

Factors Associated with the Incidence of Chronic Energy Deficiency in Pregnant Women

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ABSTRACT

Background: Chronic energy deficiency (CED) in pregnant women is a nutritional problem that can be related to maternal health and fetal growth. Identifying factors associated with CED is necessary to support maternal nutrition interventions. This study aims to analyze the relationship between energy intake, protein intake, education, family income, and antenatal care with the incidence of CED in pregnant women.

Methods: The study used a cross-sectional design in the Tukka Community Health Center (Puskesmas) working area, Central Tapanuli Regency, in 2024. A total of 120 pregnant women were involved through a total sampling technique. Data were collected using a questionnaire and analyzed univariately and bivariately using the chi-square test with SPSS.

Results: Energy intake, protein intake, and family income showed a statistically significant relationship with the incidence of CED ($p < 0.05$). Education ($p = 0.177$) and antenatal check-up ($p = 0.131$) did not show a statistically significant relationship in the study sample.

Conclusion: Energy intake, protein intake, and family income are associated with the incidence of CED in pregnant women. Health services need to consider assessing adequate intake, providing nutritional counseling, and providing appropriate dietary support to pregnant women. These findings indicate an association and cannot be used to conclude a causal relationship.

INTRODUCTION

Maternal nutritional status plays a crucial role in maternal health, fetal growth, and pregnancy outcomes (Marshall et al., 2022). Energy and nutrient needs change during pregnancy, so macronutrient and micronutrient intake needs to be tailored to the needs of the mother and fetus (Mousa et al., 2019). Chronic energy deficiency (CED) is a long-term energy and protein deficiency; in maternal nutrition services in Indonesia, mid-upper arm circumference (MUAC) is used to identify CED risk (Ministry of Health of the Republic of Indonesia, 2023). Identifying factors associated with CED is essential as a basis for targeting maternal nutrition interventions (Wati et al., 2024).

Maternal nutritional issues need to be addressed through ensuring a diverse diet and providing nutrition services during pregnancy (Marshall et al., 2022). In Indonesia, the 2023 Indonesian Health Survey (SKI) reported that the proportion of pregnant women at risk of developing CED was 16.9% (Health Development Policy Agency, 2024). This figure indicates that CED risk remains a maternal health issue that requires attention in health services and community nutrition programs.

Low maternal nutritional status is associated with poor pregnancy outcomes; a meta-analysis showed that underweight mothers based on body mass index (BMI) have a higher risk of preterm birth and low birth weight compared to mothers of normal weight (Han et al., 2011). These underweight indicators are not identical to CED identified through the MUAC. A descriptive study of pregnant women with CED at Cipto Mangunkusumo Hospital reported anemia and maternal and neonatal complications, but could

not establish the magnitude of the causal risk in the general population (Indarti et al., 2023). A cohort study in Cambodia also demonstrated an association between maternal MUAC during pregnancy and infant height growth in the first months of life (Kpewou et al., 2020). In Banyumas, energy and protein intake, education, pregnancy spacing, and frequency of antenatal care were found to be associated with CED, with differing results between bivariate and multivariate analyses (Wati et al., 2024).

A cross-sectional design can be used to identify relationships between variables, but it does not confirm temporal sequence or causality (Wang & Cheng, 2020). An initial survey at the research site identified pregnant women with CED. Therefore, this study aimed to identify factors associated with CED incidence in pregnant women in the Tukka Community Health Center, Central Tapanuli Regency.

METHOD

This study used a cross-sectional design and was conducted in Tukka District, Central Tapanuli Regency, in 2024. The study population was all 120 pregnant women who came for treatment at the Community Health Center (Puskesmas) within the Tukka working area. The sample size was 120 people and was obtained through total sampling. Inclusion criteria included pregnant women who received treatment at the Puskesmas, were willing to be respondents, and had complete medical records. Exclusion criteria included pregnant women who could not be interviewed due to illness or unwillingness to participate in the study. Data collection was carried out using a questionnaire. Data were analyzed using SPSS, with univariate analysis to describe respondent characteristics and a chi-square test to assess the relationship between variables as presented in Table 2.

RESULTS

Based on Table 1, 77 respondents (64.2%) were in the energy <1,800 category and 69 respondents (57.5%) were in the protein <60 category. 71 respondents (59.2%) had secondary education, 77 respondents (64.2%) were unemployed, and 78 respondents (65.0%) had incomes below the regional minimum wage (UMR). 61 respondents (50.8%) were in the primigravida category, 75 respondents (62.5%) were in the third trimester, and 72 respondents (60.0%) were in the adequate antenatal care (ANC) category according to the research grouping.

Table 1. Respondent Characteristics and Univariate Analysis

Variables	Category	n	%
Energy			
	<1,800	77	64.2
	≥1,800	43	35.8
Protein	<60	69	57.5
	≥60	51	42.5
Education	Intermediate	71	59.2
	Low	27	22.5
	Tall	22	18.3
Work	Doesn't work	77	64.2
	Work	43	35.8
Income	< Minimum Wage	78	65.0
	≥ Minimum Wage	42	35.0
Parity	Primigravida	61	50.8
	Multigravida	59	49.2

Variables	Category	n	%
Trimester	III	75	62.5
	II	45	37.5
ANC	Enough (≥ 4 times)	72	60.0
	Less (< 4 times)	48	40.0

Table 2 shows a statistically significant association between energy ($p = 0.001$; OR = 5.01; 95% CI: 2.24–11.24), protein ($p < 0.001$; OR = 23.41; 95% CI: 8.66–63.28), and income ($p = 0.006$; OR = 3.64; 95% CI: 1.50–8.87) and the incidence of CED in pregnant women. Education ($p = 0.177$) and ANC ($p = 0.131$; OR = 0.52; 95% CI: 0.24–1.11) did not show a statistically significant association in the study sample. The ORs in the table are measures of association and should not be interpreted as evidence of causation.

Table 2. Chi-Square Test

Variables	Category	Chronic Energy Deficiency Events		Total	OR (95% CI)	P
		No KEK	Special Economic Zone (SEZ)			
Energy	$< 1,800$	17	26	43	5.01 (2.24–11.24)	0.001
	$\geq 1,800$	59	18	77		
Protein	< 60	14	37	51	23.41 (8.66–63.28)	< 0.001
	≥ 60	62	7	69		
Education	Intermediate	48	23	71	0.44 (0.18–1.10)	0.177
	Low	13	14	27		
	Tall	15	7	22		
Income	$< \text{Minimum Wage}$	42	36	78	3.64 (1.50–8.87)	0.006
	$\geq \text{Minimum Wage}$	34	8	42		
ANC	Enough ≥ 4	50	22	72	0.52 (0.24–1.11)	0.131
	Less < 4	26	22	48		

DISCUSSION

The results of this study indicate a significant association between energy intake categories and the incidence of CED. This finding aligns with the bivariate analysis of Wati et al. (2024), which found an association between energy intake and CED in pregnant women in Banyumas. Physiologically, energy is needed to support maternal body changes and fetal growth, therefore energy sufficiency is an important part of meeting nutritional needs during pregnancy (Mousa et al., 2019). However, energy needs are influenced by the stage of pregnancy and maternal characteristics; the category boundaries in this study cannot necessarily be considered universal energy requirements for all pregnant women (Mousa et al., 2019). Because the measurements were cross-sectional, this study cannot confirm that low energy intake precedes the incidence of CED (Wang & Cheng, 2020).

Protein intake also showed a significant association with CED incidence in this study. Wati et al. (2024) reported that low protein intake remained associated with CED after multivariate analysis. Protein is necessary to support the formation of maternal and fetal tissues, so its fulfillment needs to be considered along with adequate energy and other nutrients (Mousa et al., 2019). Dietary patterns should

include a variety of nutrient-dense foods that meet the mother's needs during pregnancy (Marshall et al., 2022). Research by Angkasa et al. (2024) described the presence of food restrictions and low dietary diversity among pregnant women in rural Indonesia, but the association between food restrictions and CED was not statistically significant. Therefore, food restrictions and consumption diversity may be aspects that need to be assessed in further research, rather than being considered as factors that have been proven in this study sample.

Family income showed a significant association with the incidence of CED in this study. Selamet et al.'s (2024) ecological study in Nusa Tenggara identified a pattern of association between regional poverty levels and the prevalence of CED in pregnant women. However, findings at the regional level cannot be directly translated into individual-level relationships (Selamet et al., 2024). In this study, limited income may be related to a family's ability to obtain nutritious food, but this mechanism was not tested because food purchasing power and household food security were not reported as study variables. Interpretation of the relationship between income and CED also needs to consider possible confounding factors (Wang & Cheng, 2020).

Education did not show a significant association with CED incidence in this study. These results differ from those of Wati et al. (2024), who found an association between low education and CED in a multivariate analysis. The difference in results may be related to respondent composition, educational grouping, or analytical approach; these explanations still require testing. An insignificant p-value does not prove that education is unrelated to nutritional status in all populations.

ANC frequency also showed no significant association with CED incidence in this study sample. In contrast, Wati et al. (2024) found an association between low ANC frequency and CED. Frequency of visits should be distinguished from service content: nutrition counseling is a recommended component of antenatal care (World Health Organization [WHO], 2016). A systematic review showed that interactive nutrition counseling can improve some dietary intake and gestational weight gain outcomes, but the benefits are not uniform across maternal and infant outcomes (Dewidar et al., 2023). Because the quality of counseling and acceptance of nutrition interventions were not reported in this study, the lack of a significant association between ANC frequency and CED cannot be explained by low service quality.

Overall, the results of this study indicate an association between energy intake, protein intake, and income and the incidence of CED in pregnant women. These findings support the need for nutritional assessments that encompass family consumption patterns and socioeconomic conditions, while still considering the limitations of the study design. For antenatal care, nutrition counseling can be considered as part of efforts to improve intake; a systematic review suggests the feasibility of increasing energy and protein intake through interactive counseling, although the certainty of the evidence and results vary across studies (Dewidar et al., 2023). Providing supplementary feeding based on local foods for pregnant women who meet the target criteria can be implemented by referring to the technical guidelines of the Ministry of Health of the Republic of Indonesia (2023). The WHO recommends balanced energy and protein supplementation in malnourished pregnant women to reduce stillbirths and small-for-gestational-age infants (WHO, 2016). This recommendation should be distinguished from high-protein supplementation, which is not recommended for the purpose of improving maternal and perinatal outcomes in this population (WHO, 2016). A review of various systematic reviews also indicates that the benefits of nutrition interventions depend on the type of intervention and the outcomes assessed (da Silva Lopes et al., 2017).

This study has several limitations. The cross-sectional design limits the assessment of temporality and causality (Wang & Cheng, 2020). Sampling of pregnant women attending community health centers (Puskesmas) limits generalizability to pregnant women who do not access these services. The intake data obtained through questionnaires also need to be interpreted with consideration for potential reporting errors. The presented association analysis did not include adjustment for confounding factors, so the associations found cannot be considered independent (Wang & Cheng, 2020). Further research with standardized intake measurements and longitudinal designs is needed to more robustly assess these relationships.

CONCLUSION

In this study sample, the categories of energy intake ($p = 0.001$), protein intake ($p < 0.001$), and family income ($p = 0.006$) showed a statistically significant association with the incidence of CED in pregnant women. Education ($p = 0.177$) and ANC ($p = 0.131$) did not show a statistically significant association. The study findings are associations and cannot be used to conclude a causal relationship. Health services need to pay attention to the assessment of energy and protein intake, nutritional counseling, and dietary support according to the needs of pregnant women.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest in this research.

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