

The Relationship between Energy and Protein Intake and the Incidence of Chronic Energy Deficiency in Pregnant Women

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ABSTRACT

Background: Chronic energy deficiency (CED) during pregnancy is a nutritional concern associated with fetal growth and child health. Adequate energy and protein intake is essential to support nutritional requirements during pregnancy. This study aimed to examine the associations of energy and protein intake with CED among pregnant women in Sibabangun District, Central Tapanuli, Indonesia.

Methods: A cross-sectional study was conducted in February 2024, involving 80 pregnant women recruited through total population sampling. Data were collected using a questionnaire. The variables analyzed included energy intake, protein intake, and midupper arm circumference (MUAC). Descriptive and bivariate analyses were performed using SPSS, with associations assessed using the chi-square test.

Results: Thirty participants (37.5%) had CED. Mean energy intake was $1,877.6 \pm 325.5$ kcal/day, mean protein intake was 60.8 ± 16.6 g/day, and mean MUAC was 23.40 ± 1.43 cm. Energy intake was significantly associated with CED ($p < .001$; OR = 14.67), as was protein intake ($p = .003$; OR = 4.67). Participants consuming $<1,800$ kcal/day had higher odds of CED than those consuming $\geq 1,800$ kcal/day. Similarly, participants consuming <60 g of protein/day had higher odds of CED than those consuming ≥ 60 g/day.

Conclusion: Energy and protein intake were significantly associated with CED among pregnant women. These findings indicate crosssectional associations and do not establish causal relationships.

INTRODUCTION

Maternal nutritional status during pregnancy plays a role in fetal growth and child health. Maternal malnutrition can contribute to fetal growth retardation and increase a child's vulnerability to postnatal growth disorders (Black et al., 2013). In Indonesia, a mid-upper arm circumference (MUAC) of less than 23.5 cm is used as an indicator of chronic energy deficiency (CED) risk in pregnant women (Mutalazimah et al., 2020). MUAC measurement is an anthropometric approach to nutritional status screening, so results need to be interpreted in conjunction with information on maternal intake and condition. Energy requirements increase to support metabolism and tissue growth during pregnancy (Most et al., 2019), while protein is needed for the formation of maternal, placental, and fetal tissues (Elango & Ball, 2016).

Malnutrition in women remains a public health problem, particularly among groups with limited access to nutritious food and nutrition services (United Nations Children's Fund [UNICEF], 2023). In Indonesia, the results of the 2023 Indonesian Health Survey, presented in a fact sheet by the Health Development Policy Agency (2024), indicate that the proportion of pregnant women at risk of developing chronic energy deficiency syndrome (CED) is 16.9%. This figure is a risk indicator based on anthropometry and cannot be directly compared with estimates of malnutrition using different definitions. A systematic

review and meta-analysis by Agustina et al. (2023) also found inadequate intake of energy and several nutrients among pregnant women in Indonesia and Malaysia, with protein intake deficits particularly evident in studies from Indonesia. These findings support the need for studies of maternal nutritional intake at the local level.

Maternal malnutrition is associated with poor growth outcomes in infants and children (Black et al., 2013). A cohort study in Sulawesi showed that maternal MUAC less than 23.5 cm was associated with stunting in six-month-old infants (Thahir et al., 2023). In Boyolali, energy and protein intake were positively associated with maternal MUAC, although the strength of the correlation differed for these two nutrients (Musalazimah et al., 2020). Assessment of adequate dietary intake in Indonesia requires consideration of age and physiological conditions, including pregnancy, according to the recommended Dietary Allowances (RDA) (Ministry of Health of the Republic of Indonesia, 2019). Therefore, this study aims to analyze the relationship between energy and protein intake and the incidence of CED in pregnant women in Sibabangun District, Central Tapanuli, and to describe the characteristics, intake, and MUAC of respondents.

METHOD

This study used a *cross-sectional design* conducted in Sibabangun District, Central Tapanuli, in February 2024. The study population was all 80 pregnant women in Sibabangun District, Central Tapanuli. The study sample was 80 people obtained through total *sampling*. The inclusion criteria were pregnant women and willing to be respondents. Furthermore, the exclusion criteria were subjects who could not be interviewed due to illness and were unwilling to be respondents during the study. Data collection in this study was conducted through questionnaires and analyzed using the SPSS application.

RESULTS

Table 1 shows that 35% of pregnant women were aged 19–24 years, while 15% were in the ≥ 35 age group. The average energy intake was 1,877.6 kcal/day, protein intake was 60.8 g/day, and the MUAC was 23.40 cm.

Table 1. Respondent Characteristics and Univariate Analysis

Variables	n	%
Age		
Age 19–24 years	28	35.0
Age 25–29 years	25	31.2
Age 30–34 years	15	18.75
Age ≥ 35 years	12	15.0
Trimester		
II	39	48.7
III	41	51.3
Variables	Mean $\pm$ SD	Min–Max
Energy (kcal/day)	1877.6 $\pm$ 325.5	1100.0–2620.5
Protein (g/day)	60.8 $\pm$ 16.6	30.0–100.0
LILA (cm)	23.40 $\pm$ 1.43	20.51–26.30

Table 2 shows a significant relationship between energy intake ($p < 0.001$; OR = 14.67) and protein intake ($p = 0.003$; OR = 4.67) with the incidence of KEK in pregnant women.

Table 2. Chi-Square Test

Variables	Category	Chronic Energy Deficiency Events		Total	OR	P
		No	Yes			
Energy	<1,800 kcal/day	6	20	26	14.67	<0.001
	≥1,800 kcal/day	44	10	54		
Protein	<60 g/day	15	20	35	4.67	0.003
	≥60 g/day	35	10	45		

DISCUSSION

This study demonstrates a significant association between energy and protein intake categories and the incidence of CED in pregnant women. For comparison, Mutalazimah et al. (2020) reported a positive association between energy and protein intake and maternal MUAC in Boyolali. The similar direction of this association supports the relevance of monitoring nutritional intake in prenatal care, but the magnitude of the association cannot be generalized due to differences in population, measurement, and analysis. These findings also need to be interpreted in the context of nutritional inadequacy reported in studies in Indonesia (Agustina et al., 2023).

Physiologically, energy requirements during pregnancy include energy for resting metabolism, physical activity, and tissue growth. These requirements vary by gestational stage, pre-pregnancy body size, and maternal activity (Most et al., 2019). Therefore, low intake may be one biological explanation for the association with nutritional status, but the association found in this study does not prove a specific catabolic mechanism. Due to the cross-sectional study design, the temporal sequence between intake and CED status cannot be ascertained. The OR values reflect the comparison of CED odds between intake categories at the time of measurement, not the incidence risk or the magnitude of the causal effect.

Protein provides amino acids for the synthesis and maintenance of maternal tissues and fetal and placental growth. Protein utilization for tissue formation also depends on adequate energy availability (Elango & Ball, 2016). Therefore, the relationship between protein intake and CED needs to be interpreted in conjunction with maternal energy intake and nutritional status. A Cochrane review found that balanced energy and protein supplementation can improve fetal growth, whereas high protein supplementation does not show the same benefits and may be detrimental (Ota et al., 2015). The WHO recommends nutrition education during pregnancy and balanced energy-protein supplementation in undernourished populations to reduce adverse birth outcomes (World Health Organization, 2016).

Limitations of this study include its cross-sectional design, the limited number of respondents in one sub-district, and the bivariate analysis that did not control for confounding factors. Factors such as pre-pregnancy nutritional status, gestational age, socioeconomic status, and comorbidities may influence the observed association. Longitudinal studies with standardized intake measurements and multivariate analyses are needed to clarify this relationship.

CONCLUSION

There was a significant association between energy intake ($p < 0.001$; OR = 14.67) and protein intake ($p = 0.003$; OR = 4.67) and the incidence of CED in pregnant women. These findings indicate an association at the time of measurement and do not prove a causal relationship.

CONFLICT OF INTEREST

There is no conflict of interest in this research.

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