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Original Research Article

RELATIONSHIP BETWEEN MICRONUTRIENT INTAKE AND HEMOGLOBIN LEVELS IN PREGNANT WOMEN IN DEPOK CITY WEST JAVA

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Abstract

Background: Anemia remains a public health issue among pregnant women in Indonesia, including in the city of Depok. One of the causes is insufficient intake of micronutrients such as iron, folic acid, vitamin B12, and vitamin C, which play a crucial role in hemoglobin production.
Objectives: This study aims to investigate the relationship between micronutrient intake and hemoglobin levels among pregnant women.
Methods: This study employed a cross-sectional design in Depok city, West Java, in April to May 2025. A sample of 107 pregnant women was selected using accidental sampling. Data were collected through interviews using a 24-hour Dietary Recall questionnaire and hemoglobin level test results from medical records. The Spearman Rank test was used for data analysis.
Results: The results showed that the majority of respondents had an adequate intake of micronutrients (81.3%) and hemoglobin levels in the non-anemic category (70.1%). A significant association was found between iron, folic acid, vitamin B12, and vitamin C intake and hemoglobin levels ($p = 0.0001$). A history of anemia was also strongly associated with hemoglobin levels ($p = 0.0001$; $r = 0.706$).
Conclusion: Adequate intake of iron, folic acid, vitamin B12, and vitamin C plays a role in maintaining hemoglobin levels in pregnant women. Nutrition education and monitoring of micronutrient intake need to be improved in nursing practice to prevent anemia and pregnancy complications.

Keywords: *Anemia, Folic Acid, Iron, Micronutrient Intake, Vitamin C*

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INTRODUCTION

Maternal health is a key factor in determining the overall health of a community. Pregnancy requires special attention due to the significant physiological changes that occur, including increased nutritional needs to support fetal growth and maintain maternal health. A critical indicator of maternal health status is hemoglobin levels, which play a crucial role in transporting oxygen from the lungs to the entire body, including to the fetus via the placenta. Therefore, optimal hemoglobin levels are

essential for supporting a healthy pregnancy (Liu et al., 2022; O'Brien, 2022).

The World Health Organization (WHO) has established hemoglobin level thresholds for pregnant women as follows: ≥11 g/dL in the first and third trimesters and ≥10.5 g/dL in the second trimester (WHO, 2016). A decrease in hemoglobin levels in the second trimester is generally physiological, known as pseudoanemia. However, anemia caused by nutritional deficiency remains a serious issue (Pratiwi & Triani, 2024). According to data from the 2023 Indonesian Health Survey (SKI), the prevalence of anemia among pregnant women in Indonesia decreased to 27.7%, a decline from the 2018 Riskesdas survey, which reported a prevalence of 48.9% (Kemenkes RI, 2023).

Anemia in pregnant women is typically caused by deficiencies in essential micronutrients, including iron, folic acid, vitamin B12, and vitamin C. These deficiencies can occur due to an unbalanced diet, a lack of awareness about the importance of nutrition, and poor compliance with supplement consumption. This condition is exacerbated by social, economic, and cultural factors, including dietary habits that hinder iron absorption (Barnah et al., 2021; Efendi et al., 2023; Honaryati et al., 2021). If left untreated, anemia can increase the risk of pregnancy complications such as preterm birth, low birth weight (LBW), and maternal and fetal mortality (Kharate & Choudhari, 2024; Wibowo et al., 2021).

Adequate intake of micronutrients is essential for preventing anemia. Iron is essential for increasing blood volume, supporting fetal development, and replenishing fluid loss (Devi et al., 2023). Folic acid supports erythropoiesis and DNA synthesis, while vitamin B12 plays a role in one-carbon metabolism and embryo development. Vitamin C aids in the absorption of non-heme iron. Deficiencies in these micronutrients can increase the risk of pregnancy complications and worsen hemoglobin levels in pregnant women (Gernand et al., 2016; Meija & Rezeberga, 2017; Noviyanti et al., 2022; Shukla et al., 2021).

Various interventions, such as the provision of Multiple Micronutrient Supplements (MMS) and Supplementary Feeding, have been implemented. The Indonesian government has implemented the MMS program in several provinces, including West Java. However, its coverage remains limited, and anemia rates remain high (Kemenkes RI, 2023). In West Java, the city of Depok is among the areas with a high prevalence of anemia among pregnant women, ranking seventh (Dinas Kesehatan Jawa Barat, 2023).

Research on the relationship between micronutrient intake from food and supplements and hemoglobin levels in pregnant women is still limited.

Objective(s): The study aims to analyze the relationship between micronutrient intake and hemoglobin levels in pregnant women.

METHODS

Study Design

This study used a quantitative design with a cross-sectional approach.

Setting

This study was conducted at three community health centers in Depok City, West Java, from April to May 2025.

Research Subject

A total of 107 respondents were selected using accidental sampling based on the following inclusion and exclusion criteria. The inclusion criteria were pregnant women in the second and third trimesters who received Multiple Micronutrient Supplement (MMS) tablets and had undergone laboratory tests. Exclusion criteria were pregnant women who had chronic diseases and/or blood diseases.

The sample size was calculated using the sample size formula of the population size is

unknown, based on Lemeshow's two-proportions t-test formula.

Instruments

The research instruments consisted of a questionnaire on respondent characteristics and micronutrient intake, utilizing the Minimum Dietary Diversity for Women (MDD-W) method with the 24-hour Dietary Recall to assess iron, folic acid, vitamin B12, and vitamin C intake. The MDD-W instrument has been tested for validity and reliability by Syahradesi et al. (2023). A correlation coefficient of r ≥ 0.361 and Cronbach's Alpha of 0.874, indicating that the instrument is valid and reliable. Hemoglobin levels were obtained from secondary data, namely the latest laboratory test records in the Health Center medical records.

Data Analysis

Data analysis was performed using univariate and bivariate analysis by the Spearman Rank test.

Ethical Consideration

This study has received ethical approval from the Health Research Ethics Committee of the Faculty of Health Sciences, UIN Syarif Hidayatullah Jakarta, with ethical approval number Un.01/F.10/KP.01.1/KE.SP/04.08.012/2025.

RESULTS

Demographics of Respondents

Table 1. Characteristics of Respondents and Hemoglobin Levels of Pregnant Women from April to May 2025 (N=107)

Variable		n	%
Age	20-35 years old	14	86,0
	<20 and >35 years old	15	14,0
Education	Elementary School	3	2,8
	Junior High School	13	12,1
	Senior High School	67	62,6
	Diploma/Graduate School	24	22,4
Occupation	Not Working	85	79,4
	Working	22	20,6
Family Income	Low: <Rp4,000,000	60	56,1
	Medium: Rp4,000,000 – Rp9,999,999	42	39,3
	High: ≥Rp10,000,000	5	4,7
Parity	Multigravida	67	62,6
	Primigravida	40	37,4
History of Abortion	None	91	85,0
	Yes	16	15,0
Gestational Age	Weeks 13-27 (Second Trimester)	35	32,7
	Weeks 28-40 (Third Trimester)	72	67,3
History of Anemia	None	63	58,9
	Yes	44	41,1
Hemoglobin Levels	Not Anemia (≥11 g/dL)	75	70.1
	Anemia (≤11 g/dL)	32	29.9

Sources: Primary Data of Questionnaires and Secondary Data of The Latest Laboratory Test Records in Puskesmas Medical Records, 2025.

Based on Table 1, most respondents were aged 20–35 years (86.0%), had a high school education (62.6%), and were unemployed (79.4%). Based on family income, most respondents were in the low-income category, i.e., <Rp4,000,000 per month (56.1%). From an obstetric perspective, the majority of respondents were multigravida (62.6%), had no history of abortion (85.0%), and were in the third trimester of pregnancy (67.3%). Additionally, most respondents had no history of anemia (58.9%).

Nearly one-third of pregnant women in this study had anemia, namely 32 respondents (29.9%) with hemoglobin levels <11 g/dL. Meanwhile, the majority of respondents, 75 people (70.1%), had normal hemoglobin levels (≥11 g/dL) or did not have anemia.

Table 2. Frequency Distribution of Micronutrient Intake (N=107)

Types of Micronutrients	Intake Category	n	%
Iron Intake	Adequate (Intake ≥80% of RDA)	87	81.3
	Inadequate (Intake <80% of RDA)	20	18.7
Folic Acid Intake	Adequate (Intake ≥80% of RDA)	76	71.0
	Inadequate (Intake <80% of RDA)	31	29.0
Vitamin B12 Intake	Adequate (Intake ≥80% of RDA)	87	81.3
	Inadequate (Intake <80% of RDA)	20	18.7
Vitamin C Intake	Adequate (Intake ≥80% of RDA)	58	54.2
	Inadequate (Intake <80% of RDA)	49	45.8
Micronutrient Intake	**Adequate (Intake ≥80% of RDA)**	**87**	**81.3**
	Inadequate (Intake <80% of RDA)	**20**	**18.7**

Sources: Primary Data of Questionnaires, 2025.

The table 2 showed that the most respondents have an adequate intake of micronutrients, with 81.3% of respondents meeting or exceeding the Nutrient Adequacy Rate (NAR) of 80% or more. Conversely, 18.7% of respondents fall into the category of micronutrient deficiency (NAR < 80%).

Iron and vitamin B12 intake were the most adequately fulfilled, with 87 respondents (81.3%) classified as adequate and only 20 respondents (18.7%) classified as inadequate. For folic acid, 76 respondents (71%) met the adequacy requirement, while 31 respondents (29%) were still inadequate.

Unlike other micronutrients, vitamin C showed the lowest intake proportion, with 58 respondents (54.2%) having adequate intake of 80% of the RDA and 49 respondents (45.8%) having insufficient intake. This shows that vitamin C is the micronutrient with the lowest adequacy rate among the other micronutrients studied.

Correlation Analysis between Micronutrient Intake and Hemoglobin Levels in Pregnant Women

The study's results indicate a significant and positive correlation between micronutrient intake and hemoglobin levels in pregnant women. The majority of respondents who did not experience anemia had adequate micronutrient intake (≥80% of the Recommended Daily Allowance), totaling 74 individuals (69.2%). In contrast, only one individual (0.9%) did not have anemia despite having insufficient micronutrient intake. Conversely, 13 respondents (12.1%) had anemia despite adequate micronutrient intake, and 19 respondents (17.8%) had anemia with inadequate micronutrient intake. Statistical analysis revealed a p-value of 0.000 and a correlation coefficient of r = 0.395, indicating a significant positive relationship between low micronutrient intake and low hemoglobin levels.

Table 3. The Relationship Between Micronutrient Intake and Hemoglobin Levels in Pregnant Women

Hemoglobin Level	Micronutrient Intake				Total		R	p-value
	Adequate (≥80% RDA)		Kurang (<80% AKG)					
	N	%	N	%	N	%		
Not Anemia	74	69.2	1	0.9	75	70.1		
Anemia	13	12.1	19	17.8	32	29.9	0.395	0.000
Total	**87**	**81.3**	**20**	**18.7**	**107**	**100**		
Iron Intake								
Not Anemia	74	69.2	1	0.9	75	70.1		
Anemia	13	12.1	19	17.8	32	29.9	0.381	0.000
Total	**87**	**81.3**	**20**	**18.7**	**107**	**100**		
Folid Acid Intake								
Not Anemia	66	61.7	9	8.4	75	70.1		
Anemia	10	9.3	22	20.6	32	29.9	0.363	0.000
Total	**76**	**71.0**	**31**	**29.0**	**107**	**100**		
Hemoglobin Level	**Vitamin B12 Intake**							
	Adequate (≥80% RDA)		**Inadequate (<80% RDA)**		**Total**		**r**	**p-value**
	N	**%**	**N**	**%**	**N**	**%**		
Not Anemia	72	67.3	3	2.8	75	70.1	0.373	0.000
Anemia	15	14.0	17	15.9	32	29.9		
Total	**87**	**81.3**	**20**	**18.7**	**107**	**100**		
Vitamin C Intake								
Not Anemia	53	49.5	22	20.6	75	70.1	0.421	0.000
Anemia	5	4.7	27	25.2	32	29.9		
Total	**58**	**54.2**	**49**	**45.8**	**107**	**100**		

Sources: Primary Data of Questionnaires and Secondary Data of The Latest Laboratory Test Records in Puskesmas Medical Records, 2025

In detail, iron intake has a significant relationship with hemoglobin levels ($r = 0.381$; $p = 0.000$), with a low strength and a positive direction. Similarly, folic acid intake shows a significant relationship ($r = 0.363$; $p = 0.000$) with low strength and a positive direction. For vitamin B12 intake, the values obtained were $r = 0.373$ and $p = 0.000$, indicating a significant relationship with low strength. Vitamin C intake showed the strongest relationship among the four micronutrients analyzed, with a correlation coefficient of $r = 0.421$ and a p-value of 0.000, indicating a positive direction and moderate strength. Overall, pregnant women with adequate micronutrient intake tend to have better hemoglobin levels and a lower risk of anemia.

Correlation Analysis between History of Anemia and Hemoglobin Levels

The characteristics analyzed in this study included maternal age, education level, occupation, family income, parity, history of abortion, gestational age, and history of anemia. Based on the Spearman correlation test results, it was found that of all the characteristics tested, only the history of anemia showed a statistically significant association with hemoglobin levels ($p < 0.05$). Meanwhile, other variables such as age, education, occupation, family income, parity, history of abortion, and gestational age did not show a significant relationship ($p > 0.05$), so they are not presented in the table.

Table 4. The role of History of Anemia and Hemoglobin levels in pregnant women

Hemoglobin Level	History of Anemia				Total		r	P
	No		Yes					
	n	%	n	%	N	%		
Not Anemia (≥11 g/dL)	63	58,9	12	11,2	75	70,1	0,706	0,000
Anemia (<11 g/dL)	0	0	32	29,9	32	29,9		
Total	**63**	**58,9**	**44**	**41,1**	**107**	**100**		

Sources: Primary Data of Questionnaires and Secondary Data of The Latest Laboratory Test Records in Puskesmas Medical Records, 2025.

The results of the analysis using the Spearman correlation test showed a significant and strong relationship between the history of anemia and hemoglobin levels in second and third trimester pregnant women. The positive correlation of r = 0.706 with p = 0.001 indicates that the better the health history of anemia (no history of anemia), the better the current hemoglobin level of the mother. These results suggest that history of anemia is one of the important factors associated with hemoglobin status during pregnancy.

DISCUSSION

The results of a study involving 107 pregnant women showed that the majority of respondents (86%) were aged 20–35 years, which is the reproductive age group physiologically better prepared for pregnancy and associated with lower risk of complications. Most respondents had a high school education (62.6%), reflecting a secondary education level and potentially influencing their understanding of the importance of nutrition during pregnancy. A total of 79.4% of respondents were not employed, which could impact their exposure to health information and adherence to supplement consumption. Economically, the majority of respondents came from families with an income of less than Rp4,000,000 (56.1%), which could limit access to nutritious food and supplements. Additionally, 62.6% of respondents were multigravida, who are more likely to have a higher risk of anemia due to increased nutritional needs and the possibility of decreased iron reserves. Most respondents were in the third trimester (67.3%), characterized by increased iron requirements. Although 58.9% had no history of anemia, 44.1% did, putting them at risk of recurrent anemia during pregnancy.

The Relationship Between Micronutrient Intake and Hemoglobin Levels

The most mothers with adequate micronutrient intake (≥80% of the Recommended Daily Allowance [RDA]) had normal hemoglobin levels, accounting for 69.2% of the total. Conversely, mothers with insufficient micronutrient intake (<80% of the Recommended Daily Allowance) are more likely to experience anemia (17.8%). This suggests that adequate intake of micronutrients plays a crucial role in supporting hemoglobin levels during pregnancy. However, there are pregnant women with adequate intake who still experience anemia. This suggests that hemoglobin levels are not only influenced by nutritional intake but also by various other factors, such as a history of anemia, infections, adherence to supplement consumption, and pre-pregnancy nutritional status (Alamsyah, 2020; Masthura et al., 2021; Minasi et al., 2021; Syarfaini et al., 2019).

The Spearman test revealed a significant relationship between micronutrient intake and hemoglobin levels (p = 0.0001; r = 0.395), characterized by a low but positive correlation strength. This suggests that the higher the micronutrient intake, the higher the hemoglobin levels tend to be in pregnant women. This finding aligns with the study by Hulinggi et al. (2023), which identified a

significant association between micronutrient intake, including iron, folic acid, and zinc, and the incidence of anemia in pregnant women.

Further analysis based on micronutrient type shows that each micronutrient has a specific contribution to hemoglobin levels, including:

Iron (Fe) level shows a significant correlation with hemoglobin levels (r=0.381; p=0.000). Iron is a key component of hemoglobin, and its deficiency is the primary cause of iron deficiency anemia, particularly during pregnancy. Iron requirements increase with the expansion of blood volume and fetal growth (Noviyanti et al., 2022). This finding is supported by Meliyani et al. (2022), who reported that an insufficient intake of iron significantly contributes to the occurrence of anemia in pregnant women (p = 0.025).

Folic acid level shows a positive correlation (r=0.363; p=0.000) with hemoglobin levels. Folic acid is important in DNA synthesis and erythrocyte formation. Its deficiency can cause megaloblastic anemia (Akhmad & Listiyaningsih, 2021). The results of Tarigan et al. (2[illegible]) support this finding by stating that folic acid deficiency during pregnancy is closely associated with a decrease in hemoglobin levels (p = 0.0[illegible]).

Vitamin B12 is also positively associated with hemoglobin levels (r=0.373; p=0.000). Vitamin B12 plays a role in erythropoiesis and cell division. Its deficiency can cause macrocytic anemia (Meija & Rezeberga, 2017). This study aligns with the research by Sembiring et al. (2020) which also demonstrated a significant association between vitamin B12 intake and hemoglobin levels, with a p-value of 0.0001.

Vitamin C shows the strongest correlation among the four micronutrients (r=0.421; p=0.000), with a moderate correlation strength. Although not directly involved in hemoglobin formation, vitamin C enhances the absorption of non-heme iron from plant sources (Noviyanti et al., 2022). Research by Sumiari et al. (2022) demonstrated that adequate vitamin C intake significantly enhances iron absorption efficiency (p = 0.000).

Overall, micronutrient adequacy has been shown to play a crucial role in preventing anemia in pregnant women, although it is not the sole factor that affects hemoglobin levels.

Physiologically, these four micronutrients play a crucial role in the erythropoiesis process. Iron is required for hemoglobin synthesis. Folic acid and vitamin B12 support erythrocyte division and maturation, while vitamin C enhances iron absorption. A deficiency in one or a combination of these micronutrients can lead to various forms of anemia, including iron deficiency anemia and megaloblastic anemia.

Although the relationship found was in the low to moderate strength category, the results were still statistically and clinically significant. This indicates that adequate micronutrient intake is one factor contributing to the incidence of anemia during pregnancy, although it is not the only factor. Other factors, such as a history of anemia, infection, and compliance with supplement consumption, also play an important role.

Thus, efforts to improve hemoglobin levels in pregnant women should not be limited to iron supplementation alone but should include comprehensive nutritional interventions that address the adequacy of other micronutrients, including folic acid, vitamin B12, and vitamin C. Continuous nutrition education and regular monitoring of nutritional status are key to preventing anemia and supporting a healthy pregnancy.

Relationship between Characteristics of Respondents (History of Anemia) and Hemoglobin Levels

From statistical analysis, only a history of anemia showed a significant relationship with hemoglobin levels (p = 0.000; r = 0.706). This strong correlation indicates that mothers with a history of anemia have a higher risk of experiencing anemia again. This finding aligns with the results of Safitri et al. (2021) and

Wirawan & Nurrika (2022), who reported that pre-pregnancy anemia tends to persist into pregnancy and can hurt the child.

Other factors such as age, education, occupation, income, parity, history of abortion, and gestational age did not show a significant relationship with hemoglobin levels ($p>0.05$). However, physiological changes during pregnancy, such as hemodilution, can cause a decrease in hemoglobin levels without clinical anemia (Ali et al., 2021).

These results highlight the importance of screening for anemia early in pregnancy, providing nutrition education, and administering appropriate supplementation, particularly for mothers with a history of anemia, to prevent anemia that can compromise the health of both the mother and fetus.

CONCLUSION

This study reveals a significant and positive correlation between micronutrient intake (iron, folic acid, vitamin B12, and vitamin C) and hemoglobin levels in pregnant women attending community health centers in Depok City, with the strongest relationship observed for vitamin C. The average micronutrient intake of respondents was 92.22% of the recommended daily allowance; however, deficiencies in folic acid and vitamin were still observed. Additionally, a history of anemia was the only characteristic significantly associated with hemoglobin levels. These findings emphasize the importance of ensuring adequate micronutrient intake and regular monitoring of hemoglobin levels, particularly for pregnant women with a history of anemia, as well as the need for education and support from family and healthcare providers to prevent anemia during pregnancy.

SUGGESTIONS

Nurses need to increase their promotive and preventive roles through nutrition education and anemia screening from preconception. Further research is recommended using longitudinal designs and multivariate analysis to control for confounding variables.

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DECLARATION OF CONFLICTING INTEREST

There is no conflict of interest in this research.

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AUTHOR CONTRIBUTION

Sinta Aulia Fikriah: contributed to developing the proposal, collecting data, analyzing and wrote the first draft of manuscript.

Irma Nurbaeti: contributed to the study's conception and design, data acquisition, revised the final draft, and gave final approval of the version to be published.

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