The relationship between intake of iron, vitamin D and nutritional status on the incidence of anemia in pregnant women at Kebak Kramat 1 community health center, Karanganyar

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Abstract

Anaemia is one of the World Health Organization's five global health challenges for 2025. The causes of anaemia during pregnancy are linked to iron intake and nutritional status, which may result in severe consequences such as miscarriage, preterm birth, pre/postpartum haemorrhage, and low birth weight. This study aimed to investigate the association between iron intake, vitamin D, nutritional status, and the prevalence of anaemia during pregnancy. This was an analytical cross-sectional study involving a population of 132 pregnancies. The sample included 30 pregnancies. The data was analyzed through the Chi-square, logistic, and multiple linear regression tests. Iron deficiency demonstrated a 15-fold increase in the risk of anaemia (p-value 0.016) without correlation. Vitamin D intake is unrelated to anaemia, while nutritional status is unrelated to anaemia (p-value 0.787). Insufficient iron intake may increase the risk of anaemia, whereas a good vitamin D and adequate nutritional status may lower this risk. Therefore, further research is needed on the particularities of anaemia knowledge education during pregnancy.

Keywords : *Iron intake, Vitamin D, Nutritional State, Anemia, Pregnancy*

Introduction

Anaemia in pregnant women in Indonesia is still relatively high. According to Riskesdas data (2018), anaemia in pregnant women has increased by 48.9%. Meanwhile, in Karanganyar Regency in 2021, 1,163 cases of moderate anaemia (8-11 mg/dl) were found in pregnant women in Karanganyar Regency covering 21 regions (Karanganyar Public Health Service, 2021). Factors influencing the causes of anaemia in pregnant women. Risk factors for anaemia in pregnant women are related to iron intake, and the mother's nutritional status also influences cases of anaemia (El-Kholy *et al*., 2023; Yang *et al*., 2023). This research by Tadesse *et al.* (2021) said that Fe intake is eight times less likely to cause anaemia due to the less varied diet of pregnant women, especially foods that are sources of iron.

The source of iron that pregnant women often consume is vegetable side dishes because they are affordable. Apart from that, you also often consume sweet tea twice a day, which can inhibit iron absorption. Drinking tea has a 2.785 times greater risk of developing anaemia compared to pregnant women who never drink tea (Santhakumar *et al*., 2023; Wiafe *et al*., 2023)

An indicator of success in preventing iron anaemia is consuming food sources of iron such as animal protein (processed meat, processed chicken, processed fish) (Sukmawati *et al.*, 2019). Apart from that, the government has taken several steps to reduce cases of iron deficiency anaemia, namely by fortifying minerals and vitamins (such as Fe, zinc, folic acid, thiamine, and riboflavin) already on the market (Nugraheni *et al*., 2019). This study aims to determine the effect of differences in iron intake and nutritional status on anaemic pregnant women in the working area of the Kebak Kramat 1 Health Center, Karanganyar Regency.

Methods

This cross-sectional study was conducted in the Kebak Kramat 1 Community Health Center, Karanganyar Regency, for one month in July 2023. Based on the data of the health report from the Karanganyar public health office in 2022, there were 132 pregnant women with anaemia in the Kebak Kramat 1 Community Health Center. Research subjects in research are calculated using the formula from the application http://www.www.openepi.com/SampleSize/SSPropor.htm (Probandari *et al.*, 2020) from which we got at least 30 research subjects. The inclusion criteria included pregnant women in the first and second trimesters of pregnancy, aged 20-35 years old, and haemoglobin level <9-10 g/dl. Pregnant women who had high blood pressure (>120/80 mmHg), parity history >3, postpartum bleeding, and pregnancy history <2 years were excluded from this study.

Data on basic characteristics and food frequency were collected by direct interviews using open and SQ-FFQ (semi-quantitative food frequency questionnaire) questionnaires, respectively. Data on the nutritional status were collected by measuring MUAC (mid-upper arm circumference). Numerical data were presented as mean and standard deviation and statistically analyzed using a linear regression test. Categorical data were presented as frequency and percentage and statistically analyzed using the chi-square test. Multiple logistic regression test was used to analyze independent and confounding variables against the dependent variable with a significant value <0.05.

Results and Discussions

The sample characteristics consist of maternal age, maternal education level, and family income, which can be seen in the following table:

Table 1. Characteristic sample

Subject Characteristic	Frequency	Percentage
	n	%
Mother's Age		
No Risk (20-35 th)	**21**	**70**
Risk (>35 th)	**9**	**30**
Gestational Age		
First Trimester (4-13 weeks)	**7**	**23**
Second Trimester (14-26 weeks)	**21**	**70**
Third Trimester (27-40 weeks)	**2**	**7**
Mother's Education level		
Elementary School	**3**	**10**
Middle and High School	**24**	**80**
College	**3**	**10**
Family Income		
Below the regionl minimum wage (<Rp2.000.000)	**24**	**80**
Above the regionl minimum wage (>Rp2.000.000)	**6**	**20**

Based on **Table 1**, information was obtained that the majority of pregnant women were not at risk, as many as 21 people (70%), while nine people (30%) were pregnant women who were at risk (>35 years). Pregnant women with the majority of gestational age in the second trimester (14-26 weeks) were 21 people (70%), while in the first trimester, there were seven people (23%), and in the third trimester, there were two people (7%). Most pregnant women had a secondary education level (SMP-SMA), as many as 24 people (80%). In comparison, the maternal education levels were primary and higher (university) as many as three people (10%). The majority of the mother's family had an income below the regional minimum wage (<Rp. 2,000,000), as many as 24 people (80%), while the family income was above the provincial minimum wage (>Rp. 2,000,000) as many as six people (20%).

Table 2. Analyzed Univariate Independent and Dependent Variables

Independen and Dependen Variable	Frequency	Percentage
	n	%
Iron Intake		
Not enough	**24**	**70**
Enough	**6**	**30**
Vitamin D intake		
Not Enough	**24**	**70**
Enough	**6**	**30**
Nutritional Status		
Malnutrition	**24**	**70**
Good Nutrition	**6**	**30**
Anemia Occurrence		
Anemic	**25**	**75**
Non Anemic	**5**	**25**

Based on **Table 2.** Most pregnant women's food intake is deficient in iron, as many as 24 people (70%), while six people (30%) have sufficient iron intake in pregnant women. Most pregnant women's food intake of vitamin D is

deficient, as many as 24 people (70%), while pregnant women with sufficient vitamin D intake are six people (30%). Most pregnant women experienced poor nutritional status, 24 people (70%), while six pregnant women experienced good dietary grade (30%). Most pregnant women also experience anemia, as many as 25 people (75%), while five people (25%) do not experience anemia

Table 3. Relationship between Iron Intake, Vitamin D, and Nutritional Status on the Incidence of Anemia Using Bivariate Analysis

Variable	Anemia Occurrence				OR	CI 95%		P^a
	Anemic		Not Anemic			Lower	Upper	
	n	%	n	%				
Iron Intake					15,00	1,652	136,172	0,016*
Not enough	19	45	5	25				
Enough	4	20	2	10				
Vitamin D Intake					0,427	0,033	4,228	0,417
Not enough	19	45	6	30				
Enough	4	20	1	5				
Nutritional Status					0,787	0,165	10,743	0,787
Malnutrition	19	45	5	25				
Good Nutrition	4	20	2	10				

P[a]: *Chi-Square Test *) P<0.05 Significant n: number of people*

Table 3 shows that iron intake is significantly related to the incidence of anaemia (OR=15, 95% CI, p=0.016), namely that 19 pregnant women (45%) who experienced insufficient iron intake resulted in anaemia. The OR value is 15, meaning inadequate iron intake can increase the risk of anaemia by 15 times compared to sufficient iron intake. Vitamin D intake was not significantly related to the incidence of anaemia (OR=0.427, 95% CI, p=0.417). Nineteen pregnant women (45%) who experienced insufficient vitamin D intake resulted in anaemia. The OR value is 0.427, meaning inadequate vitamin D intake can increase the risk of anaemia by 0.427 times compared to sufficient vitamin D intake. Nutritional status was not significantly related to the incidence of anaemia (OR=0.787, 95% CI, p=0.787); namely, 19 pregnant women (45%) who experienced poor nutritional status resulted in anaemia. The OR value is 0.287, meaning poor nutritional quality can increase the risk of anaemia by 0.287 times compared to good nutritional status.

Table 4. Relationship between Mothers age, Family Income, Mother's Education Level, and Gestational Age on the Incidence of Anemia Using Bivariate Analysis

Variable	Anemia Occurrence				OR	CI 95%		P^a
	Anemic		Not Anemic			Lower	Upper	
	n	%	n	%				
Mother's Age								
No Risk (20-35 th)	6	30	3	15	0,287	0,048	2,457	0,279
Risk (>35 th)	7	35	4	20				
Family Income								
Below the regionl minimum wage (<Rp2.000.000)	9	45	5	25	0,139	0,616	32,069	0,128
Above the regionl minimum wage (>Rp2.000.000)	4	20	2	10				
Mother's Education level								
Elementary School	2	10	1	5	1,009	0,240	4,233	0,419
Middle and High School	9	45	5	25				
College	2	10	1	5				
Gestational Age								
First Trimester (4-13 weeks)	7	35	4	20	2,151	0,346	13,392	0,895
Second Trimester (14-26 weeks)	5	25	3	15				
Third Trimester (27-40 weeks)	1	5	0	0				

**) p 0.05 Significant n: number of people*

Based on **Table 4**, information was obtained that maternal age was not significantly related to the incidence of anaemia (OR=0.287, 95% CI, p=0.279), namely that six mothers (30%) were at risk of developing anaemia. Seven pregnant mothers (35%) are not at risk of anaemia. The OR value is 0.287, which means that the age of a mother at risk can increase the risk of anaemia by 0.287 times compared to that of a mother who is not at risk. Family income was not significantly related to the incidence of anaemia (OR=0.139, 95% CI, p=0.128). That is, nine pregnant women (45%) whose income was below the minimum wage (<Rp. 2,000,000) experienced anaemia, and as many as four pregnant women (20%) who earned above the minimum wage (>Rp. 2,000,000) experienced anaemia. The OR value = 0.139

means that mothers whose income is below the minimum wage can increase the risk of anaemia 0.139 times compared to mothers who earn above the minimum wage. The level of education was not related to the incidence of anaemia (OR=1.009, 95% CI, p=0.419). Namely, nine pregnant women (45%) had secondary education (middle and high school), and two pregnant women (10%) had essential (primary) and tertiary (college) education levels. An OR value of 1.009 means that pregnant women with a basic education level can increase the risk of anaemia by 1.009 compared to mothers with a higher education level. Gestational age was not significantly related to the incidence of anaemia (OR 2.151, 95% CI, p=0.895), namely seven pregnant women (35%) in the first trimester (4-13 weeks) and five pregnant women (25%) in the second trimester. (14-26 weeks), as many as one pregnant woman (5%) in the third trimester (27-40 weeks).

Table 5. Multiple Analyzed Independent Variable and Confounding

Variable	B	Wald	Sig	OR	CI95%	
Nutrition status	-1.544	0.382	0.537	0.214	Lower	Upper
Mother's age	-1.374	0.587	0.444	0.253	0.002	28.616
Gestational age	38.254	0.000	0.998	4.107	0.008	8.509
Level of education	-0.281	0.020	0.889	0.755	0.000	
Family income	36.991	0.000	0.998	1.162	0.015	38.579
Iron intake	-58.885	0.000	0.997	0.000	0.000	
vitamin D intake	16.935	0.000	0.999	22.64	0.000	

Pa: Multiple linear regression test *) p<0.05 significant

Based on **Table 5,** it can be concluded that of all the independent variables (nutritional status, maternal age, education level, family income, iron intake, and vitamin D intake it is thought not to influence anaemia in pregnant women. The largest OR value was 22.64, meaning that vitamin D intake has a 22.64 times chance of causing anaemia in pregnant women.

Based on **Table 1,** information was obtained that the majority of mothers were not at risk (20-35 years) as many as 11 people (55%). Meanwhile, nine mothers are not at risk (45%). Maternal age < 20 years or above and > 35 years can cause anaemia. This is because iron consumption for 20 years is divided by the fetus in the womb and its biological growth, which, of course, still requires a lot of iron consumption (George *et al*., 2021). After the age of 35, they enter an early degenerative stage when body function is not optimal, and they have various health problems. Pregnancies under 20 years and over 35 years are pregnancies with a risk of anaemia (Bellakhal *et al*., 2019; Sunuwar *et al.*, 2019)
According to Parischa *et al*. (2023), mothers of at-risk ages can reduce the incidence of anaemia by 0.68 times compared to mothers of non-risk ages. The results of this study show that there is conformity with the theory put forward by (Guo *et al*., 2022) that the ideal maternal age in pregnancy is the 20-35 year age group and at this age, mothers have healthy reproduction and are less at risk of pregnancy complications. The age group < 20 years is at risk of anaemia because reproductive development is not yet optimal, and according to Kumar and Lahiri (2023), pregnancy in the 35-year age group is associated with deterioration and decreased endurance as well as various diseases that often occur at this age. Pregnancy at >35 years of age is a high-risk pregnancy because, at this age, chronic health problems often occur, one of which is the risk of anaemia. Bleeding that occurs during childbirth, if not handled properly, will cause anaemia. Apart from that, age is not the only factor that causes anaemia. There are other factors, namely socio-economic factors (Kang *et al*., 2023).

Based on **Table 1**, information was obtained that the majority of mothers had a secondary education level (SMP-SMA), as many as 14 people (70%). Meanwhile, there were three mothers (15%) who had primary (primary) and higher (university) education. According to research by Edison (2019), the relationship between education level and the incidence of anaemia in pregnant women shows that the prevalence of anaemia in mothers who have a low level of education reaches 90.3% compared to mothers who have a high level of education, which is only 9.7%. The Chi-Square test results obtained a value of ρ= 0.001. This is due to the mother's lack of knowledge on how to process good food so that it does not damage the nutritional content in it and also due to low education, the mother does not work, which reduces household income, and the mother cannot buy nutritious food so that due to this limitation anaemia occurs (Panchal *et al* ., 2022). Based on interviews during the preliminary study, mothers only received education from health workers at the Community Health Center only once a month. So, the information obtained is lacking because, during the education class for pregnant women, only one theme is given, such as consuming blood supplement tablets regularly.

Based on **Table 1**, information was obtained that the majority of family income was below the minimum wage (<Rp. 2,000,000), as many as 14 people (70%). Meanwhile, six people (30%) had family income above the minimum

wage (>Rp. 2,000,000). The prevalence of anaemia is greater in pregnant women with incomes lower than the Regional Minimum Wage (UMR). This affects the purchasing power of food families consume because >57% of family income is spent on purchasing food (Gibore et al., 2021; Pasricha et al., 2023). According to Septiasari (2019) research, it was found that 25 out of 39 pregnant women (61.0%) of mothers with income < minimum wage experienced anaemia, while among pregnant women with income ≥ minimum wage, there were 16 out of 47 people (39.0 %) have anaemia. The results of the chi-square statistical test show that the p-value = 0.005 (p ≤0.05), RP 3.460 (95% CI = 1.421 – 8.425), so it can be concluded that mothers with an income <UMR increase the incidence of anaemia by 34 times compared to mothers with an income >UMR causes mothers not to get adequate nutrition, thereby risking anaemia. The number of families will influence the food distribution within the family. The lack of family income causes a reduction in the location and purchase of daily food, thereby reducing the quantity and quality of the mother's food per day, which has an impact on reducing nutritional status. A common nutritional disorder in pregnant women is anaemia. The food sources needed to prevent anaemia generally come from protein sources, which are more expensive and difficult for those with low incomes. This deficiency increases the risk of anaemia in pregnant women and accelerates the risk of morbidity in mothers (Mekonen & Alemu, 2021; Maugliani & Baldi, 2023). Based on preliminary study interviews, as many as 65% of pregnant women said they consumed two pieces of vegetable protein (tempeh, tofu, processed nuts) 3-4 times per week.

Based on **Table 1,** information was obtained that the majority of pregnant women with poor nutritional status were 14 people (70%). Meanwhile, there were six pregnant women with good nutritional status (30%). Steven et al. (2022) stated the relationship between nutritional status and the incidence of anaemia. *Nutritional status* is also defined as health status resulting from a balance between nutrient needs and input and is a basic need for pregnant women. Nutritional status and the incidence of anaemia were also shown by Dewi and Mardiana (2021), who found that the risk of anaemia in pregnant women was 2.9 times higher for pregnant women with poor nutritional status than those with good nutritional status. This comparative figure has a large role in influencing the health of pregnant women. The estimated determinant of R2 is 0.047, meaning that nutritional status contributes 4.7% in influencing the incidence of anaemia. Even though the contribution value is small, as long as the regression coefficient β1 is not statistically zero, scientifically, it can be proven that there is an influence between nutritional status and the incidence of anaemia (Guo *et al*., 2022)

Based on **Table 1**, information was obtained that the majority of mothers' iron intake was less than 14 people (70%). Meanwhile, six people (30%) had sufficient iron intake, according to research conducted in Jatinangor District regarding the consumption patterns of pregnant women, which shows that the intake of food sources of iron (Fe) in pregnant women is still inadequate, namely 53 people (93%) out of 57 pregnant women (Putri *et al*., 2020). This happens because the source of iron consumed does not come from heme, such as meat and animal food sources, so it is not easy to absorb and does not support the presence of iron in the body. The same thing was done in research in TuaTunu Pangkal Pinang Village regarding the relationship between nutritional intake and the incidence of anaemia in preconception women, which showed that the intake of food sources of iron (Fe) in preconception women was still insufficient, namely 98.4% (Devriany & Wardani, 2019). This is because the consumption of less balanced foods can interfere with the absorption of iron in the body, and the majority of respondents consume more vegetable protein than animal protein. In addition, the lack of consumption of side dishes, which are a source of iron which is useful during pregnancy for the formation of new haemoglobin, compensates for the small amount of iron which is constantly excreted by the body (especially through urine, faeces and sweat), and replaces iron losses during pregnancy—lactation for milk secretion (Devriany & Wardani, 2019).

Mothers who are malnourished are at risk of having a difficult or long labour, giving birth to a baby prematurely (not yet full term), bleeding in the mother after giving birth and usually during labour, the mother also lacks the strength to push during the labour process so giving birth using a high surgical procedure for pregnant women lack nutrition (Xu *et al*., 2022). There are 41% of pregnant women suffer from malnutrition. The emergence of nutritional problems in pregnant women, such as the incidence of CED, cannot be separated from the social, economic, and biosocial conditions of pregnant women and their families, such as education, income level, food consumption, age, parity and so on (Andersen *et al*., 2022). Malnutrition can cause the mother to suffer from anaemia; the blood supply that delivers oxygen and food to the fetus will be hampered, so that the fetus will experience impaired growth and development. Therefore, monitoring the nutrition of pregnant women is very important (Nuru *et al*., 2021).

Based on **Table 1**, it was found that the majority of mothers' vitamin D intake was less than 14 people (70%). Meanwhile, six people (30%) had sufficient vitamin D intake. Vitamin D is a vitamin that is needed for various metabolic processes in the body. It is fat-soluble and is produced by human skin with energy obtained from food intake.

Vitamin D deficiency in pregnant women has an impact on the fetus and newborn. The prevalence of vitamin D deficiency is 63% in Indonesia and Malaysia. According to Smith M. Ellen and Tang Pricha Vin (2019), vitamin D can increase erythropoiesis by increasing the proliferation of erythroid progenitors and reducing proinflammatory cytokines. Additionally, by decreasing proinflammatory cytokines that stimulate hepcidin and through direct transcriptional regulation of the HAMP gene, vitamin D can suppress hepcidin expression. Reducing proinflammatory cytokines and hepcidin may increase iron bioavailability for erythropoiesis and haemoglobin synthesis by restoring iron recycling, preventing iron absorption in macrophages, and eliminating impaired iron absorption, thereby protecting against anaemia.

Conclusions

Iron intake is significantly related to the incidence of anaemia ($p=0.016<0.05$) and can increase the risk of anaemia 15 times. Meanwhile, vitamin D intake is not significantly related to the incidence of anaemia ($p=0.417>0.05$). Nutritional status is not significantly related to the incidence of anaemia ($p=0.787 >0.05$). Factors that have a significant influence on anaemia are family income and gestational age. There is a need for further research regarding interviews using recall to determine the food ingredients consumed by respondents and education using questionnaires regarding anaemia in pregnant women.

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