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Risk Factors of Chronic Energy Deficiency among Pregnant Women in Minahasa

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Abstract
Chronic Energy Deficiency (CED) remains a major public health concern among pregnant women and is associated with adverse maternal and neonatal outcomes. This study aimed to analyze the risk factors for CED and identify the dominant predictors among pregnant women in Minahasa. A cross-sectional analytical design was employed involving 246 pregnant women. Data were collected using structured questionnaires, dietary assessments, and Mid-Upper Arm Circumference (MUAC) measurements. Bivariate analysis was performed using the Chi-square test, and multivariate analysis was conducted using logistic regression. The prevalence of CED was 41.5%. Significant factors associated with CED included maternal age (p=0.012; OR=3.9), parity (p=0.004; OR=4.7), knowledge (p<0.001; OR=14.8), and dietary patterns (p=0.002; OR=2.9). Multivariate analysis revealed that maternal knowledge was the strongest predictor of CED (aOR=15.25; 95% CI: 3.80–61.20), followed by parity, age, and dietary diversity. Education and antenatal care (ANC) visits were not significantly associated with CED prevalence. These findings indicate that knowledge gaps and poor dietary diversity are key determinants of CED. Strengthening culturally sensitive nutrition education within antenatal care services is essential for improving maternal nutrition and supporting stunting reduction strategies.

Keywords: *maternal nutrition, pregnancy, chronic energy deficiency, dietary diversity, antenatal care*

Abstrak
Defisiensi Energi Kronis (CED) tetap menjadi masalah kesehatan masyarakat yang serius di kalangan ibu hamil dan dikaitkan dengan hasil kehamilan yang buruk bagi ibu dan bayi baru lahir. Penelitian ini bertujuan untuk menganalisis faktor risiko CED dan mengidentifikasi prediktor utama di kalangan ibu hamil di Minahasa. Desain penelitian analitik cross-sectional digunakan dengan melibatkan 246 ibu hamil. Data dikumpulkan menggunakan kuesioner terstruktur, penilaian pola makan, dan pengukuran Lingkar Lengan Atas Tengah (MUAC). Analisis bivariat dilakukan menggunakan uji Chi-square, sedangkan analisis multivariat dilakukan menggunakan regresi logistik. Prevalensi CED sebesar 41,5%. Faktor-faktor signifikan yang terkait dengan CED meliputi usia ibu (p=0,012; OR=3,9), paritas (p=0,004; OR=4,7), pengetahuan (p<0,001; OR=14,8), dan pola makan (p=0,002; OR=2,9). Analisis multivariat menunjukkan bahwa pengetahuan ibu merupakan prediktor terkuat CED (aOR=15,25; 95% CI: 3,80–61,20), diikuti oleh paritas, usia, dan keragaman makanan. Pendidikan dan kunjungan perawatan antenatal (ANC) tidak secara signifikan terkait dengan CED. Temuan ini menunjukkan bahwa kesenjangan pengetahuan dan keragaman pola makan yang buruk merupakan faktor penentu utama CED. Memperkuat pendidikan gizi yang sensitif terhadap budaya dalam layanan perawatan antenatal sangat penting untuk meningkatkan gizi ibu dan mendukung strategi pengurangan stunting.

Kata Kunci: gizi ibu hamil, kehamilan, kekurangan energi kronis, keragaman makanan, perawatan antenatal.

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Introduction

Chronic Energy Deficiency (CED) among pregnant women remains a critical global health concern, particularly in low- and middle-income countries. Maternal undernutrition significantly increases the risk of adverse pregnancy outcomes, including low birth weight, intrauterine growth restriction, and stunting (Heidkamp et al., 2021; WHO, 2020). Recent evidence suggests that improving maternal nutrition is essential for breaking the intergenerational cycle of malnutrition (Zenbaba & Yaya, 2026).

In Indonesia, the prevalence of KEK among pregnant women is 18.4% and shows no difference between urban and rural areas.(Kemenkes, 2023). Despite improved access to antenatal care (ANC), maternal nutritional outcomes remain suboptimal, indicating that access alone is insufficient (UNICEF, 2023).

Previous studies have identified maternal age, parity, education, knowledge, and dietary patterns as key determinants of CED (Bappenas, 2020; Beressa, Whiting, & Belachew, 2024; Siregar et al., 2025). Among these, maternal knowledge and dietary diversity are consistently associated with nutritional status (Nastiti et al., 2025; Ramenzoni, 2023). Cultural beliefs and food taboos further influence dietary intake during pregnancy, often leading to inadequate nutrient consumption despite food availability (Agustina et al., 2023).

A preliminary study in Minahasa reported a CED prevalence of 20%, with knowledge and dietary diversity identified as the major contributing factors. However, a comprehensive analysis of these determinants remains to be conducted.

Therefore, this study aimed to analyze the association between maternal characteristics, knowledge, dietary patterns, and ANC visits with CED and to identify the dominant predictors among pregnant women in Minahasa.

Methods

This study employed an analytic cross-sectional design involving 246 pregnant women from Minahasa. Participants were selected using purposive sampling based on the following inclusion criteria: pregnant women in the first or second trimester, residing in the study area, and willingness to participate. Women with chronic diseases or pregnancy complications were excluded from the study.

Data were collected using structured questionnaires and anthropometric measurements. Maternal knowledge was assessed using a 10-item questionnaire, with scores categorized into “good” and “poor.” Dietary patterns were evaluated using a modified Food Frequency Questionnaire (FFQ) and the Dietary Diversity Score (DDS). Antenatal care visits were categorized into <4 and ≥ 4 visits. CED was determined using Mid-Upper Arm Circumference (MUAC), with a cutoff point of <23.5 cm.
The validity and reliability of the instruments were tested before data collection, with Cronbach’s alpha exceeding 0.70. Ethical approval was obtained, and informed consent was obtained from all participants.

Data analysis included descriptive statistics, Chi-square tests for bivariate analysis, and logistic regression for multivariate analysis. Statistical significance was set at $p<0.05$.

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Results

Table 1. Characteristics of Respondents (n=246)

Characteristic	n	%
Age 21–35 years	197	80.1
High education	194	78.9
Multipara	156	63.4
Good knowledge	178	72.4
Good dietary pattern	172	69.9
ANC ≥4 visits	204	82.9
CED	102	41.5

Table 1 shows that most respondents were of reproductive age (21–35 years) and had adequate access to ANC. However, the prevalence of CED remained high, indicating behavioral and nutritional gaps.

Table 2. Bivariate Analysis

Variable	OR	95% CI	p-value
Age	3.9	1.5-9.8	0.012
Education	1.6	0.9-2.8	0.118
Parity	4.7	1.8-12.1	0.004
Knowledge	14.8	6.2-35.1	<0.001
Dietary pattern	2.9	1.6-5.3	0.002
ANC	1.3	0.7-2.4	0.284

Knowledge showed the strongest association with CED (p<0.001), followed by parity (p = 0.004), age (p = 0.012), and dietary patterns (p = 0.002).

Table 3. Multivariate Analysis

Variable	aOR	95% CI	p-value
Knowledge	15.25	3.80–61.20	<0.001
Parity	4.50	1.20–16.88	0.021
Age	3.10	1.15–8.35	0.032
Dietary pattern	2.80	1.05–7.46	0.039
Education	2.10	0.90–4.80	0.082
ANC	1.80	0.60–5.40	0.298

Table 3 revealed that maternal knowledge remained the strongest independent predictor of CED (P = <0.001). Women with less knowledge are 15.25 times more likely to experience KEK.

Discussions

This study revealed a high prevalence of chronic energy deficiency (CED) among pregnant women in Minahasa (41.5%), exceeding national estimates and indicating persistent nutritional vulnerability in rural populations. This finding is consistent with recent studies in Indonesia and other low- and middle-income countries, which reported that maternal undernutrition remains a major contributor to adverse pregnancy outcomes and intergenerational malnutrition (Aiman et al., 2025; Heidkamp et al., 2021).

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The most striking finding of this study was that maternal knowledge emerged as the strongest predictor of CED. Pregnant women with poor knowledge were more than 15 times more likely to experience CED. This finding aligns with recent evidence suggesting that knowledge significantly influences dietary behavior, food choices, and adherence to nutritional recommendations during pregnancy (Agustina et al., 2023; Mangwane, Egal, & Oosthuizen, 2024). Despite adequate access to food and health services, misconceptions and a lack of specific knowledge, particularly related to nutrient requirements and food taboos, may lead to inadequate intake of essential nutrients.

Dietary patterns were also significantly associated with CED, reinforcing the importance of dietary quality rather than quantity alone. Women with poor dietary diversity had nearly three times higher risk of CED. This is consistent with FAO and WHO findings that dietary diversity is a key indicator of nutrient adequacy (FAO, 2010; WHO, 2020). In many Indonesian communities, cultural beliefs and food taboos limit the consumption of protein-rich foods such as eggs and fish, thereby reducing overall nutrient intake (Ramenzoni, 2023; Sulistyorini et al., 2025).

Maternal age and parity also contributed significantly to CED risk. Younger mothers (≤20 years) were more vulnerable due to competing nutritional demands between maternal growth and fetal development (Butkiewicz et al., 2024; Kabahenda & Stoecker, 2024; Aiman et al., 2025). Meanwhile, grand multiparous women showed a higher risk due to cumulative nutritional depletion from repeated pregnancies without adequate recovery time (Dasa, Okunlola, & Dessie, 2022; Sheikh et al., 2024; Nuryana, 2025). These findings highlight the need for targeted interventions for high-risk groups.

Interestingly, antenatal care (ANC) visits were not significantly associated with CED. This suggests that the issue lies not in access to services, but in the quality of counseling provided. Similar findings have been reported in previous studies where frequent ANC visits did not necessarily translate into improved nutritional outcomes due to inadequate or non-contextualized counseling (Neha et al., 2023). This highlights a critical gap between service utilization and effective behavior change.

From a policy perspective, these findings emphasize the urgent need to strengthen nutrition education within ANC services, particularly by incorporating culturally sensitive approaches. Integrating local wisdom into nutrition education may improve acceptability and effectiveness, especially in communities where traditional beliefs strongly influence dietary practices.

This study has several limitations. First, the cross-sectional design limits causal inference. Second, dietary assessment relied on self-reported data, which may introduce recall bias. Third, cultural factors were not deeply explored qualitatively, which could provide richer insights into behavioral determinants.

Conclusions

This study concludes that maternal knowledge is the most dominant predictor of chronic energy deficiency among pregnant women in Minahasa. Other significant factors include parity, maternal age, and dietary patterns. Antenatal care visits were not significantly associated, indicating gaps in counseling quality. Strengthening culturally sensitive nutrition education is essential to improve maternal nutritional status and support national stunting reduction programs.

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References

Agustina, R., Rianda, D., Lasepa, W., Birahmatika, F. S., Stajic, V., & Mufida, R. (2023). Nutrient intakes of pregnant and lactating women in Indonesia and Malaysia: Systematic review and meta-analysis. Frontiers in Nutrition, 10, 1030343.

Aiman, U., Riskika, F., Septiawan, N. A., Syahrani, S., Nurhidaya, I., Fitrasyah, I., ... & Hartini, D. A. (2025). A cross-sectional study on determinant factors of Chronic Energy Deficiency (CED) among pregnant women in disaster-prone areas: A case study at Talise Community Health Center, Palu City. *Nutrición Clínica y Dietética Hospitalaria*, *45*(3).

Butkiewicz, A. F., Amaral, A., Cerveira-Pinto, M., & Kordowitzki, P. (2024). Assessing the influence of maternal age in bovine embryos and oocytes: a model for human reproductive aging. *Aging and Disease*, *16*(2), 757.

Dasa, T. T., Okunlola, M. A., & Dessie, Y. (2022). Effect of grand multiparity on adverse maternal outcomes: A prospective cohort study. *Frontiers in Public Health*, *10*, 959633.

Food and Agriculture Organization (FAO) of United Nations. (2010). Guidelines for measuring household and individual dietary diversity. Retrieved from https://www.fao.org/4/i1983e/i1983e00.pdf

Heidkamp, R. A., Piwoz, E., Gillespie, S., Keats, E. C., D'Alimonte, M. R., Menon, P., ... & Bhutta, Z. A. (2021). Mobilising evidence, data, and resources to achieve global maternal and child undernutrition targets and the Sustainable Development Goals: an agenda for action. *The Lancet*, 397(10282), 1400-1418.

Kabahenda, M. K., & Stoecker, B. J. (2024). Associations between maternal dietary intake and nutritional status with fetal growth at 14 to 26 weeks gestation: a cross-sectional study. BMC nutrition, 10(1), 77.

Kementerian Kesehatan Republik Indonesia (Kemenkes). (2023). Survei Kesehatan Indonesia (SKI) Dalam Angka.

Mangwane, Q. E., Egal, A., & Oosthuizen, D. (2024). Impact of a nutrition knowledge intervention on knowledge and food behaviour of women within a rural community. *Nutrients*, *16*(23), 4107.

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Nastiti, A. A., Triharini, M., Sari, N. W., Armini, N. K. A., Nursalam, N., & Poddar, S. (2025). Nutritional fulfillment behavior of pregnant women based on the health belief model theory in Indonesia. *Nutrición Hospitalaria*, *42*(1).

Neha R.J, Natalia E.P, Shivani K., Dawn L.C., Phuong H.N., Melissa F.Y. (2023). Opportunities and barriers for maternal nutrition behavior change: an in-depth qualitative analysis of pregnant women and their families in Uttar Pradesh, India. *Front Nutr*, 10:1185696.

Nuryana, R. (2025). Characteristics of Pregnant Women who Experience Chronic Energy Deficiency in the Community Health Center. *Omni Nursing Journal*, 2(1), 24-29.

Ramenzoni, V. C. (2023). Taboos, food avoidances, and diseases: Local epistemologies of health among Coastal Endenese in Eastern Indonesia. *Frontiers in Sustainable Food Systems*, 7, 977694.

Sheikh, J., Allotey, J., Kew, T., Khalil, H., Galadanci, H., Hofmeyr, G. J., ... & Thangaratinam, S. (2024). Vulnerabilities and reparative strategies during pregnancy, childbirth, and the postpartum period: moving from rhetoric to action. *EClinicalMedicine*, *67*.

Siregar, N., Indriasari, R., Salmah, U., Jafar, N., Arsyad, M., Sudirman, J., ... & Mallongi, A. (2025). Interventions Of Chronic Energy Deficiency (Ced) In Pregnant Women: A Review OfCurrent Evidance. *The Review of Diabetic Studies*, 12-20.

Sulistyorini, D., Kako, M., Ehsanul Huq, K. A. T. M., Shaluhiyah, Z., & Moriyama, M. (2025). Exploring cultural factors contributing maternal mortality among pregnant women: an ethnographic study in the Banjarnegara community, Central Java, Indonesia. *Frontiers in Global Women's Health*, *6*, 1677072.

UNICEF Indonesia. (2023). Maternal nutrition in Indonesia. Landscape analysis and recommendations. Retrieved from https://www.unicef.org/indonesia/nutrition/reports/maternal-nutrition-indonesia

World Health Organization (WHO). (2020). Nutritional interventions update: multiple micronutrient supplements during pregnancy. Retrieved from https://www.who.int/publications/i/item/9789240007789

Zenbaba, D., & Yaya, S. (2026). Breaking the Cycle: Intergenerational Transmission of Stunting in Sub-Saharan Africa—Evidence From 19 Countries. *Maternal & Child Nutrition*, *22*(1), e70177.