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The consumption of protein, zinc, and vitamin A associated with ferritin levels in pregnancy

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ABSTRAK

Latar Belakang: *Permasalahan gizi dalam kehamilan berupa defisiensi makronutrien, mikronutrien, dan anemia. Kejadian anemia defisiensi besi pada ibu hamil di Indonesia berdasarkan data WHO tahun 2019 dan Riskesdas 2018 adalah 44,2% dan 48,9%. Persentase kasus anemia pada ibu hamil di Sumatera Barat dan Kota Padang tahun 2019 adalah 18,10% dan 11,2% dengan penyebab antara lain defisiensi makronutrien dan mikronutrien dan pola konsumsi. Defisiensi besi dapat diidentifikasi dengan pemeriksaan kadar ferritin.*
Tujuan: *Penelitian ini bertujuan mengetahui hubungan asupan protein, asupan zink, dan vitamin A dengan kadar ferritin ibu hamil trimester III.*
Metode: *Penelitian analitik cross sectional ini dilaksanakan di Puskesmas Lubuk Kilangan dan Laboratorium Biomedik Universitas Andalas pada November 2021-Juli 2022. Subjek penelitian sebanyak 64 orang ibu hamil trimester III dan teknik sampling menggunakan total sampling. Asupan protein, zink, dan vitamin A diperoleh melalui wawancara menggunakan kuesioner SQ-FFQ dan kadar ferritin diperiksa dengan metode ELISA. Uji normalitas data mengunakan Kolmogorov Smirnov sementara analisis bivariat dan multivariat menggunakan uji korelasi Pearson dan regresi linear (p<0,05).*
Hasil: *Rerata asupan protein adalah 92.56 gr, asupan zink 7.35 mg, vitamin A 824,98 µgRE dan kadar ferritin 16,267 µg/L. Asupan protein (p=0,001; r= 0,714), zink (p=0,001; r=0,428) dan vitamin A (p=0,001; r=0,531) memiliki hubungan bermakna dengan kadar ferritin. Hasil uji regresi linear menunjukkan asupan protein merupakan factor yang paling berhubungan dengan kadar ferritin (p= 0,001; β=0,598).*
Kesimpulan: *Penelitian ini menyimpulkan terdapat hubungan bermakna antara asupan protein, zink, dan vitamin A dengan kadar ferritin ibu hamil trimester III. Pada kelas ibu hamil perlu diberikan edukasi gizi mengenai jenis dan peran gizi dalam mencegah anemia dan defisiensi besi*

KATA KUNCI: *asupan protein; ferritin; kehamilan; Vitamin A; zinc*

ABSTRACT

Background: *Macronutrient and micronutrient deficiencies, as well as anemia, are nutritional issues during pregnancy. According to WHO in 2019 and Basic Health Research in 2018, 44.20% and 48.90% of pregnant women in Indonesia were anemic. In 2019 there were 18.10% and 11.20% respectively of pregnant women who were anemic in West Sumatra Province and Padang City. Macro and micronutrient deficiencies as well as poor eating habits were the main causes of anemia in pregnancy. A trustworthy sign to detect iron deficiency anemia was the ferritin level.*
Objectives: *This research aimed to determine the association between protein, zinc, and vitamin A consumption with ferritin level in third trimester of pregnancy.*
Methods: *This analytical cross-sectional research was held in Lubuk Kilangan Health Center and the Biomedical Laboratory of Andalas University on November 2021-July 2022. The subject were 64 third trimester pregnant women. Protein, zinc, and vitamin A consumption were obtained by the SQ-FFQ questionnaire and the ferritin levels were examined by ELISA method. Normality test used Kolmogorov Smirnov. The bivariate and multivariate analysis used Pearson correlation and linear regression (p <0,05).*
Results: *The mean level of protein, zinc, and vitamin A consumption were 92.56 g, 7.35 mg and 824.98 µgRE and ferritin level 16.26 µg/L. Protein (p=0.001; r=0.771), zinc (p=0.001; r=0.428) and vitamin A consumption (p=0.001; r=0.531) were significantly associated with ferritin levels. The linear regression test revealed protein consumption was the most associated factor with ferritin levels (p = 0.001; β= 0.598).*
Conclusions: *There was a significant association of protein, zinc, and vitamin A consumption with ferritin levels in third trimester of pregnancy. Nutritional education about the types and roles of nutrients should be given to pregnant women in the antenatal class to prevent anemia and iron deficiency.*

KEYWORD: *consumption; ferritin; pregnancy; protein; vitamin A; zinc*

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INTRODUCTION

Nutritional issues in pregnancy include anemia and iron deficiency. According to data released by the WHO in 2019, Indonesia had a 44.20% anemia and iron deficiency rate in pregnant women (1). According to Basic Health Research, demonstrating a significant rise in anemia cases during pregnancy. The percentage of anemic pregnant women increased from 37.10% in 2013 to 48.90% in 2018 (2), this data shows there was a very significant increase in cases of anemia during pregnancy.

The percentage of anemic pregnant women in West Sumatra in 2018 was 18.10%. The same problem also happened in Padang City, the percentage of anemic pregnant women in 2020 was 10.10% and increased to 17.70% in 2021. Lubuk Kilangan Health Center was one of the health centers in Padang with a decrease in anemia cases in pregnancy of less than 1% (3), which means anemia in pregnancy is still one issue to resolve priority. Greater nutritional requirements, reduced food consumption, and non-variety foods are the main contributors to nutritional problems during pregnancy. Macro and micro-nutrients are known to have an association with the incidence of iron deficiency (4). One kind of macronutrient which is protein plays a role in in preventing iron deficiency and so do the others micronutrient such as zinc and

vitamins A (5), (6). Protein plays a role in hematopoiesis and furthermore, protein derived from animal foodstuffs contains highly bioavailable iron (7). Additionally, prior studies discovered that a lack of protein intake during pregnancy was associated with a 2.18 higher risk of anemia and low protein intake was a risk factor for low ferritin levels (8) (9).

Zinc-rich diets were advantageous for raising ferritin levels, erythrocyte counts, and IGF-1 levels, which were necessary for the manufacture of protoporphyrin IX (10), (11). Low ferritin levels during pregnancy might also result from a vitamin A deficiency(12) . Anemia can be diagnosed by hemoglobin levels and other biomarkers and serum ferritin level <30 µg/L is a reliable indicator to mark anemia and anemia iron deficiency in pregnancy (13).This research was the one and only to determine the association between these three independent variables with ferritin levels in the third trimester of pregnancy in Lubuk Kilangan Health Center. The purpose of this research was to determine the association between protein, zinc, and vitamin A consumption with ferritin levels in pregnancy.

MATERIALS AND METHODS

Research Design and Samples

This analytical cross-sectional research was held at the Lubuk Kilangan Health Center and the Biomedical Laboratory of Andalas University on November 2021- July 2022. The population were 64 pregnant women in the third trimester of pregnancy in seven sub-districts of the Lubuk Kilangan Health Center. Intake data collection was conducted by interviewing the SQ-FFQ to measure the consumption of protein, zinc, and vitamin A in daily food. Measuring ferritin levels using the Human Ferritin Kit from DBC (Diagnostics Biochem Canada) Inc. with the Enzyme-Linked Immunosorbent Assay (ELISA) method in sensitivity and specificity of 93.00% and 75.00%

Data collection Techique

The subjects of this research were chosen by total sampling based on inclusion and exclusion criteria. After receiving a brief description of the research's objectives, subjects were asked to sign an informed consent form to indicate their understanding and willingness to take part.

Three milliliters of venous blood from 64 pregnant women was taken by analysts during the research at the Lubuk Kilangan Health Center. Ferritin levels were examined by an analyst and researcher at the Biomedical Laboratory, Faculty of Medicine, Andalas University.

Statistical Analyses

The data were processed and analyzed statistically computerized and also presented in tabular form. The normal distribution of the data were controlled using the Kolmogorov-Smirnov test (n>50). The result of univariate analysis such as the characteristics of subjects was shown in the frequency distribution table. Furthermore, the analysis of bivariate and multivariate used Pearson correlation test and linear regression ($p<0.05$). This research has received ethical approval from The Research Ethics Committee of Medical Faculty Andalas University number 733/UN.16.2/KEP-FK/2022.

RESULTS AND DISCUSSIONS

Based on table 1 known that most pregnant women in the third trimester of pregnancy were 20-35 years (75.00%), gestational age was 28-33 weeks (84.40%), and not working (82.80%). Most of them were multiparous (43.80%) and had a high school education (56.20%).

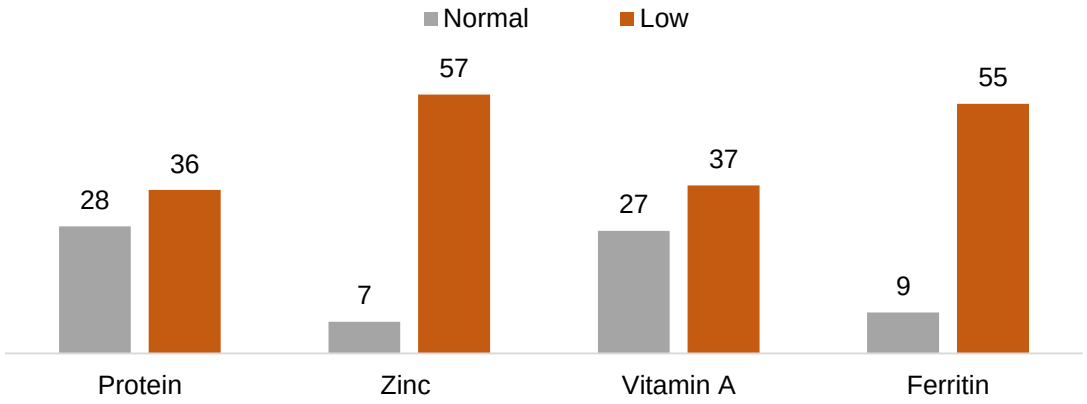
Table 1. The Characteristics of Pregnant Women

Characteristics	n	%
Age (Year)		
20-35	48	75.00
>35	16	25,00
Gestational age		
28-33 weeks	54	84.40
34-40 weeks	10	15,60
Parity		
Nulliparous	14	21.90
Primiparous	22	34.40
Multiparous	28	43.80
Occupation		
Working	11	17.20
No working	53	82.80
Education		
Elementary School Graduated	5	7.80
Junior High School Graduated	4	6.30
Senior High School Graduated	36	56.20
College Graduated	19	29.70

Based on the results (**Table 2**), known that the mean level of protein consumption (92.56 g) had reached the minimal standard for pregnant women in the third trimester which was 90 gr/day but not in the mean of zinc (7.35 mg), vitamin A (824.98 µgRE), and ferritin levels (16.26 µg/L) which were under the minimal standard; zinc 12 mg/day, vitamin A 850 µgRE/day, and ferritin levels 30µg/L.

Table 2. The Mean of Protein, Zinc, Vitamin A Consumption and Ferritin Levels

Variables	*n*	*Mean*	Min	Max
Protein (gr)	*64*	*92.56 ± 47.37*	*30.59*	*203.03*
Zinc (mg)	*64*	*7.35 ± 3.2*	*2.49*	*16.90*
Vitamin A (µgRE)	*64*	*824.98 ± 538.14*	*96.14*	*2619.22*
Ferritin levels (µg/L)	*64*	*16.26 ±14.70*	*1.98*	*62.08*



Graphic 1 The distribution of pregnant women based on the status of consumption and ferritin levels

Based on the results (**Table 3**) known that there was a significant association between protein, zinc, and vitamin A consumption with ferritin levels in pregnancy. Pregnant women who fulfill their protein, zinc, and vitamin A consumption would have better ferritin levels.

Table 3. Association of Protein, Zinc, and Vitamin A Consumption with Ferritin Levels

Independent variables	*Dependent variable*	*r*	*R^2 Linear*	*P-value*
Protein (gr)	*Ferritin Levels (µg/L)*	*0.714*	*0.510*	*0.001*
Zinc (mg)		*0.428*	*0.183*	*0.001*
Vitamin A (µgRE)		*0.531*	*0.281*	*0.001*

Based on the regression linear results (**Table 4)** known that protein consumption was the most associated factor with ferritin levels. Low protein intake results in low ferritin levels, which are then followed by low hemoglobin levels in the future.

Table 4. The Factors associated with Ferritin Levels

Model	β	t	*P- value*
(Constant)		-2.019	.048
Protein	.603	5.559	.001
Vitamin A	.219	2.014	.049
Iron	.110	.634	.528
Zinc	-.156	-.590	.558
Energy	.091	.499	.620
(Constant)		-4.685	.000
Protein	.601	5.580	.001
Vitamin A	.217	2.010	.049
Iron	.091	.542	.590
Zinc	-.059	-.331	.741
(Constant)		-4.780	.000
Protein	.590	5.823	.001
Vitamin A	.214	2.004	.050
Iron	.046	.466	.643
(Constant)		-4.853	.000
Protein	.598	6.034	.001
Vitamin A	.232	2.342	.022

Association between protein consumption with ferritin levels in pregnancy

Protein consumption contributed 51% to ferritin levels. Protein is a building block of life and one of the primary sources of nutrition and it has a role in supplying iron. Protein is the catalysator in heme and erythropoiesis synthesis, and a preventer of oxidant toxic potential (13). Transferrin is also a unique protein that transports iron. Fulfillment of inadequate iron during pregnancy triggers anemia which is characterized by low iron stores or ferritin levels (14)

Absorption of protein consumption from animal foods can increase iron absorption better than from plant foods. In this research found that most pregnant women had a deficiency in protein consumption. This thing showed that there was an association between protein consumption with ferritin levels. Two studies reported that there was a significant relationship between ferritin levels and protein consumption in pregnant women and mothers with low protein consumption had a 2.18 times higher risk of suffering from anemia (8), (9).

The reason that there were still many pregnant women who lacked protein consumption is the low frequency of consuming animal and plant protein. Adequate protein consumption but not consuming foods containing vitamin C is also the cause of low iron absorption in the body. This state is in line with research that reported there was highly increased hemoglobin in the iron and vitamin C group for two weeks of treatment (15).

The association between protein consumption and ferritin levels could be explained by a factor which is an amino acid that binds and catalysts the absorption of iron and create plasma transferrin. The synthesis of hemoglobin also requires sufficient protein. Pregnant women with adequate protein consumption but low ferritin levels could be caused by the consumption of inhibitor substances.

Pregnant women in this research consumed tea frequently, even though tea contains substances that inhibit iron absorption. This state was in line with some studies that declared tannin was found in tea as an iron inhibitor (16) This explanation implies that inadequate protein consumption and inhibitor factor affect iron storage, and iron metabolism, and also causes anemia.

Association between zinc consumption with ferritin levels in pregnancy

This research found that there was a significant association between zinc consumption with ferritin level, with a correlation value of 0.428 which indicates a mid positive association. Zinc contributed 18.3% to ferritin levels. Zinc is an essential mineral and plays a role in metabolism and biological process and high concentration is found in animal foods.

The association between zinc consumption with ferritin levels in this research could be explained for some reasons. First, pregnant women in this research consume more zinc from plant foods which is contained phytic; an inhibitor of zinc bioavailability (17). Second

related to the topography of the research area which is a high plateau and the access to the coast is far enough that affects getting high-zinc kinds of seafood.

Zinc has a role as a cofactor of levulinic acid which is needed in transferrin synthesis of the heme synthesis process and transported by the same transporter named transferrin (6). Erythropoietin binding to its receptor causes the release of GATA-1, a zinc-finger protein transcription that plays a role in erythrocyte synthesis. Lack of zinc consumption causes GATA-1 in hematopoiesis to decrease so that the production of ferritin and hemoglobin also decreased (18).

The result of this research was in line with the research in Ghana which reported supplementation of iron and zinc increased serum ferritin (19). The other researcher also reported that these combined minerals affected the increase of IGF-1, hemoglobin, and erythrocytes. The previous study also found that zinc was needed in protoporphyrin IX biosynthesis (10), (11).

Association between vitamin a consumption with ferritin levels in pregnancy

This research found that vitamin A consumption contributed 28.1% to ferritin levels, which means that 28.1% of vitamin A consumption affects ferritin levels. Vitamin A is one of several micronutrients that act as iron enhancers. Vitamin A also plays an important role in the absorption and mobilization of iron for erythropoiesis and the growth and differentiation of erythroid cells (20).

Fulfillment of vitamin A consumption is obtained through the consumption of various foods and animal foods, vegetables, and fruits are the primary sources of vitamin A. Pregnant women are recommended to consume 850 µgRE/day of vitamin A (21). The association between vitamin A consumption and ferritin levels was also found in some previous research (22).

This research also found that there were pregnant women who consume enough vitamin A but have low ferritin levels. This thing can be caused by some factors, one of them is consuming fewer foods that help vitamin A absorption which is protein and fat consumption (23). This finding was in with the result that most pregnant women had less protein consumption. The explanations conclude that enough vitamin A and iron consumption has the beneficial thing in decreasing and preventing iron deficiency and anemia and helping iron utilization and erythropoiesis.

Protein is the most associated factor with ferritin levels

The regression linear results concluded protein consumption contributed 53.5% to ferritin levels. Increased iron consumption during pregnancy is also needed to balance the increased needs of the mother and fetus. The previous research also reported protein consumption from animal foods has correlated with iron metabolism (24).

Protein plays a role in iron transport and the absorption of iron especially in apical duodenum requires a special protein transport

named transferrin (25). Protein also acts as a source of heme iron, which forms hemoglobin and blood grains. Lack of protein consumption affects iron absorption and causes the body to lack iron and decreases ferritin levels.

This research found that pregnant women consume more plant protein. The cause of this thing is associated with the study area which is far from the coast so has limited access to get high animal protein from seafood. Another thing is the economic and occupational status. An individual who has the ability to purchase food and has good nutritional knowledge is easier and more likely to fulfill nutritional needs. These explanations concluded that protein plays an important role in building body tissues and transporting iron. Animal protein consumption in this research was also affected by social and occupational status. Inadequate protein consumption affects the disruption of iron transport and creates iron deficiency and anemia.

CONCLUSIONS AND RECOMMENDATIONS

There was a significant association between protein, zinc, and vitamin A consumption with ferritin levels in pregnancy. Nutritional education about the types and roles of nutrients should be given to pregnant women in the antenatal class to prevent anemia and iron deficiency. Pregnant women also should have their care at the health center, midwives, and other health facilities.

This research used a reliable indicator to detect anemia and iron deficiency in pregnancy, but it still had a limitation, which did not examine the C-reactive protein in blood samples

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