Correlation between Micronutrient intake and Hemoglobin Preconception Women

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ABSTRACT

The preconception period is the time to prepare for pregnancy, and it is prone to anemia. While iron deficiency is considered the main cause of nutritional anemia, changes in vitamin B6, vitamin B12, folic acid and zinc status are also associated with the formation and hemoglobin levels. This study aims to determine the relationship between intake of iron, vitamin B6, vitamin B12, folic acid and zinc with hemoglobin levels in preconception women in Banggai Regency from October 2016 to April 2017. This study was cross-sectional study design. Using data from a 24-hour food recall assessment, measuring the daily intake for each respondent of 132 preconception women in three sub-districts in Banggai Regency. Micronutrient intake was obtained by comparing nutritional intake with the table of the Nutrient Adequacy Rate (NAR) 2013. Hemoglobin levels were measured by the *cyanmethaemoglobin* method. The result of this study, the proportion of RDA is below-estimated average needs. As a result, the average hemoglobin level was 12.67 ± 1.24 g/dl. There were 20% anemia, from anemia respondents suffering from mild anemia (16%) and moderate anemia (4%). With the Pearson correlation test, there was no significant relationship between iron (r=0.056), vitamin B6 (r=0,06), vitamin B12 (r=0.085), folic acid (r=0.062) and zinc intake with hemoglobin levels. In conclusion, the most preconception women are still at risk of lacking micronutrients such as iron, zinc, folate, vitamin B12, and vitamin B6. Prenatal counseling about the importance of nutrition for the health of pregnant women and their babies are needed.

***Keywords**: preconception women, micronutrient intake*

INTRODUCTION

Globally, around 32 million pregnant women and 273 million children under five suffer from anemia in Southeast Asia, the burden of anemia is very high and more than 1 in 4 women suffer from anemia during pregnancy. The causes of anemia vary, but iron deficiency has been identified as the most common and has been associated with an increased risk of maternal and perinatal death and poor birth outcomes[1].

Banggai Regency in Central Sulawesi Province, Indonesia has a high prevalence of anemia of 36.6% in women[2] compared to the prevalence of anemia on the national scale recently 22.7%[3] prevalence rate anemia is higher in Banggai Regency. The study was conducted in three sub-districts, namely Luwuk, North Luwuk and South Luwuk sub-districts in Banggai Regency, to determine the prevalence of anemia in preconception women. Anemia has been associated with poor health outcomes such as cognitive impairment, reduced work capacity, increased maternal morbidity and mortality, low birth weight, and increased fetal and neonatal mortality.

Anemia is a wide public health problem associated with an increased risk of morbidity and mortality. Among many factors, good nutrition (such as vitamins and mineral deficiencies), non-nutrients (such as infections and *hamoglobinopathies*, blood loss, and metabolic disorders) that contribute to the onset of anemia[4,5]. Although iron deficiency is a major cause of anemia, especially in women of reproductive age, anemia can also be caused by a lack of folic acid, vitamin B12, vitamin B6 and zinc status is also associated with the development and control of heme formation[5]. The point of determining *hemoglobin* for the diagnosis of anemia

in women of reproductive age <12 g / dl.

In the human body iron deficiency is very common as the most common cause of anemia throughout the world. To better understand iron deficiency anemia, for the production of erythrocytes requires iron. Need a large amount of strong iron for erythrocytes and its precursors, further for the production of hemoglobin and heme. Iron is very important for the structure and function of hemoglobin[6].

The prevalence of anemia is still highly influenced by micronutrient deficiency as one of the factors in heme synthesis in the body. Vitamin B6 deficiency can block the initial enzymatic steps of heme synthesis and use of iron in *erythropoietic* cells. Vitamin B6 deficiency of the aminolevulinate synthase enzyme can cause iron refractory[7]. This study aims to determine the relationship between micronutrient intake and hemoglobin levels in preconception women.

MATERIAL AND METHOD

This research was conducted in Banggai Regency in 3 sub-districts; Luwuk, North Luwuk and South Luwuk from October 2016 to April 2017. This research was an observational study with cross-sectional design. The study population consisted of 132 pre-conception women who were included in the inclusion criteria, aged between 18-35 years, had never been pregnant and did not suffer from an infectious disease. The research population has been registered to be married at the Office of Religious Affairs (ORA) of Banggai Regency, Central Sulawesi. Mothers come to sign an informed consent, are willing to take part in the research, and attend the recruitment process. The research data used a questionnaire which included the average intake of micronutrients for iron, folate, vitamin B6, vitamin B12, zinc and Hb examination as primary data.

The research data was obtained from the study population who entered the inclusion criteria by interviewing using a questionnaire. Data collection on the average intake of micronutrients (iron, folate, vitamin B6, vitamin B12, zinc) using in-depth interview methods for daily food consumption, 24-hour recall of food, namely quantitative methods of food consumption surveys that can provide information about food and drinks consumed by the subject for 24 hours. The 24-hour Food Recall method is used to assess the consumption of food eaten and drunk for the past 24 hours, since waking up yesterday morning to sleep at night, a 24-hour recall should be done repeatedly and not consecutive days. Food consumption intake data can represent respondents' eating habits.

The respondents' micronutrient intake data were then processed using Nutrisurvey software, compared to the adequacy of micronutrient consumption based on the table of NAR 2013. The NAR is a reference for nutritional intake for Indonesia aimed at knowing the right daily nutritional intake for individuals in Indonesia. To see the level of adequacy of micronutrients respondents used two categories of inadequate if <77% NAR and adequate if ≥ 77% NAR[8]. The next step is measuring the hemoglobin level of the subject using the cyanmethemoglobin method.

Research data is processed and analyzed statistically. Univariate analysis was carried out by entering data and then explained the mean and standard intake of iron, zinc, folate, vitamin B6, vitamin B12, *hemoglobin* levels in preconception women. The relationship of each intake of micronutrients with Hb levels was analyzed using bivariate Pearson correlation test analysis.

RESULTS

Data obtained from the results of the study showed that some respondents did not suffer from anemia by 80% with an average hemoglobin level of 12.67 ± 1.24 g/dl. A total of 27 respondents (20%) suffered from anemia, and most of the anemia respondents had mild anemia of 77.8% while moderate anemia was 22.2% (**Table 1**).

Table 1: Distribution of hemoglobin levels of respondents

Category	n	%
Anemia (Hb<12g/dl)	27	20
Non Anemia (Hb>12g/dl)	105	80
Total	132	100

Table 2 shows the mean intake of micronutrients among study participants. There is no correlation between micronutrient intake and haemoglobin level of the respondents. However, Vitamin B12 shows the highest adequacy levels while folic acid is the lowest.

Table 2: Average intake of micronutrients and respondents, and the results of the correlation with hemoglobin levels

Variable	Mean ± SD	Min	Max	Adequacy Levels (%)	p
Fe	6.29 ± **4.2**	1.98	24.39	48.38	0.52
Vit B6	0.92 ± **0.38**	0.38	2.63	70.76	0.49
Vit B12	2.92 ± **2.18**	0.10	2.91	121.66	0.33
Folic Acid	97.80 ± **48.18**	22.0	283.30	24.25	0.48
Zinc	6.04 ± **2.61**	2.12	19.85	46.46	0.99
Hb level	12.68 ± **1.24**	7.3	15.9		

DISCUSSION

Women of childbearing age have low iron reserves, so women tend to be more vulnerable to iron deficiency when iron intake is reduced or when demand increases. If the intake of too little food contains iron and iron in the consumption of low bioavailability and iron reserves in the body are used continuously to meet the required iron requirements, the stored iron will be depleted and the body will be deficient in iron[9].

The form of iron consumed and other constituents in food greatly affect the absorption of iron. Iron derived from plant products is often consumed, while iron with bioavailable higher in heme iron is often consumed in small amounts. Non-heme iron is often poorly absorbed[10]. Haem iron can be obtained about 40% iron in meat, fish, poultry and is well absorbed by the body, about 60% of iron is obtained from animal tissues (liver). Iron from plants (fruits, vegetables, grains, beans) non haem iron forms is relatively difficult to absorb. The average iron intake of respondents is still less than the recommended NAR and the level of adequacy is adequate, reaching only 48.38%. After being processed using Nutrisurvey software, it turns out that the consumption deficit of iron, so that the process of hemoglobin synthesis still uses iron reserves in the body. The 24-hour recall results stated the lack of iron consumption in respondents because the majority of iron sources were obtained from non-haem iron, namely vegetables, fruits, cereals (rice, corn) and consumption of haem iron from fish and ungags. The average consumption of iron negatively correlates with hemoglobin levels. Respondents who were not anemic, the consumption of iron deficit and the possibility of respondents still having iron stores of ferritin in the liver for hemoglobin synthesis.

The results showed that the average intake of vitamin B6 from respondents was insufficient, still less than the recommended NAR and only reached 70.76% (<77% NAR). 24-hour recall analysis showed that vitamin B6 intake on average was lower, and consumption of vitamin B6 did not correlate significantly with hemoglobin. Vitamin B6 deficiency can block the enzymatic steps of initial heme synthesis and use of iron in erythropoiet5ic cells. Vitamin B6 deficiency of the aminolevulinate synthase enzyme can cause iron refractory Vitamin B6 acts as an enzyme cofactor in the process of heme biosynthesis. This vitamin must be sufficient for hemoglobin synthesis so that the heme formation process runs well, when its availability in the body is low it will interfere with globin synthesis and is not available for erythropoiesis[7].

The average intake of vitamin B12 respondents was good, and reached 121.66%. The results of a 24-hour recall show that the food source of vitamin B12 consumed by respondents is eggs, fish, and poultry. Further analysis showed that vitamin B12 intake did not correlate significantly. Although vitamin B12 intake is good, but it does not directly increase hemoglobin levels, because micronutrients interact with each other to increase hemoglobin levels. Vitamin B12 plays a role in various metabolic as a coenzyme. Vitamin B12 (cobalamin), the active form of cobalamin as methylcobalamin, coenzyme synthase methionine, an enzyme involved in the synthesis of methionine and tetrahydrofolate from methyl tetrahydrofolate and homocystein. This is where the folate and cobalamin (vitamin B12) metabolic pathways meet and are called

"folate traps" Cobalamin deficiency is usually caused by poor absorption of folate in the digestive tract[11].

Food sources rich in folate are wheat germ, yeast, innards (especially liver), cereals, and leafy vegetables. The folate content in food will decrease significantly when it takes too long to cook vegetables. Folate is a sensitive molecule that can be degraded by heat and oxidation. This is what causes folate deficiency to occur[12]. Lack of consumption of folate by respondents. Because of the lack of sources of food consumption of folic acid from respondents such as liver, and meat, which is not a habit of the respondent's diet. The results of 24-hour recall, the average intake of folate respondents was inadequate, still less than the recommended and only reached 24.25% (<77% NAR). Analysis showed that folate intake did not correlate significantly with hemoglobin NAR. Because folic acid is not biochemically active, folate is converted to tetrahydrofolate acid and methyltetrahydrofolate. This form of folic acid is transported by receptor-mediated endocytosis in cells to maintain normal erythropoiesis. Lack of folate and cobalamin (vitamin B12) ultimately causes thymidylate deficiency. DNA contains 2 pyrimidine bases (thymin and cytosine) and 2 purine bases (adenine and guanine). When thymidylate or thymine is deficient in position in the strand the DNA will be replaced by uracil. When uracil units in the structure of DNA, repair enzymes know and try to repair DNA. If it fails to repair DNA abnormal DNA synthesis or apoptosis will occur, which will cause erythropoiesis to be ineffective[11].

Foods that contain lots of zinc come from animals, especially meat. Other foods rich in zinc are legumes, whole grains, nuts, and seeds. Heme formation can be disrupted if the body suffers from zinc deficiency and this usually occurs due to insufficient need for zinc[13]. The average zinc consumption of respondents was less than the recommended NAR and the level of adequacy was inadequate because it only reached 46.46% (NAR <77%). The results of the 24-hour recall analysis showed that respondents consumed fish, poultry and peanut groups as sources of zinc food. Zinc intake did not correlate significantly with hemoglobin. Zinc is involved in the synthesis of hemoglobin through the activity of zinc-dependent enzyme systems, namely aminolevulinic acid dehydrase which plays a role in heme synthesis, which occurs in the cytosol cell[14].

CONCLUSION

Preconception mothers are mostly at risk of lacking micronutrients such as iron, zinc, *folate*, vitamin B12, and vitamin B6 which can interfere with the formation of hemoglobin. Understanding the importance of nutrition is needed, through prenuptial counseling about the importance of nutrition for the health of pregnant women and their babies.

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