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Analysis of dietary patterns on the nutritional status of pregnant women in Depok City, West Java

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ABSTRACT

Background: *The nutritional status of pregnant women affects fetal growth. Inadequate nutrition intake can lead to poor maternal nutritional status, ultimately resulting in insufficient nutrients being transferred to the fetus. A good and correct dietary pattern and nutritional intake will meet the nutritional needs of pregnant women.*
Objective: *To determine the relationship between dietary pattern and nutritional intake with the nutritional status of pregnant women, including CED status, anemia status and weight gain in Pancoran mas, Depok City .*
Method: *This study was* a prospective cohort conducted on 115 pregnant women*. Respondents were observed for 7 days over 4 weeks to measure their dietary patterns and nutritional intake using Food Frequency Questionnare (FFQ) and the* 24-hour *Food Record* and then processed using Nutrisurvey*. Their nutritional status was then measured. CED and anemia status were measured using MUAC and hemoglobin tester after observation. Weight gain was measured before and after observation. The data were analyzed using the chi-square test.*
Results: *The average energy intake of respondents was 1.884,2 383,30 kcal/day; the average protein intake was 79 14,75 gram/day; the average iron intake was 24,8 12,3 mg/day; and the average folic acid intake was 359,6 83,04 mcg/day. There was a relationship between dietary patterns and the risk of CED, anemia status, and weight gain ($p<0.05$). There was a relationship between energy and protein intake and weight gain in pregnant women ($p<0.05$).*
Conclusion: *Dietary patterns are related to the nutritional status of pregnant women. The average intake of energy, protein, iron, and folic acid in pregnant women is still far from the nutritional adequacy level. Health workers are expected to strengthen nutrition education, and pregnant women are expected to pay attention to their dietary patterns and nutritional intake during pregnancy.*

KEYWORD*: dietary patterns; nutritional status; pregnant women*

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INTRODUCTION

A pregnant woman's nutritional status reflects the body's equilibrium, shaped by dietary intake and the utilization of nutrients to sustain life and preserve organ function (1). The nutritional status of pregnant women can be evaluated through the risk of Chronic Energy Deficiency (CED) assessed by Mid-Upper Arm Circumference (MUAC), anemia status determined by hemoglobin levels, and pre-pregnancy Body Mass Index (BMI), which is calculated from pre-preg-nancy weight and height alongside weight gain during gestation (2).

Pregnant women with poor nutritional status cause a lack of nutrients for the fetus. If food is insufficient, the fetus will adapt by slowing down its growth (3). If the fetus experiences malnutrition throughout preg-nancy, the baby will be small and propor-tionate. When fetal malnutrition occurs during the mid or late stages of pregnancy, the newborn is likely to be underweight or shorter in length (4). Fetal growth disorders result in long-term complications such as hyper-tension, increased risk of metabolic diseases, cardiovascular disorders, kidney disorders, and neurological disorders (5). Malnutrition in pregnant women remains a challenge, with 28% of pregnant women suffering from anemia and 17% at risk of CED. About one in every four women has her first birth prior to turning 20 years old. According to the Kemenkes RI (6), malnutrition among preg-nant women remains a concern, with close to three out of ten experiencing anemia and 17% identified as being at risk of CED. Furthermore, data from Kemenkes RI (6) indicate that anemia among pregnant women remains a public health concern in Indonesia, with a prevalence rate of 27.7%. The propor-tion of anemia decreased by 21.2% (from 48.9% to 27.7%) when compared to Riskesdas (7). The most significant reduction in anemia prevalence among pregnant women occurred in the 15–24 age group, dropping from 84.6% to 14.5%. In contrast, within the 24-34 age group, which accounts for most pregnancies, the decline was minimal at only 2.3% (from 33.7% to 31.4%).

Diet is a determinant of nutritional status. When dietary intake is adequate and appropriate, it meets the nutritional demands of both the pregnant woman and her fetus. Diet is defined as the composition of food consumed at a particular time, including meal frequency, variety, and portion size. The increasing availability of diverse foods and the ease of access through online services, however, may hinder optimal fulfillment of nutritional requirements.

The coverage of maternal health services in Depok City in 2023 was 47,540, spread across all government and private health service centers. CED was identified in 1,350 pregnant women, whereas 2,319 experienced anemia. It can be calculated that the percentage of nutritional disorders in pregnant women was 7,7% of all pregnant women (8). This is a matter of considerable concern given the impact of these problems. Therefore, this study carried out a dietary

assessment to examine the nutritional status of pregnant women in Pancoran Mas, Depok City.

MATERIALS AND METHODS

This research employed a cohort prospective method. Dietary patterns refer to the quantity, proportion, variety or combination of various foods. It was measured using Food Frequency Questionare (FFQ). Assestment was conducted using a scoring system and categorized into good with a score (71-140) and poor with a score (1-70). The nutritional intake questionnaire used a 24-hour Food Record and was processed using Nutrisurvey. Dietary patterns and nutritional intake will be observed for 7 days over 4 weeks with the following details: Week I (Monday and Tuesday), Week II (Wednesday and Thursday), Week III (Friday and Saturday), Week IV (Sunday).

Nutritional status assessment includes CED status, anemia status and weight gain. CED status was measured using the MUAC after observation. Anemia status is defined as a hemoglobin level <11g/dL. Hemoglobin levels sere measured after observation. Weight gain was defined as the weight after the observation minus the weight before the observation. The instruments applied in the study were a measuring tape and an *Easy Touch* GCHb digital hemoglobin tester and scale.

The sample size was calcilated using the Slovin formula, and the sampling technique used was simple random sampling. The study sample comprised 115 pregnant women who fulfilled the inclusion criteria, namely pregnant women who could read and hear well and did not have eating disorders, and the exclusion criteria, namely pregnant women with pathological diagnoses such as antepartum hemorrhage, hypertension, history of prematurity, and pregnant women with other complications such as diabetes mellitus, tuberculosis, and HIV/AIDS.

The data collected in this study were analyzed using percentage, mean values, minimal-maximal and standard deviation to describe the data characteristics. Data analysis used the chi-square test to determine relationship between dietary paterns and nutritional intake with nutritional status of pregnant woman. Ethical clearance for this research was granted by the Health Research Ethics Committee, Faculty of Health Sciences, National University, with approval number 058/e-KEPK/FIKES/VI/2025.

Table 1. Characteristics respondent

Characteristics	n	%
Age		
Risk	24	20.9
No risk	91	79.1
Education		
Basic-Intermediate	101	87.8
Advanced	14	12.2
Work		
Not working	75	65.2
Working	40	34.8
Parity		
Primipara	41	35.7
Multipara	51	44.3
Grandemultipara	23	20

RESULTS AND DISCUSSION

RESULTS

Based on the results **Table 1** of data analysis in this study, the following results were found. In addition to the characteristics of the respondents, we found the average measurements of nutritional status and nutritional intake as follows. Based on **Table 2**, the average MUAC of respondents was 25.7 cm, the average Hb level was 10.9 g/dL, and the average weight gain in 1 month was 1.157 grams. The average energy intake of respondents was 1.884.2 kcal, the average protein intake was 79 grams, the average iron intake was 24.8 mg, and the average folic acid intake was 359.6 mcg. The chi-square test results are as follows.

Based on **Table 3**, the statistical test results showed a p-value of 0.000 (<0.05), meaning that there was a significant

Table 2. Average Measurement of Nutritional Status and Nutrient Intake

Variables	Mean	Min-Max	SD
MUAC (cm)	25.7	18 – 33	3.21
Hemoglobin level (g/dL)	10.9	7.1 – 14.1	1.34
Weight gain (gr)	1.157	0 – 3.000	687.01
Energy (kcal)	1.884.2	1.209 – 2.710	383.3
Protein (gr)	79	46.4 – 116.1	14.75
Iron (mg)	24.8	7.8 – 56.8	12.03
Folic Acid (µg)	359.6	200.8 – 610.2	83.04

Table 3. Relationship between dietary patterns, energy intake, protein intake, iron intake, folic acid intake, and CED Status

Variable	CED Status				Total		P-Value
	Risk CED		Not Risk CED				
	n	%	n	%	n	%	
Diet							
Poor	13	56.5	10	43.5	23	100	0.000*
Good	12	13	80	87	92	100	
Energy							
Poor	7	29.2	17	70,8	24	100	0.476
Adequate	18	19.8	73	80,2	91	100	
Protein							
Poor	8	18.6	35	81.4	43	100	0.692
Adequate	17	23.6	55	76.4	72	100	
Iron							
Poor	13	20.6	50	79.4	63	100	0.929
Adequate	12	23.1	40	76.9	52	100	
Folic Acid							
Poor	25	22.5	86	77/5	111	100	0.283
Adequate	0	0	4	1-Mar	4	100	

(note: *p<0,05 Chi-square test)

Table 4. Relationship between dietary patterns, energy intake, protein intake, iron intake, folic acid intake, and anemia status

Variable	Anemia Status				Total		P-Value
	Anemia		Not Anemia				
	n	%	n	%	n	%	
Diet							
Poor	17	73.9	6	26.1	23	100	0.001*
Good	30	32.6	62	67.4	92	100	
Energy							
Poor	13	54.2	11	45.8	24	100	0.209
Adequate	34	37.4	57	62.6	91	100	
Protein							
Poor	18	41.9	25	58.1	43	100	1
Adequate	29	40.3	43	59.7	72	100	
Iron							
Poor	28	44.4	35	55.6	63	100	0.504
Adequate	19	36.5	33	63.5	52	100	
Folic Acid							
Poor	44	39.6	67	60.4	111	100	0.158
Adequate	3	75	1	25	4	100	

*Note: *p<0,05 Chi-square test*

Table 5. Relationship between dietary patterns, energy intake, protein intake, iron intake, folic acid intake, and weight gain

Variable	Weight Gain				Total		P-Value
	Less		Normal				
	n	%	n	%	n	%	
Diet							
Poor	18	73.3	5	21.7	23	100	0.001*
Good	35	38	57	62	92	100	
Energy							
Poor	22	91.7	2	8.3	24	100	0.000*
Adequate	31	34.1	60	65.9	91	100	
Protein							
Poor	13	30.2	30	69.8	43	100	0.015*
Adequate	40	55.6	32	44.4	72	100	
Iron							
Poor	29	46	34	54	63	100	1
Adequate	24	46.2	28	53.8	52	100	
Folic Acid							
Poor	51	45.9	60	54.1	111	100	0.873
Adequate	2	50	2	50	4	100	

*Note: *p<0,05 Chi-square test*

relationship between dietary patterns and CED status. Statistical tests showed that there was no relationship between energy intake, protein intake, iron intake, and folic acid intake with CED status (>0.05).

Based on **Table 4**, the statistical test results showed p = 0.001 (<0.05), meaning that there was a significant relationship between dietary patterns and the incidence of anemia. Statistical tests showed no relationship between energy intake, protein intake, iron intake, and folic acid intake and anemia status (>0.05).

Based on **Table 5**, the statistical test results showed p = 0,001 (<0.05), which means there was a significant relationship between diet and weight gain. The p-value = 0,000 (<0.05) indicated a highly significant relationship between energy intake and weight gain. The statistical test showed p = 0,015 (<0.05), meaning there was a significant relationship between protein intake and weight gain. The test results showed p = 1,000 (>0.05), which means there was no significant relationship between iron intake and weight gain. The test results showed p = 0,873 (>0.05), so there was no significant relationship between folic acid intake and weight gain.

DISCUSSION

Based on **Table 2**, this study identified that the mean daily energy intake among respondents was 1.884,2 kcal, which does not meet the Indonesian Nutrient Adequacy Rate. The Recommended Dietary Allowance (RDA) recommends an additional 180 kcal/day in the first trimester and an increment of 340-450 kcal/day during the second and third trimesters of pregnancy (9). Therefore, if pregnant women are of reproductive age, the average energy required for pregnant women is 2.400-2.550 kcal/day. During pregnancy, maternal energy expenditure increases due to weight gain and the growth of maternal and fetal tissues. To meet these additional metabolic demands, the Dietary Reference Intakes (DRI) advise an increase in daily energy intake of about 340 kcal in the first trimester and 452 kcal in the third trimester to support healthy pregnancy outcomes (10). The nutrients available to the fetus depend on the mother's dietary intake, the nutrient concentration in her blood, and the placenta's ability to transfer these nutrients into the fetal circulation. Inadequate energy and micronutrient intake are associated with low maternal weight, loss of maternal fat reserves, and impaired fetal growth (11).

This also did not meet the RDA. The study also found that the average protein intake of respondents was only 79,0 grams/day. Protein requirements during pregnancy are 1 gram/day in the first trimester, 10 grams/day in the second trimester, and 30 grams/day in the third trimester (9). During pregnancy, protein requirements rise, with protein being deposited in the fetus, placenta, and maternal tissues such as the breasts. A total of approximately 925 grams of protein is accumulated, of which 440 grams are

allocated to fetal development, 216 grams to the expansion of blood and extracellular fluid, 166 grams to uterine growth, and 100 grams to the placenta (12). Additional protein is needed to maintain tissue development.

This study identified that the aver-age daily iron intake among participants was 24,8 mg, which did not align with the RDA. Iron requirements are set at 18 mg/day in the first trimester and rise to 27 mg/day for the second and third trimester (9). Iron is essential for supporting the rise in red blood cell production that occurs during pregnancy. Adequate iron intake can prevent complications during pregnancy such as iron deficiency anemia, reduce the risk of low birth weight, premature birth, and reduce the risk of fetal growth disorders in the womb (13). If pregnant women do not get enough iron intake, they will experience anemia. Anemia in pregnancy is defined as hemoglobin levels falling below 11 g/dL in the first and third trimesters, or below 10.5 g/dL in the second trimester(14).

Iron demand increases during gestation, with the highest requirements occurring in the second and third trimesters due to accelerated fetal development. Although iron absorption increases during pregnancy, iron intake is often insufficient. Maternal iron requirements rise substantially during pregnancy, with total additional needs exceeding 1.000 mg across gestation. Approximately 300-350 mg of this iron is allocated for fetal and placental growth, while an extra 250-450 mg or more supports the expansion of maternal blood volume and compensates for blood loss during delivery (15). These iron needs are typically not met through a regular diet. Moreover, pregnancy is accompanied by conditions that may heighten the risk of maternal malnutrition. Therefore, the WHO recommends iron supplementation for pregnant women.

Iron intake can be categorized into heme iron, obtained from animal products such as meat and fish, and non-heme iron, which is found in plant-derived foods and supplements. Compared to non-heme iron, heme iron exhibits greater bioavailability and is minimally affected by dietary absorption inhibitors (16). In non-anemic conditions, the absorption rate of heme iron from animal-based foods reaches 25%, while in anemic conditions, the absorption rate exceeds 35%. Meanwhile, plant-based foods containing iron only have an absorption rate of only 1-5% (17).

Folic acid functions as a coenzyme, which is essential in amino acid metabolism, cell division, and tissue growth. Insufficient folate consumption during the preconception stage is associated with neural tube defects and various congenital malformations. Current guidelines recommend a daily intake of 400 µg folic acid for pregnant women –(18). This study found that the average folic acid intake was 359.6 µg/day, which is slightly below the recommended amount. This condition indicates a potential risk if requirements are not consistently met. Evidence indicates that daily iron and folic acid

supplementation effectively reduces the likelihood of low birth weight and neural tube defects (NTDs), while also preventing anemia and iron deficiency among pregnant women (19). NTDs can be largely prevented through daily folic acid supplementation. Because the neural tube closes by the 28th day of gestation, folic acid intake starting in the preconception period is essential to minimize the risk of NTDs (20).

Folic acid deficiency can cause anemia due to the formation of immature red blood cells. The Indonesian government recommends that pregnant women consume folic acid and iron tablets during pregnancy, amounting to 90 tablets. The iron-folic acid supplementation program should be supported by rigorous monitoring and evaluation. Tools such as the Maternal and Child Health book (MCH Books) and Posyandu services can be utilized to track the health status of pregnant women and their adherence to folic acid supplementation (21).

Relationship between Dietary Patterns, Energy Intake, Protein Intake, Iron Intake, Folic Acid Intake, and CED Status

The findings of this study based on **Table 3** indicate a significant association between dietary patterns and CED status (p = 0,000). Respondents with poor dietary patterns had a higher risk of CED than respondents with good dietary patterns. In contrast, energy, protein, iron, and folic acid intake were not significantly associated with CED status, despite observable differences between the deficient and adequate groups. CED among pregnant women may arise as a result of infections or inadequate dietary patterns during pregnancy. Optimal nutritional intake during pregnancy is determined by multiple factors, such as maternal knowledge of nutritional requirements, household and environmental sanitation, age, gender, marital status and spousal age difference, educational level, socioeconomic status, and the availability of food within the household (22).

CED is defined as a nutritional disorder in which energy intake falls short of the body's requirements, thereby disrupting the balance between demand and availability of nutrients. MUAC measurement is a practical indicator for detecting the risk of CED in pregnant women. Pregnant women with MUAC <23.5 cm are classified as at risk for CED. Adequate dietary intake is therefore vital to preserve maternal health and ensure optimal fetal development (23). CED during pregnancy is associated with heightened risks of anemia, hemorrhage, deviations in weight gain, and increased vulnerability to infections. In fetuses, CED can cause growth disorders, premature birth, and even miscarriage (abortion). Therefore, adequate nutrition before and during pregnancy is very important for mothers because it directly affects fetal growth and development (24).

Efforts are needed to address the nutritional needs of pregnant women suffering from CED, one of which is through the provision of supplementary food. Supple-

mentary foods may consist of items that are energy-dense and provide a balanced amount of protein (25). Supplementary feeding in pregnant women with CED has been shown to enhance nutritional status, support maternal weight gain, and promote fetal growth. Balanced Energy-Protein (BEP) supplementation, which provides energy with a proportional protein content (less than 25% of total energy), has been shown to effectively improve maternal body composition, as indicated by increases in MUAC(26,27).

Relationship between Dietary Patterns, Energy Intake, Protein Intake, Iron Intake, Folic Acid Intake, and Anemia Status

Nutritional intake is a key determinant in the prevention and management of anemia. Consumption of foods that contain balanced macronutrients and micronutrients, rich in iron, vitamin B12, and folic acid is essential to support the formation of healthy red blood cells. The diet of pregnant women should include all essential nutrients in their daily consumption. During pregnancy, the fetus obtains nutrients and iron from the mother's body, so the mother's iron levels tend to decrease(28).

In this study based on **Table 4**, it was found that only diet had a significant relationship with anemia status (P = 0,001). Meanwhile, the variables of energy, protein, iron, and folic acid intake did not show a significant relationship with anemia status. This indicates that the interaction of various factors in the overall diet is more important than the intake of a particular type of nutrient alone.

The World Health Organization defines anemia in pregnancy as hemoglobin (Hb) levels below 11 g/dL, categorized by severity: mild anemia (Hb 9-10,9 g/dL), moderate anemia (Hb 7-8,9 g/dL), and severe anemia (Hb 4,5-7 g/dL) (29). Anemia during pregnancy poses serious risks for both mother and fetus. It can lead to maternal fatigue, increased risk of fetal anemia, low birth weight, preterm delivery, postpartum hemorrhage, impaired fetal growth, and even mortality. Additionally, anemia negatively impacts work performance, reduces immune function, causes shortness of breath, and diminishes both physical and cognitive capacities (30). If a pregnant woman has anemia, her body is unable to produce enough red blood cells, so the body's oxygen needs are not adequately met.

Anemia in pregnant women is caused, among other things, by an unbalanced diet and nutrient absorption during pregnancy. Nutritional status is greatly influenced by nutritional intake, so pregnant women who do not meet their macro and micro nutrient requirements through a balanced diet are at risk of nutritional problems that can ultimately lead to anemia (31). A woman should consume at least five of the ten key food groups—including grains, tubers, eggs, nuts, green vegetables, dairy products, meat, and fruits—to ensure adequate intake of essential micronutrients such as vitamins A, D, E, folate, calcium, iron, and magnesium. Ade-

quate consumption of these foods can help prevent anemia in pregnancy and lower the risk of low birth weight(32).

The Relationship Between Dietary Patterns, Energy Intake, Protein Intake, Iron Intake, and Folic Acid Intake with Weight Gain

Based on **Table 5** this study showed that there was a significant relationship between diet, energy intake, and protein intake with weight gain in pregnant women. Respondents with poor dietary patterns mostly (73,3%) experienced inadequate weight gain compared to those with good dietary patterns (38%) (p=0.001). A similar pattern was observed in energy intake, where there was a significant relationship with weight gain (p=0.000). A significant relationship was also found for protein intake (p=0.015). However, distribution showed that respondents with adequate protein intake experienced more inadequate weight gain (55.6%) compared to those with inadequate protein intake (30.2%). Meanwhile, iron and folic acid intake did not show a significant relationship with weight gain.

This is in line with research conducted by Ronaldi et al., (33) which states that weight gain during pregnancy is influenced by food intake. Diet during pregnancy has a significant relationship with weight gain in mothers. Weight gain in pregnant women is also associated with low birth weight and stunting. Underweight pregnant women are at higher risk of giving birth to low birth weight babies or experiencing intrauterine growth restriction. Low birth weight itself is a risk factor for various health problems in children, including stunting. Pregnant women who experience excessive weight gain, such as those who are overweight or obese, also face multiple risks and complications during pregnancy, such as diabetes mellitus, hypertension, preeclampsia, cesarean section, macrosomia, postpartum hemorrhage, and even death of the mother or fetus(34).

According to Ta'adi et al., (35) normal weight gain for pregnant women in Indonesia ranges from 10 to 12 kg, with approximately 1,1 kg gained in the first trimester, 2,2 kg in the second trimester, and 5 kg in the third trimester. Weight gain in pregnant women is influenced by fetal growth, the placenta, amniotic fluid, enlargement of the reproductive organs, increased blood volume, and body fat reserves. If the mother was underweight before becoming pregnant, intervention must begin from the first trimester to achieve the ideal weight. During the second trimester, the body prioritizes fetal nutrient requirements, meaning that insufficient maternal energy stores can compromise fetal growth (36). Energy requirements during pregnancy also have a significant effect on maternal weight gain. In pregnant women with normal conditions, an additional 180-300 kcal and up to 30 grams of protein per day are required. Meanwhile, to achieve a weight gain of about 0,5 kg per week, including in pregnant women with CED, an additional energy intake of about

500 kcal per day is required. However, the proportion of protein in the additional food should not exceed 25% of the total energy (25). Energy balance is determined by energy intake and expenditure. During pregnancy, energy requirements increase by approximately 200 kcal/day in the first trimester, 300 kcal/day in the second trimester, and 400 kcal/day in the third trimester. However, these figures may vary depending on BMI, basal metabolism, and physical activity. Chen et al., (37) reported that the average increase in maternal energy intake during pregnancy was only about 132 kcal/day, which is substantially lower than the increments recommended in many nutritional guidelines.

Protein consumption during pregnancy is essential for the development of fetal and placental tissues. Variations in the impact of animal versus plant proteins on fetal growth are believed to result from differences in amino acid profiles. Additionally, these effects may be influenced by the mother's overall nutritional status. Pregnant women with higher animal protein intake generally have better nutritional status, so additional animal protein can increase protein levels in the body to beneficial levels (38). Fetal growth is strongly affected by maternal nutritional intake during pregnancy. When a pregnant woman maintains good health and adequate nutrition, both maternal and fetal health outcomes are likely to be favorable. These nutritional needs are necessary for a pregnant woman to be able to provide good nutrition for her fetus for its growth and development in the womb, which is influenced by the food consumed by the mother. Adequate nutrition during pregnancy prevents maternal malnutrition. If this continues, it can affect fetal development and cause low birth weight and obesity (39).

This study has limitations that should be considered when interpreting the findings. The assessment of dietary patterns relied on the FFQ and 24-hour food record, both of wich depend heavily on the respondent's ability to accurately remember the foods consumed, potentially leading to recall bias.

CONCLUSION AND RECOMMENDATION

This study concludes that the average maternal intake of energy, protein, iron, and folic acid remains substantially below the Recommended Dietary Allowance. Dietary patterns are significantly correlated with CED, anemia status, and maternal weight gain, with energy and protein intake showing a direct association with weight gain. To address these issues, it is recommended that health institutions and practitioners intensify nutrition education programs for pregnant women. Furthermore, collaboration between health workers and family members is vital to ensure adequate dietary intake and to mitigate the risk of low birth weight.

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