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The Relationship Between Energy, Protein, and Fat Intake in Pregnant Women with Infant Weight and Length

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Keywords

Energy intake, protein intake, fat intake, birth weight, and birth length.

ABSTRACT

The 2018 Basic Health Research (Riskesdas) data highlights the prevalent issue of Chronic Energy Deficiency (KEK) among pregnant women. This prospective cohort study investigates the correlation between energy, protein, and fat intake in pregnant women and their infants' birth weight and length. Utilizing purposive sampling, third-trimester pregnant women were interviewed through questionnaires and food recall tables. Data processing involved editing, entering, and tabulating, with correlation analysis revealing that inadequate energy intake (61%) and protein intake (51.2%) were typical. Fat intake, predominantly sufficient (87.8%), exhibited minimal inadequacy (5%). Although energy intake influenced body weight, it did not impact birth length. Protein intake affected body length but not body weight, while fat intake influenced body weight without affecting birth length. Notably, most infants exhibited average birth weight (95.1%) and regular body length (95.1%).

INTRODUCTION

Pregnant women are an essential target group to receive special attention. In the body of a pregnant woman, a fetus is growing in the mother's womb. Pregnancy lasts 40 weeks. The medical term for pregnant women is "*gravida,*" while the baby inside is called an embryo (early weeks) and then a fetus until birth (Arum et al., 2021). Based on 2018 Basic Health Research *(Riskesdas)* data shows that one of the nutritional problems that often occur in pregnant women is Chronic Energy Deficiency (KEK), Anemia, Hyperemesis Gravidum, Preeclampsia, and Eclampsia (Kemenkes, 2018).

Chronic Energy Deficiency (CED) is a condition of long-term malnutrition caused by an imbalance between nutritional intake (energy and protein) characterized by a pregnant woman's upper arm circumference (LILA) of less than 23.5 cm. CED can affect fetal growth and result in Low Birth Weight (LBW) (Houshiar-Rad et al., 1998; Stephens et al., 2014). Based on data from the Indonesian Ministry of Health (2018), the KEK rate among pregnant women in Indonesia is 17.3%, and in North Sumatra, it is 14.8%. This figure has exceeded the Ministry of Health's 2018 target (Tumanggor & Siregar, 2022).

According to Suparyanto (2019), Low Birth Weight (LBW) ranges from 1500-2500 grams. Indonesia has the second largest prevalence of LBW among other Southeast Asian (ASEAN) countries (21.2%) (Aulia et al., 2019). Based on the 2017 Indonesian Demographic Health Survey (SDKI), the incidence of low birth weight (LBW) in Indonesia reached 6.2% (Rahadinda et al., 2022). According to the Indonesian Ministry of Health, 2018 average birth body length is 48-52 cm. Below 48 cm is said to be a short birth length (PBLP). According to Riskesdas data (2018), birth length <48 in Indonesia experienced an increase. In 2013, it was 20.2%, and in 2018, the prevalence of birth length <48 cm was 22.7%. In North Sumatra it was 18.6% (Arum et al., 2021).

Lack of nutritional intake during pregnancy occurs due to increased dietary requirements to meet the needs of the mother and fetus (Au et al., 2023; Crume et al., 2016). During pregnancy, nutrients are transferred from the mother's body to the fetus's body through the placenta (Darawati, 2017). Lack of nutritional intake, such as insufficient energy, protein, and fat, can affect the growth of the fetus in the womb and the baby's birth weight (Usrina et al., 2021).

Energy intake in pregnant women will increase, especially in the second and third trimesters used for fetal and placental growth. If energy needs are met, tissue formation, repair, and metabolic regulation will run optimally. The fetus meets its needs through the placenta. Pregnant women with low protein and energy intake will give birth to more LBW babies (Jebeile et al., 2016). Based on the 2019 Nutritional Adequacy Rate (AKG), energy is added at 180 kcal per day during the first trimester of pregnancy and 300 kcal in the second and third trimesters. The research results by Usrina (2021) state that an increase of 1 kcal in energy intake increases the baby's body length at birth by 0.003 cm (Darawati, 2017; Tabata et al., 2023).

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Proteins are the building blocks of all cells and components of enzymes, membranes, transport carriers, and other hormones. Protein is needed to form new tissue, as well as the placenta and fetus. Almost 70% of protein is used for the child she is carrying. Mothers who suffer from protein deficiency cause the size of the placenta to be smaller so that the supply of nutrients from the mother to the fetus is reduced. Study Marwati (2017) said that a lack of protein intake in pregnant women impacts the baby Field's birth weight and body length (Afa, 2017; Grootendorst-van Mil et al., 2018). Based on the 2019 Nutritional Adequacy Rate (AKG), one g/day of protein is added during the first trimester of pregnancy, ten g/day in the second and 30 g/day in the third trimester. Research result Usrina (2021) states that 1 kcal in protein intake increases the baby's body length at birth by 0.053 cm (Arum et al., 2021; Inadera et al., 2020).

Fat is a substance that is rich in energy. Pregnant women need additional fat to complete their energy needs (Darawati, 2017). Fat has various functions. The first function is an energy source. Fat is the most significant source of energy, namely 9 kcal per gram. According to Usrina (2021), low fat intake in pregnant women can affect the growth of the fetus in the womb and the baby's birth weight. Based on the 2019 Nutritional Adequacy Rate (AKG), 2.3 g/day of fat is added during pregnancy's first, second, and third trimester. The research results of Usrina (2021) state that every increase in the percentage of energy from fat is associated with an increase in body length of 0.1 cm.

METHODS

This research is quantitative with a prospective cohort method. The study was conducted in Percut Village, Cinta Damai Village, and Tanjung Selamat Village, Percut Sei Tuan District, which was carried out in March 2023. The selection of these areas was based on the results of a research survey where, in these three villages, pregnant women gave birth to children with low birth weights.

The population of this study was all third-trimester pregnant women in three villages of Percut Sei Tuan District, totaling 103 people. The sampling technique for this research is random Purposive Sampling, which means pregnant women meet specific criteria.

Data was collected by obtaining primary data such as identity, energy intake data, protein intake, fat intake, birth weight, and birth length. Secondary data was obtained through searches by researchers in the village head's office, including a general description of the research location and the number of pregnant women.

Researchers conducted food recalls for three non-consecutive days. Election days are Sunday, Tuesday, and Friday. The data that has been collected is then processed manually using a computer through process stages, starting with editing, entry, coding, cleaning, and tabulating the data; then, the data is analyzed. Micronutrient intake data is processed using Nutrisurvey.

Data analysis in this study consisted of univariate analysis and bivariate analysis. Univariate analysis to describe each variable is presented as a frequency table. Bivariate analysis uses the Pearson correlation test for data that is not normally distributed based on the test Shapiro Wilk. However, if the data obtained is known to be not normally distributed, then the data will be analysed using the Spearman rank correlation test.

RESULTS

Sample Characteristics

Table 1. Subject characteristics

Variable	Category	n	%
Mother's age	18	2	4.9
	19-29	27	65.9
	30-49	12	29.2
Mother's education	Elementary School	6	14.6
	Junior High School	12	29.3
	Senior High School	18	43.9
	College	5	12.2
Number of children	1-3	34	82.9
	>4	7	17.1

Most subjects were aged 19-29 (65.9%) and had a high school/vocational education (49.3%). The highest number of children (parity) is 1-3 people (82.9%) (Table 1). The interview results used the method of food recall. For three non-consecutive days, the average macronutrient intake of pregnant women was still below the 2013 nutritional adequacy rate (AKG). However, the average dietary status of babies born (the baby's weight and height) was in the average nutritional status range, namely 3120.8 grams for body weight Baby and 49 cm for the baby's body length **(Table 2).**

Table 2. Frequency Distribution of Average Nutrient Intake and Nutritional Status

Variable	Mean	SD	Min	Max
Nutrient Intake				
Energy	1967.9	127.8	1615.9	2248.2
Protein	72.03	8.6	54.9	88.6
Fat	66.7	9.7	43.8	83.4
Nutritional status	3120.85	505.9	2000	4400
BBL	49.07	1.385	47	53
PBL				

Table 3. Distribution of Nutrient Intake Levels

Intake	Intake Level			
	Enough(N)	%	Less (N)	%
Energy	16	39%	25	61 %
Protein	20	49%	21	51.%
Fat	36	87.8 %	5	12.2 %

Correlation of Macronutrient Intake with Baby's Birth Weight and Length

Table 4. Relationship between macronutrient intake and baby's birth weight and length

Variable	Birth Weight		Body Length at Birth	
	r	p	r	p
Energy Intake	0.468	0.002	0.277	0.079
Protein Intake	0.229	0.150	0.379	0.014
Fat Intake	0.366	0.019	0.038	0.814

Correlation test results Spearman showed a significant relationship between energy intake and baby's birth weight p-value 0.002 indicates a moderate relationship (r=0.468). Meanwhile, the relationship between energy intake and the baby's birth length was obtained with a *p-value of* 0.014, which means there is no significant relationship between the energy intake of pregnant women and the baby's birth length.

The relationship between protein intake and the baby's birth weight was obtained as *p-value* = 0.150 > α, which means Ha is rejected. It can be concluded that there is no significant relationship between protein intake and baby's birth weight. Meanwhile, the relationship between protein intake and the baby's birth length was obtained *p-value* = 0.014 < α, which means that Ha is accepted so that there is a significant relationship between protein intake and birth length, with a moderate relationship strength (r = 0.379) and a positive correlation coefficient meaning that the more a mother's protein intake increases during pregnancy, the more body length increases. Baby being born.

The relationship between fat intake and the baby's birth weight was obtained from the analysis *p-value* = 0.019 < α, which means that Ha is accepted so that a significant relationship exists between fat intake and the baby's birth weight, with a moderate relationship strength (r = 0.366). Meanwhile, the results showed an association between fat intake and the baby's birth length *p-value* = 0.814 > α means that Ha is rejected, so there is no significant relationship between fat intake and birth length (Table 4).

Discussion

Based on the results of statistical tests on Spearman correlation, the analysis results were obtained *p-value*=0.002 < α, which means that Ha is accepted so that in this study, it was stated that there was a significant relationship between energy intake and the baby's birth weight. It is known that the relationship between energy intake and the baby's birth weight shows a moderate relationship (r = 0.468), and the correlation coefficient is positive, meaning the higher the energy intake of pregnant women, the higher the baby's birth weight. Meanwhile, the results of the statistical test between energy intake and birth length of the baby using the Spearman correlation were obtained *p-value* = 0.079 > α, which means that Ha is rejected, so there is no significant relationship between energy intake and the baby's birth length.

Energy is the primary source for the body. Energy is obtained from carbohydrates, fats, and proteins. Increasing gestational age can affect the body's metabolism and calorie needs. Increasing gestational age can affect the body's metabolism and calorie needs. Insufficient intake of nutrients such as energy, protein, fat, and carbohydrates can affect the growth of the fetus in the womb and the baby's birth weight and length (Blau et al., 2018; Lim et al., 2018).

This research is not in line with research. Usrina (2021) stated that there was a relationship between energy intake and the baby's birth length. Energy requirements in the third trimester continue to increase until the end of pregnancy. During the third trimester, additional fetal and placental growth energy is used. There is no relationship between energy intake and newborn body length due to the lack of other components, such as the baby's genetics. Based on previous research, the baby's size is related to the mother's genetics. This is based on the study by Addo (2013), which states that the mother's height is associated with the child's growth process.

This research is in line with research conducted by Aghadiati (2019). This study shows a significant relationship between energy intake and birth weight ($p < 0.05$). Mothers who experience insufficient energy intake will experience impaired growth and function of the placenta, described by lower placental weight and smaller placental size. Malnutrition in the mother will reduce blood flow to the placenta, resulting in sub-optimal placental size and reducing the transfer of nutrients to the fetus, resulting in BBL.

Energy intake during pregnancy is inadequate *and* is one of the risk factors for short-birth babies. Low consumption of energy nutrients can result in adequate nutritional reserves to provide physiological needs during pregnancy, namely hormonal changes, and an increase in blood volume for fetal growth in the womb so that the need for nutrients for the fetus is reduced. The impact is slowed growth and development of the fetus. Inadequate nutritional intake during pregnancy plays a role in the occurrence of cases of babies with malnutrition status (Lim et al., 2018).

The relationship between protein intake and the baby's birth weight was obtained as p-value = 0.150 > α, which means Ha is rejected. It can be concluded that there is no significant relationship between protein intake and baby's birth weight. Meanwhile, the relationship between protein intake and the baby's birth length was obtained *p-value* = 0.014 < α, which means that Ha is accepted, so there is a significant relationship between protein intake and birth length. It is known that the relationship between protein intake and the baby's birth length shows a moderate relationship (r = 0.379), and the positive correlation coefficient means that intake increases. The mother's protein during pregnancy increases the baby's body length.

Protein is part of all living cells and is the most significant part of the body after water. Protein has a unique function: building and maintaining cells and body tissues so that other substances cannot replace protein. Protein functions as the foundation of cells in humans. Protein is a substance that plays a role in building tissue, forming body structure, growth, oxygen transportation, and forming the immune system.

The average protein intake obtained by pregnant women is 72 g. The average maternal protein intake is still less than the adequate figure for pregnant women based on the AKG (Sullivan et al., 2014). Based on the level of protein intake, it shows that most pregnant women have a protein intake in the deficient category (51.2%). Insufficient protein intake during pregnancy can impair fetal growth in the womb, impacting birth weight and length (Fitri & Wiji, 2018).

The results align with research conducted by Amriani (2020), which stated the relationship between the level of protein intake and the incidence of BBL at RSIA Makkasar City. It was found that there was no significant relationship between maternal protein intake and the baby's birth weight. According to researchers, the results of this study show that pregnant women's protein intake does not significantly impact the baby's birth weight. This happens because protein primarily functions as a growth substance necessary for the baby's body length growth. Besides being a growth agent, protein also functions as an energy source if carbohydrates and fats are insufficient. Based on the results of food recall interviews, the energy intake of pregnant women is still less than the adequate figure for pregnant women. So, if energy intake is lacking, protein will be broken down as an energy source. Apart from insufficient information, there are several other factors, such as gestational age, maternal height and weight, lifestyle factors, medical complications during pregnancy, prematurity, poor maternal behavior, maternal anthropometry, socioeconomics, maternal education, household income, and the number of children. or parity (Ratnasari et al., 2017).

The primary function of protein in the body is as a growth agent to build body cells apart from being an energy source if carbohydrates and fat are insufficient. 70% of a pregnant woman's protein forms new tissue and fetal growth. Inadequate protein intake during pregnancy can impair fetal development in the womb, impacting birth length (Fitri & Wiji, 2018).

This research aligns with Suparyanto and Rosad Field (2019), which state that a significant relationship exists between protein intake and the baby's birth length with r= 0.141. If protein increases by 1 gram, the baby's body length will increase by 0.141 cm. These results are strengthened by research by Ernawati (2013), which says that pregnant women who consume below-average protein are 1.6 times more likely to have a stunted baby in the next 12 months.

The relationship between fat intake and the baby's birth weight was obtained from the analysis p-value = 0.019 < α, which means that Ha is accepted so that in this study, it is stated that there is a significant relationship between fat intake and the baby's birth weight. It is known that the relationship between fat

intake and the baby's birth weight shows a moderate relationship (r = 0.366), and the correlation coefficient Positive means that the more the mother's fat intake increases during pregnancy, the more the baby's birth weight will increase. Meanwhile, the results showed a relationship between fat intake and the baby's birth length p-value = 0.814 > α, which means that Ha is rejected, so there is no significant relationship between fat intake and the baby's birth length.

Fat or lipid is one of the most significant sources of energy compared to other nutrients, namely 9 kilocalories/gram, and functions to dissolve fat-soluble vitamins such as A, D, E, and K. This research is in line with research conducted by Fitri & Wiji (2018) The results of this study show that there is a significant relationship between fat intake and birth weight of the baby.

Fat has a vital role in increasing birth weight. Babies who have stunted growth with low birth weight are caused by hormonal imbalances or poor absorption by the mother's body during pregnancy so that the transfer of fat to the fetus is not perfect so that the baby's need for fat becomes less and interferes with fetal growth (Syari et al., 2015). Fetal growth depends on the body's metabolic results, which are transferred through the placenta to meet the mother's needs during pregnancy and fetal nutrition to grow and develop so the baby can have an average birth weight.

This research is in line with the study conducted by Murfat (2022), which stated that there was no relationship between fat intake and the baby's birth length p-value 0.143 > p = 0.05 and states that micronutrients and genetic factors influence the baby's birth length. However, research by Siska (2021) states that there is a relationship between fat intake and the baby's birth length.

Most of the functions of fat are as an energy source. Fat is used for long-term energy needs and as a reserve if energy from food intake is lacking. In the body, fat provides twice as much energy as protein. Besides that, fat also functions as a source of essential fats, namely linoleic and linolenic, which influence brain growth and development.

Adequate fat intake in pregnant women does not affect the baby's birth length because pregnant women consume food from outside more often, so most fat consumption comes from oil and coconut milk. Fat as an energy source should not meet needs because it only comes from coconut oil/coconut milk with a low essential fatty acid content. The highest fat intake is obtained from fried foods. When discussing with one of the pregnant women, the eggs that are usually consumed and the animal or vegetable side dishes that are consumed are always fried. Excessive fat intake, such as oil and low-fat meat, if ingested by the mother during pregnancy, will interfere with the baby's growth, resulting in an abnormal birth length (Syari et al., 2015).

CONCLUSION

the study highlights relationships between pregnant women's nutritional intake and infant outcomes. Notably, a significant positive association exists between energy intake and the baby's birth weight, underscoring the critical role of sufficient energy during pregnancy for optimal fetal weight gain. However, this positive correlation is not mirrored in the case of birth length, suggesting that energy intake may not directly influence the infant's linear growth. Conversely, protein intake does not show a significant impact on birth weight but is found to be positively correlated with birth length. This suggests that protein intake plays a more pronounced role in influencing the linear dimensions of the newborn rather than their overall weight. Furthermore, the study indicates that fat intake in pregnant women is positively related to the baby's birth weight, emphasising the importance of adequate fat consumption for promoting healthy birth weights. However, this positive correlation is not evident in the case of birth length, suggesting that while fat intake contributes to weight gain, it does not significantly affect the linear growth of the infant. These nuanced findings underscore the need for a comprehensive understanding of the distinct effects of energy, protein, and fat intake on different aspects of fetal development, guiding future interventions to ensure well-rounded maternal nutrition and optimal infant outcomes.

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