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Relationship of Protein Intake with Hemoglobin and Reticulocyte Hemoglobin Levels in Pregnant Women

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ABSTRACT

Anemia in pregnant women is a big problem in Indonesia, including West Sumatra. In the city of Padang, the provincial capital and the largest city in West Of the 23 Puskesmas in Padang City, the highest cases of anemia in pregnant women were recorded at the Pauh Puskesmas, which was 20%. One of the important causes of anemia is iron deficiency in the body of pregnant women. Iron deficiency during pregnancy occurs due to a doubling of the need for iron caused by an increase in blood volume to meet the mother's needs and the fetus's growth during pregnancy. Protein is the structure of hemoglobin. Therefore, protein intake is important in preventing iron deficiency in the blood, especially in pregnant women. The mother's hemoglobin and reticulocyte hemoglobin levels are normal if protein intake is suitable during pregnancy. This study used a cross-sectional research design at the Pauh Puskesmas and the Central Laboratory of RSUP Dr. M. Djamil Padang. The research sample is 62 pregnant women. Sampling using consecutive sampling. Data analysis used the computerized SPSS Pearson Correlation test ($p<0.05$). The results showed that the average protein intake, hemoglobin, and reticulocyte hemoglobin in the first, second, and third trimesters was 88.20 g, 84.48 g, 86.48 g, 11.86 g/dL, 11.42 g/dL, 11.13 g/dL, 29.32 pg, 29.83 pg, and 28.95 pg. Protein intake significantly correlated with hemoglobin levels. Protein intake was significantly associated with reticulocyte hemoglobin levels.
The study concluded that there was a relationship between protein intake and hemoglobin and reticulocyte hemoglobin levels in pregnant women.

Keywords: *Pregnancy, Hemoglobin, Reticulocyte Hemoglobin, Protein Intake*

INTRODUCTION

Anemia during pregnancy is one of the biggest problems in Indonesia. It is a condition of pregnant women with hemoglobin (Hb) <11 g/dL in the first trimester, <10.5 g/dL in the second trimester, and <11 g/dL in the third trimester. The biggest cause of anemia during pregnancy in Indonesia is iron deficiency (iron deficiency anemia). Cases of iron deficiency anemia affect 40% of pregnant women and 42% of children worldwide [1,2,3].
The World Health Organization (WHO) states that around 40% of maternal deaths are related to anemia in pregnancy. The 2018 National Health Basic Research (Riskesdas) data stated that pregnant women who experienced anemia in Indonesia increased from the previous five years, namely in 2013, by 37.1% to 48.9% in 2018. The incidence of anemia in pregnant women in West Sumatra is 24.7% [4].

One of the important causes of anemia is iron deficiency in the body of pregnant women. Iron deficiency during pregnancy occurs due to a doubling of the need for iron caused by increased blood volume to meet the mother's needs and the fetus's growth during pregnancy.

Protein is the structure of hemoglobin. Therefore, protein intake is important in preventing iron deficiency in the blood, especially in pregnant women. If protein intake is suitable during pregnancy, the mother's hemoglobin and reticulocyte hemoglobin levels are normal [5,6].

Of the 23 Puskesmas (District Health Centre) in Padang City, the highest cases of anemia in pregnant women were recorded at the Pauh Puskesmas in Padang, with nearly 300 cases or around 20%.

Research on the relationship between cases of anemia in pregnant women and protein intake in Padang City has been carried out. Still, in general, these studies were carried out by examining hemoglobin and ferritin levels. So far, researchers have not found other studies related to protein intake with Ret-He levels [7,8].

LITERATURE REVIEW

Iron Deficiency Anemia

Iron deficiency anemia occurs due to a lack of iron in the blood. This anemia condition arises due to a reduced supply of iron for erythropoiesis due to depleted iron stores, resulting in reduced hemoglobin formation. This iron deficiency anemia is characterized by microcytic hypochromic anemia and decreased serum iron [9]. Iron deficiency anemia causes the formation of red blood cells and other functions in the body to be disrupted.

Nutritional anemia occurs due to a deficiency of nutrients the body needs to form and produce red blood cells. An example of nutritional anemia is anemia due to iron deficiency or iron deficiency anemia (ADB) [10].

Examination of iron deficiency anemia (ADB) can be done on several examination parameters, namely hemoglobin (Hb) level, hematocrit level (Ht), erythrocyte count, Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Red-cell Distribution Width (RDW)), Reticulocyte Hemoglobin Content (Ret-He/CHr), ferritin, Serum Iron (SI) and Total Iron Binding Capacity (TIBC).

Protein Intake

Protein is a source of macro-nutrients important for the body as building blocks and regulators. Lack of protein intake will obstruct iron transport, so that iron deficiency will occur. Foods high in protein, especially those of animal origin, contain lots of iron. The lower the protein intake, the person tends to have low hemoglobin levels and is at risk of anemia [11].

The level of protein consumption needs to be considered because the lower the level of protein consumption, the result is a person suffering from anemia. Proteins and blood pigments that are red in color function as carriers of oxygen and carbon dioxide in bonds called protein bonds. Protein also plays a role in transporting nutrients, including iron, from the digestive tract into the blood, blood to tissues, and cell membranes into cells (Setyandari, 2016).

Lack of protein will cause disturbances in the absorption and transportation of nutrients. Lack of protein intake from food can also cause protein synthesis in the blood to be disrupted. Iron is transported by a protein called transferrin in blood or other body fluids. Transferrin will carry iron in the blood, which will be used to synthesize hemoglobin. If the level of transferrin in the blood decreases, the transportation of iron cannot run properly, and in the end, the hemoglobin level in the blood also decreases (Setyandari, 2016).

Hemoglobin levels

Hemoglobin is a unique protein in erythrocytes that functions as an oxygen transport medium. So, oxygen that is inhaled and enters the lungs will later be transported again by hemoglobin in the blood to be distributed to the brain, heart,

kidneys, muscles, bones, and all organs of the body. Hemoglobin (Hb) is a protein that is very helpful in the blood. Located in the erythrocytes, whose job is to transport oxygen inside [12,13].

Anemia in pregnancy is a condition of pregnant women with hemoglobin (Hb) <11 g/dL in the first trimester, <10.5 g/dL in the second trimester, and <11 g/dL in the third trimester.

Reticulocyte Hemoglobin (Ret-He) Levels

Reticulocyte hemoglobin is the average value of the distribution of hemoglobin content in reticulocytes which describes the availability of iron in the process of erythropoiesis in the spinal cord in the last few days. The reticulocyte hemoglobin level accurately measures the available iron for hemoglobin production. The reticulocyte hemoglobin content will decrease when the iron for erythropoiesis is reduced [14,15].

Reticulocyte hemoglobin has good sensitivity and specificity as a parameter of iron status. The Ret-He cut-off value for diagnosing iron deficiency differed between countries, between 25 and 32.4 pg.

MATERIALS & METHODS

Study Design and Research Sample

This study used a cross-sectional research design at the Pauh Puskesmas and the Central Laboratory of RSUP Dr. M. Djamil Padang. The research sample is 62 pregnant women. Sampling using consecutive sampling.

Operational Definition

The dependent variable in this study was pregnant women's hemoglobin and reticulocyte hemoglobin levels. The Independent variable is the protein intake in pregnant women.

STATISTICAL ANALYSIS

Univariate analysis was used to explain the characteristics of the dependent and independent variables. The univariate analysis will produce a frequency distribution of each variable. Data analyzed univariately included gestational age, hemoglobin levels, reticulocyte hemoglobin levels, and protein intake.

Bivariate analysis was used to determine the relationship between the independent variables, which include protein intake, and the dependent variable, namely hemoglobin and reticulocyte hemoglobin levels. A normality test was performed by Kolmogorov-Smirnov (data > 50).

The normally distributed data is then tested with the Pearson correlation test, but if it is not normally distributed, it is tested with the non-parametric Spearman correlation test (Dahlan, 2020). The results of the data test with p <0.05 stated that there was a correlation between the two variables.

RESULT

Table 1. Characteristics of Pregnant Women

No	Characteristics	f	Percentage (%)
1.	**Age (Year)**		
	20-35 Year	47	75,8
	>35 Year	15	24,2
2.	**Gestational Age**		
	Trimester I	16	25,8
	Trimester II	19	30,7
	Trimester III	27	43,5
3.	**Parity**		
	Nullipara	14	22,6
	Primipara	22	35,5
	Multipara	26	41,9
4.	**Occupation**		
	Working	20	32,3
	Not Working	42	67,7
5.	**Education**		
	Elementary	3	4,8
	Middle High	3	4,8
	High School	36	58,1
	University	20	32,3

Table 1 shows that as many as 75.8% of pregnant women aged 20-35 years, as many as 27 people (43.5%) were in the third trimester, and 26 people (41.9%) had multiparous parity. 42 pregnant women do not work (67.7%). The most recent education was SMA/SMK, with 36 people (58.1%).

Table 2. Average Protein Intake in Pregnant Women

Variable	Gestational Age	F	Mean ± SD
Protein Intake	Trimester I	16	88,20 ± 61,00
	Trimester II	19	84,48 ± 38,99
	Trimester III	27	86,48 ± 40,52

Table 2 shows the average protein intake in first-trimester pregnant women is 88.20 g/day. This figure states that the average protein intake meets the minimum limit. The RDA for pregnant women in the first trimester is 61 g/day. Second-trimester pregnant women get a moderate protein intake of pregnant women, namely 84.48 g/day. This figure also states that the average protein intake meets the minimum limit for pregnant women in the first trimester, namely 70 g/day. In contrast, in the third trimester, the average protein intake for pregnant women is 86.48 g/day. This figure indicates that the average protein intake does not meet the minimum RDA for pregnant women in the third trimester, namely 90 g/day.

Table 3. Average Hemoglobin Levels in Pregnant Women

Variable	Gestational Age	F	Mean ± SD
Hemoglobin Levels	Trimester I	16	11,86 ± 1,46
	Trimester II	19	11,42 ± 1,16
	Trimester III	27	11,13 ± 1,52

Table 3 shows the average hemoglobin level of pregnant women, which is within the normal range of hemoglobin levels in pregnant women, namely in the first trimester ≥11.6 g/dL, second trimester ≥9.7 g/dL, and third trimester ≥9.5 g/dL

Table 4. Average Reticulocyte Levels in Pregnant Women

Variable	Gestational Age	F	Mean ± SD
Retikulosit Hemoglobin Levels	Trimester I	16	29,32 ± 3,08
	Trimester II	19	29,83 ± 2,55
	Trimester III	27	28,95 ± 3,15

Table 4 shows that pregnant women's average reticulocyte hemoglobin level is within the normal range, namely 28-36 pg.

Table 5. Correlation of Protein Intake with Hemoglobin Levels in Pregnant Women

Variable	f	Correlation coefficient (r)	*p-Value*
Protein Intake	62	0,600	0,000
Hemoglobin levels			

Table 5 shows a significant correlation between protein intake and hemoglobin levels in pregnant women with p = 0.000 (p <0.05). The direction of the relationship between these two variables is positive with a strong correlation (r = 0.600). It means that when the fulfillment of adequate protein intake, the better the hemoglobin level. The value of 0.36 in linear R2 means that protein intake contributes 36% to hemoglobin levels.

Table 6. Correlation of Protein Intake with Hemoglobin Levels in Pregnant Women

Variable	F	Correlation coefficient (r)	*p-Value*
Protein Intake	62	0,564	0,000
Retikulosit Hemoglobin Levels			

Table 6 shows a significant correlation between protein intake and reticulocyte hemoglobin levels in pregnant women with p=0.000 (p <0.05). The direction of the relationship between these two variables is positive with moderate correlation strength (r = 0.564). It means that when the fulfillment of protein intake is sufficient, the level of reticulocyte hemoglobin will also be better. The linear R2 obtained was 0.318. It stated that 31.8% of protein intake contributed to the levels of reticulocyte hemoglobin.

DISCUSSION

The average protein intake in third-trimester pregnant women based on the 2019 RDA in this study has not met the minimum limit set. It is in line with research by Purwaningtyas and Prameswari (2017) that there were 70 people (95.6%) pregnant women who experienced a lack of protein intake and 4 people (4.4%) pregnant women with adequate protein intake.

Protein intake in pregnant women plays a vital role in the transportation of iron in the body. Lack of protein intake will obstruct iron transport so iron deficiency will occur. Iron deficiency can affect hemoglobin levels. Low protein intake cannot be optimal in forming reticulocytes and hemoglobin. Low levels of reticulocyte hemoglobin and hemoglobin in the blood are indicators of anemia.

This study found that the cause of insufficient protein intake based on interviews using the FFQ questionnaire was

the infrequent consumption of animal and vegetable protein foods. Sources of protein from food can be in the form of animal and vegetable protein. Animal protein is the best and high-quality protein because it is easily absorbed and of high quality, composed of complete essential acids, and the structural structure is almost the same as what the body needs.

The average hemoglobin level of pregnant women was 11.86 g/dL in the first trimester, 11.42 g/dL in the second trimester, and 11.13 g/dL in the third trimester. This figure states that pregnant women's average hemoglobin level has reached normal.

Hemoglobin is a protein molecule in red blood cells that is a medium for transporting oxygen from the lungs to all body tissues and carrying carbon dioxide from body tissues to the lungs. Hemoglobin level is a measure to determine the amount of hemoglobin in units of g/dL. Low hemoglobin levels can indicate anemia in pregnant women.

Hemoglobin requires iron and protein in the formation of synthesis. Protein plays a role in the transportation and storage of iron and helps the absorption of iron. The number of reticulocytes in the blood of pregnant women has increased due to increased needs during pregnancy and an ineffective healthy lifestyle, insufficient nutritional needs of pregnant women such as protein, vitamin C, and iron, causing the process of absorption of Fe in the body to be unstable which can result in the level of hemoglobin in the blood decreases so that the production of reticulocytes increases.

Protein is a substance that builds body tissues, forms body structures, and substances for growth, transports oxygen and nutrients, and immunity to the body. Protein plays a vital role in the transportation of iron in the body. A lack of protein intake causes iron transport to be hampered, resulting in iron deficiency.

Foods that are high in protein, especially foods of animal origin, usually contain more iron. Intake of animal protein can increase the absorption of iron in the body. Low protein consumption can lead to low absorption of iron by the body. This condition can cause the body to lack iron and can cause a decrease in reticulocyte levels and inhibit hemoglobin formation.

The need for protein during pregnancy will increase the fetus's growth and maintain the mother's health. Pregnant women are encouraged to consume foods derived from animal protein, such as fish, meat, eggs, and milk because animal protein contains amino acids that are complete and easy to digest to meet the nutritional needs of mothers during pregnancy [2,3].

Research by Fera et al. (2021) states that hemoglobin levels in pregnant women are normal because they consume enough animal protein. This study supports the results obtained by Tarigan et al. (2021), namely that there is a relationship between protein intake and the anemia status of pregnant women. Food sources of protein consumed by pregnant women with normal hemoglobin levels are animal protein and heme iron.

CONCLUSION

This study concludes that there is a relationship between protein intake and hemoglobin levels in pregnant women, and there is a relationship between protein intake and reticulocyte hemoglobin levels in pregnant women.

Declaration by Authors

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REFERENCES

1. Manuaba, Ida Bagus. (2013). *Ilmu Kebidanan, Penyakit Kandungan & Keluarga Berencana untuk Pendidikan Bidan*. Jakarta: Kedokteran EGC.
2. *World Health Organization Global Health Observatory*. (2020). Tersedia dari: URL: http://www.who.int

3. Dinkes Kota Padang. (2020). *Profil Kesehatan Tahun 2020*. Padang: Dinas Kesehatan Kota Padang.
4. Riset Kesehatan Dasar. (2018). *Laporan Provinsi Sumatera Barat Riskesdas Tahun 2018*. Sumatera Barat: Badan Penelitian dan Pengembangan Kesehatan.
5. Tarigan, Lora, dan Siti. (2021). Asupan Energi, Protein, Zat Besi, Asam Folat, dan Status Anemia Ibu Hamil di Wilayah Kerja Puskesmas Petumbukan. *Wahana Inovasi, Vol. 10, No. 10, Januari-Juni 2021 (2089-8592)*.
6. Fera, Dian. Maiza, D. Enda, S. (2021). The Relationship Adequacy of Animal Protein Consumption and Hemoglobin Levels for Pregnant Women. *JNS: Journal of Nutrition Science. Vol. 2, No. 1*.
7. Badriyah, Nurul. (2021). Hubungan Status Gizi dan Kadar Vitamin C dengan Kadar Hemoglobin pada Ibu Hamil Anemia di Wilayah Kerja Puskesmas Pauh Kota Padang. *Jurnal Kesehatan Andalas 2021*.
8. Jasnidar, Ariva. (2021). Hubungan Asupan Protein dengan Kejadian Anemia pada Ibu Hamil Trimester III di Wilayah Kecamatan Lubuk Kilangan Kota Padang. *Jurnal Kesehatan Andalas 2021*.
9. Setiawan, A. Lipoeto, N (2013). Hubungan Kadar Hemoglobin Ibu Hamil Trimester III dengan Berat Bayi Lahir di Kota Pariaman. *Jurnal Kesehatan Andalas. 2013; 2 (1): 34-7*.
10. Iqbal, Muhammad. Desty Ervira. (2018). *Penilaian Status Gizi ABCD*. Jakarta: Salemba Medika.
11. Hardinsyah. Dewa Nyoman. (2016). *Ilmu Gizi: Teori & Aplikasi*. Jakarta: EGC Kedokteran
12. Arisman. (2014). *Gizi dalam Daur Kehidupan*. Jakarta: EGC Kedokteran.
13. Kilic, Merve. Aysel, O. Mustafa, S. Meltem, K. Muhittin, S. (2022). The Effect of Reticulcyte Hemoglobin Content on the Diagnosis of Iron Deficiency Anemia: A Meta-Analysis Study. *J Med Biochem 2022; 41 (1)*.
14. Dalimunthe, N.N. A.R. Lubis. (2014). Peningkatan Nilai Parameter Status Besi Reticulocyte Hemoglobin Equivalent setelah Pemberian Suplemen Besi Intravena pada Pasien Hemodialisis Reguler. *Journal of Medical School 47 (2): 82-85*.
15. Sysmex Europe. (2016). The Importance of Reticulocyte Detection. *Sysmex Educational Enhancement and Development, Januari:2-8*.

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