of 4 food groups	23	8,19	258	91,81	
Lacking intake of 4 food groups	13	33,33	26	66,67	

4. DISCUSSION

4.1. Pregnancy Iron-Deficiency Anemia Rates

Our study, which screened 320 pregnant women, reported an anemia prevalence of 18.12%. This rate is lower than that observed in several domestic studies but slightly higher than Zeisler H.'s study in Australia, which found an anemia prevalence of 17.2%. Variations in anemia prevalence across studies may be influenced by dietary habits, healthcare access, socioeconomic conditions, and iron supplementation policies [9], [10].

The prevalence of iron-deficiency anemia (IDA) in our study was 11.25%, which is higher than Zeisler H.'s reported rate of 9.88% but lower than the 23% prevalence observed by Finkelstein JL in women attending their first prenatal visit [11]. Furthermore, the World Health Organization (WHO) estimates a global IDA prevalence of 15.5%, placing our findings below the global average [12].

One potential explanation for these discrepancies is the ferritin threshold used for diagnosing iron deficiency. In our study, we used a ferritin threshold of <12 µg/L, whereas some other studies, including WHO recommendations, use a cutoff of <15 µg/L. The variation in ferritin thresholds may lead to differences in IDA classification across studies. Moreover, a recent review by Wiafe et al. (2023) emphasized that nutritional status, iron bioavailability, and underlying infections significantly affect anemia prevalence and diagnostic accuracy [13].

These findings highlight the importance of standardized anemia diagnostic criteria for better crossstudy comparisons and emphasize the need for region-specific interventions that consider dietary patterns, supplementation practices, and economic disparities in addressing iron-deficiency anemia during pregnancy.

4.2. Analysis of Associated Factors Demographic Factors

In our study, over 50% of pregnant women had a high school education or lower. While higher education is often associated with better health awareness and increased antenatal care utilization, we found no statistically significant difference in the prevalence of iron-deficiency anemia (IDA) between education levels.

This aligns with Muhsen and Hamad, reported no significant correlation between anemia and socio-demographic factors, including education, age, occupation, and family size. Our additional analysis of maternal age and occupation similarly showed no significant relationship with anemia prevalence [15].

Instead, dietary habits and economic status appear to play a more direct role in IDA risk. Research suggests that low economic status can lead to inadequate protein and iron intake, increasing anemia risk. Muhsen and Hamad found a strong correlation between IDA and poor intake of iron-rich foods ($p < 0.001$), particularly red meat, fish, and vegetables. Additionally, frequent tea consumption was associated with lower hemoglobin levels due to its inhibitory effect on iron absorption.

These findings suggest that while education may influence health-seeking behavior, improving access to iron-rich foods and

promoting nutritional education are more effective in reducing anemia than focusing solely on education levels. Addressing economic barriers and dietary choices should be prioritized in maternal health strategies to effectively lower IDA prevalence among pregnant women [15]. ***Factors related to obstetrics***

The iron requirements during pregnancy increase compared to non-pregnant women, leading to a higher risk of iron-deficiency anemia for those who have been pregnant and given birth multiple times. Several other studies have also noted an association between anemia and lower maternal education levels, as well as maternal age during pregnancy, particularly in adolescence. Our study also indicates that compared to primiparous women, multiparous women have a higher risk of iron-deficiency anemia, particularly those giving birth for the second time (PR = 2,53).

However, there are still studies both domestically and internationally that do not find a correlation between the number of childbirths and iron-deficiency anemia. This inconsistency may be explained by various factors, with the supplementation of iron during pregnancy being a significant factor. Pregnant women who have given birth multiple times but still ensure proper iron supplementation may minimize the risk of iron-deficiency anemia. ***Nutritional factors during pregnancy***

The correlation between iron-deficiency anemia (IDA) and nutrition during pregnancy has been extensively documented in the literature. Studies have consistently shown that dietary patterns, food diversity, and nutrient absorption inhibitors significantly influence anemia prevalence.

Similarly, low dietary iron intake was a major contributing factor to anemia among adolescents. In our study, we observed a significant relationship between dietary diversity and IDA prevalence, with only 8.19% of pregnant women consuming all four essential food groups experiencing anemia.

The findings align with a systematic review by Wiafe et al. (2023), which identified low dietary diversity, meal skipping, and inadequate iron intake as primary risk factors for anemia. Additionally, it emphasized that socioeconomic status plays a crucial role, as limited financial resources may restrict access to iron-rich foods such as meat, fish, and leafy greens [13].

These results suggest that enhancing dietary diversity and improving iron absorption through strategic nutritional interventions could be more effective in preventing IDA than simply focusing on iron supplementation alone.

Furthermore, substances such as tea, coffee, and tobacco are known to inhibit iron absorption, increasing the risk of IDA. However, our findings did not confirm this correlation. Interestingly, pregnant women who consumed tea had a lower prevalence of IDA (6.31%) compared to non-tea drinkers (13.88%). This paradoxical result may be attributed to confounding factors or errors in dietary data collection.

Our study found no significant correlation between Body Mass Index (BMI) and iron-deficiency anemia (IDA) in pregnant women. This contrasts with Zeisler H.'s findings, which reported a significant relationship between BMI and IDA during pregnancy. One possible explanation for this discrepancy is the use of BMI classification systems specific to Asian populations in our study, which may lead to different cutoff points and interpretations compared to other international studies [14].

Recent research by Kadhim (2023), published in the Journal of Medicine and Life, further supports the notion of a relationship between higher BMI and lower iron levels. The study, conducted on 100 primigravida women in Iraq, found a significant inverse correlation between BMI and hemoglobin (Hb) and serum ferritin (SF) levels. Specifically, obese women had lower Hb and SF levels compared to normalweight women ($p < 0.05$). These findings align with previous studies suggesting that increased BMI may contribute to iron deficiency due to chronic inflammation, which leads to elevated hepcidin levels, a key regulator that inhibits iron absorption and utilization [14].

Regarding nutritional supplementation, widespread promotion through media and healthcare systems may have influenced high adherence rates among pregnant women. Consequently, we found no significant association between IDA and iron supplementation in our study. This aligns with findings indicating that pre-existing inflammation in overweight or obese individuals may reduce the efficacy of oral iron supplements [16].

These results suggest that while BMI itself may not always predict anemia, it is crucial to consider underlying metabolic changes and inflammation in overweight and obese pregnant women, which may impair iron metabolism and contribute to IDA risk.

5. CONCLUSION

In the first trimester of pregnancy, we recorded an anemia rate of 18.12%, an iron deficiency rate of 13.44%, and a combined rate of anemia and iron deficiency of 11.25%. We also identified some factors related to the iron-deficiency anemia status during pregnancy. Specifically, a significant difference was observed between the groups of pregnant women with no nausea symptoms (7.83%).

In addition, the prevalence of iron deficiency anemia also showed a significant difference between groups of pregnant women who consumed tea (13.88%), those who consumed all four food groups (8.19%), and those who used iron supplements since pregnancy detection (5.88%) compared to the non-consumer group. Based on these results, it can be

concluded that iron deficiency anemia during pregnancy is associated with various factors, and proper nutrition and iron supplementation can help minimize this risk.

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