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Prediction of Risk Factors for Economic Status and Anemia with Chronic Energy Deficiency in Pregnant Women in the Tamalate Community Health Center Area, Makassar City

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ABSTRACT

Background: Chronic energy deficiency (CED) affects 35–75% of pregnant women globally, with the highest prevalence occurring in the third trimester of pregnancy. National prevalence in Indonesia stands at 16.9%, with 12.1% in Makassar City and 19.38% at Tamalate Community Health Center. Multiple factors—including poverty, prenatal nutrition deficiency, anemia, and limited knowledge—accumulate in behaviors that negatively impact child stunting outcomes.

Methods: A quantitative observational analytical study using a case-control design was conducted on 140 subjects at Puskesmas Tamalate, Makassar, comprising 70 CED cases and 70 non-CED controls selected by simple random sampling. Economic status was assessed by monthly family income level, and anemia status was determined by hemoglobin (Hb) measurement. Data were processed and analyzed using the Odds Ratio (OR) statistical test with SPSS version 24.

Results: Economic status was significantly associated with CED in pregnant women ($p=0.000 < \alpha=0.05$), with a predicted OR of 5.54 (95% CI: 2.67–11.47). Anemia status was also significantly associated with CED ($p=0.000 < \alpha=0.05$), with a predicted OR of 9.7 (95% CI: 3.5–27.2).

Conclusion: Low family income and anemia are significant risk factors for CED in pregnant women. Adequate nutritional education utilizing affordable food sources and Hb screening before and during pregnancy are strongly recommended to reduce CED incidence.

ABSTRAK

Latar Belakang: Kekurangan energi kronik (KEK) masih menjadi masalah global yang memengaruhi 35–75% wanita hamil, dengan prevalensi tertinggi pada trimester ketiga kehamilan. Di Indonesia prevalensinya sebesar 16,9%, di Kota Makassar 12,1%, dan tertinggi 19,38% di wilayah Puskesmas Tamalate. Berbagai faktor seperti kemiskinan, defisiensi nutrisi prenatal, anemia, dan keterbatasan pengetahuan terakumulasi dalam perilaku yang berdampak negatif terhadap kejadian stunting pada anak.

Metode: Penelitian analitik observasional kuantitatif dengan rancangan kasus-kontrol dilakukan pada 140 subjek di wilayah Puskesmas Tamalate, Makassar, terdiri atas 70 kasus KEK dan 70 kontrol non-KEK yang dipilih melalui simple random sampling. Status ekonomi dinilai berdasarkan tingkat pendapatan keluarga per bulan, dan status anemia ditentukan berdasarkan pengukuran kadar hemoglobin (Hb). Data diolah dan dianalisis menggunakan uji statistik Odds Ratio (OR) dengan SPSS versi 24.

Hasil: Status ekonomi berdasarkan tingkat pendapatan keluarga berhubungan secara signifikan dengan kejadian KEK pada ibu hamil ($p=0,000 < \alpha=0,05$), dengan prediksi OR sebesar 5,54 (CI 95%: 2,67–11,47). Status anemia juga berhubungan secara signifikan dengan kejadian KEK ($p=0,000 < \alpha=0,05$), dengan prediksi OR sebesar 9,7 (CI 95%: 3,5–27,2).

Kesimpulan: Tingkat pendapatan keluarga yang rendah dan status anemia merupakan faktor risiko signifikan terhadap kejadian KEK pada ibu hamil. Edukasi gizi dari sumber pangan terjangkau serta skrining kadar Hb prahamil dan selama kehamilan sangat direkomendasikan untuk menekan angka kejadian KEK.

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INTRODUCTION

Pregnant women constitute a vulnerable population at risk of various physical and mental health problems due to the demands associated with pregnancy, placing women at elevated risk of malnutrition resulting from increased nutritional requirements, causing micronutrient and macronutrient deficiencies if dietary intake is not increased (Nguyen, 2020). Additionally, significant metabolic and physiological changes occur to support embryonic development in the mother, serving as the sole source of nutrition required by the fetus during pregnancy, obtainable only from maternal food intake (de Kok et al., 2021).

Chronic energy deficiency (CED) is most commonly experienced by mothers over prolonged periods ranging from months to years as a result of inadequate nutrient intake both before and during pregnancy through delivery. This directly affects not only maternal health but also fetal development and the health of the newborn, subsequently influencing child growth and development into adulthood, and consequently impacting the quality of human resources that may hinder future development (Mousa & Naqash, 2019). Therefore, maternal nutritional status before and during pregnancy through delivery is not only important but must receive attention to ensure healthy pregnancy outcomes.

CED in pregnant women has detrimental effects on the occurrence of stunting, which currently represents a problem in many countries. Stunting is frequently observed among impoverished populations where inadequate intrauterine nutrition, knowledge, and attitudes accumulate into behaviors contributing to CED. Consequently, premature birth and low birth weight (LBW) can lead to maternal, infant, and child mortality. As a long-term consequence, stunted children may never achieve optimal height, brain development, and cognitive potential (Keats et al., 2021).

Global prevalence of CED in pregnant women ranges from 35–75%, with the highest rates occurring in the third trimester of pregnancy. The WHO reports that approximately 40% of maternal deaths in developing countries are closely associated with CED (WHO & World Bank, 2021). The 2023 Indonesian Health Survey (Survei Kesehatan Indonesia/SKI) recorded CED prevalence in pregnant women in Indonesia at 16.9%, a slight decrease from 17.3% in the 2018 Basic Health Research (Riskesdas) (Ministry of Health RI, 2023b). According to the 2020 routine report from the Ministry of Health, of the 4,656,382 pregnant women whose mid-upper arm circumference (MUAC) was measured, approximately 451,350 (9.7%) experienced CED (Ministry of Health, Republic of Indonesia, 2021).

The 2020 Nutritional Status Monitoring (Pemantauan Status Gizi/PSG) in South Sulawesi recorded pregnant women at risk of CED at 12.1% in Makassar City. In 2022, the highest CED prevalence in Makassar City was found at the Tamalate Community Health Center with 126 cases, followed by the Bara-Barayya Community Health Center (97 cases) and the Rappokalling Community Health Center (93 cases) (Makassar City Health Office, 2022). This situation indicates that the Tamalate Community Health Center has become a priority for CED intervention in Makassar City.

At the 78th World Health Assembly in 2025, WHO member states adopted a resolution to extend the Global Nutrition Targets to improve maternal, infant, and early childhood nutrition from 2025 through 2030, aligned with the Sustainable Development Goals 2030 agenda (WHO-UNICEF, 2025).

Multiple factors are presumed to be associated with CED development in pregnant women. Direct factors include food intake influenced by beliefs, customs, food taboos, and disease (infection, anemia, protein deficiency). Indirect factors include food availability, low family income level, environmental factors (family, interpregnancy interval, parity), disease history, health services, education, occupation, and maternal knowledge. Structural barriers such as low nutritional literacy, limited decision-making autonomy, household food insecurity, and inadequate antenatal care are common in rural Southeast Asian populations, including the Tamalate Community Health Center area (UNICEF, 2023).

Based on the foregoing discussion, this research aims to identify predicted risk factors of economic status based on monthly family income level and anemia status on CED occurrence in pregnant women at the Tamalate Community Health Center area, Makassar City, so that research findings can serve as a basis for developing CED prevention programs through cross-program and cross-sectoral collaboration.

METHOD

Types of Research

This is a quantitative observational analytical study employing a case-control design aimed at determining the magnitude of the influence of economic status and anemia status on CED occurrence in pregnant women

Research Location and Time

The study was conducted in the service area of the Tamalate Community Health Center, Makassar City, South Sulawesi. Data collection was undertaken during 2025.

Population and Sample

The target population consisted of all pregnant women registered in the Tamalate Community Health Center area, totaling 650 women. Eligible participants were pregnant women in the first, second, or third trimester who, at the time of interview, were in good physical and mental health and capable of understanding and responding to questionnaires. Women showing signs of serious physical or mental health conditions that would interfere with interview participation were excluded. These inclusion and exclusion criteria were essential to maintain data quality and research ethics integrity.

Sample size was determined based on sample size estimation according to Lemeshow et al. (1997) for two subject groups, yielding a total of 140 pregnant women divided into two groups: 70 pregnant women with CED (MUAC <23.5 cm at the first antenatal care visit) as the case group, and 70 non-CED pregnant women (MUAC ≥23.5 cm) as the control group, matched according to gestational age. Sampling was conducted using simple random sampling.

Data Collection

Data were obtained through interviews using structured questionnaires prepared in advance according to study variables, as well as direct observation. Economic status was measured based on monthly family income level (high/adequate if ≥Makassar City Minimum Wage/UMK, and low if <UMK). Anemia status was determined based on hemoglobin (Hb) measurement results in the first trimester of pregnancy (anemia: Hb <11 g/dL; no anemia: Hb ≥11 g/dL).

Data Processing and Analysis

Data were processed and analyzed using univariate analysis with SPSS version 24 software to obtain a description of respondent characteristics, followed by bivariate analysis using the Odds Ratio (OR) predictive statistical test to identify the presence or absence of significant relationships between independent and dependent variables and the magnitude of their influence on CED occurrence in pregnant women. Analysis results were presented in frequency distribution tables described both descriptively and analytically.

RESEARCH RESULTS

The study was conducted in the Tamalate Community Health Center area, Makassar City. From identification of 650 registered pregnant women with complete data according to study variables, 19.8% were classified as having CED. Subsequently, 70 pregnant women with CED were randomly selected as the case group at a 1:1 ratio with 70 non-CED pregnant women as the control group. The data were then processed and analyzed using univariate and bivariate analyses with the following results.

Table 1. Characteristics of Age and Education Level of Respondents in Relation to Family Income Level and Anemia Status with Chronic Energy Deficiency (CED) in Pregnant Women at the Tamalate Community Health Center Area, Makassar City, 2025

Characteristics	n	Percent (%)
Age		
20 – 34 years	101	72.1
<20 and/or ≥35 Years	39	27.9
Education		
Primary School	12	8.6
Junior Secondary School	19	13.6
Senior Secondary School/Equivalent	69	49.3
Diploma	22	15.7
Bachelor's Degree (S-1)	18	12.9

Data presented in Table 1 show that among 140 pregnant women who were study subjects, the highest number fell in the 20–34 year age group (72.1%), which reproductively falls within the safe category, higher than pregnant women in the high-risk category (<20 and/or ≥35 years) at 27.9%.

Educationally, respondents' education levels were highly varied. There remained pregnant women with very low education levels (primary school: 8.6%), followed by junior secondary school at 13.6%. The most common education level was senior secondary school or equivalent at 49.3%, followed by diploma at 15.7%, and bachelor's degree (S-1) at 12.9%. This data indicates that the majority of pregnant women possessed adequate education levels to receive continuous nutritional health information.

Table 2. Relationship of Family Income Level and Anemia Status with Chronic Energy Deficiency (CED) in Pregnant Women at the Tamalate Community Health Center Area, Makassar City, 2025

Variables	Non-CED		CED		Total		p-value	OR	95% CI	
	n	%	n	%	n	%			Lower	Upp
Economic Status (Family Income)	46	66.7	18	25.7	64	45.7	0.000	5.54	2.67	11.47
High/Adequate	24	34.3	52	74.3	76	54.3				
low										
Anemia Status										
No Anemia	13	92.9	40	57.1	105	75	0.000	9.75	3.50	27.19
Anemia	7	7.1	30	42.9	35	25				

Table 2 demonstrates that from the perspective of monthly family income level, the high/adequate category in the non-CED group was 46 (66.7%), substantially higher than the CED group at 18 (25.7%) of pregnant women. Conversely, the CED group had more individuals with low family income levels, namely 52 (74.3%), compared to the non-CED group at 24 (34.3%).

Bivariate analysis results for monthly income level yielded a p-value of 0.000 < α=0.05, indicating that economic status is significantly associated with CED occurrence in pregnant women. The OR value of 5.54 (95% CI: 2.67–11.47) indicates that pregnant women with low family income levels have a 5.54-fold increased risk of experiencing CED compared to pregnant women with adequate economic status.

Regarding anemia status, the non-CED group had more individuals without anemia (65; 92.9%) compared to the CED group (40; 57.1%). Conversely, the CED group had more individuals with anemia (30; 42.9%) compared to the non-CED group (5; 7.1%).

Bivariate analysis results showed a p-value of $0.000 < \alpha=0.05$, indicating that anemia status is significantly associated with CED occurrence in pregnant women. The OR value of 9.75 (95% CI: 3.50–27.19) signifies that pregnant women with anemia have a 9.75-fold increased risk of developing CED compared to pregnant women without anemia.

DISCUSSION

CED in pregnant women remains a pressing global health problem. Its prevalence remains relatively high in various countries, including Indonesia as a developing nation, particularly in the Tamalate Community Health Center area, Makassar City, where 19.8% of the 650 pregnant women population experienced CED. This research was conducted in 2025 to identify predicted risk factors of economic status and anemia using a case-control design.

Descriptively, respondent age in the low-risk category (20–34 years) was more prevalent in the non-CED group, while those in the high-risk category (<20 and/or ≥35 years) were more prevalent in the CED group. Bivariate analysis results revealed no significant relationship between age and CED occurrence. This finding suggests that reproductively, mothers already possess knowledge to schedule pregnancies during safe periods (Novitasari, Wahyudi, & Nugraheni, 2019).

Respondents' generally adequate education levels should provide good comprehension abilities if they continuously receive nutritional information. However, during interviews and dietary recall, subjects were identified who consumed only rice and salt daily, demonstrating that food diversity had not been achieved. According to educational and behavioral science experts, individuals who acquire information cognitively become capable of processing it to form positive attitudes (Notoatmodjo, 2014; Nutbeam, Corbin, & Lin, 2021).

Family income level impacts household food insecurity conditions, closely related to the potential for CED occurrence in pregnant women. With increased household income, family food security can be achieved. Analysis results demonstrate that family income level is significantly associated with CED occurrence ($p=0.000 < 0.05$) with an OR value of 5.54 at CI limits of 2.67–11.47. This finding is consistent with literature indicating that poverty is a primary determinant of CED in developing countries (UNICEF, 2023).

Anemia in pregnant women represents an issue inseparable from the pregnant woman's condition due to its relationship with physiological changes occurring with pregnancy progression. Adequate nutrition is the best approach to prevent anemia during pregnancy, particularly through consumption of iron-rich foods that help maintain adequate hemoglobin supply. Bivariate analysis results demonstrated an OR value of 9.75 (95% CI: 3.50–27.19) with $p=0.000 < 0.05$, indicating that anemia status exerts substantial influence on CED occurrence in pregnant women.

Nutritional anemia begins with depletion of iron reserves (ferritin) and reduced transferrin saturation, resulting in low hemoglobin levels. Pregnant women with anemia cause insufficient blood supply to the placenta, affecting placental function toward the fetus. This condition is exacerbated by limited purchasing power due to low economic conditions, such that inadequate consumption patterns become a trigger for CED (Andrawulan et al., 2020; Ministry of Health RI, 2020; Mates et al., 2024; Wang et al., 2025).

This study's findings confirm that comprehensive nutritional intervention, encompassing income improvement, food diversification, and anemia management from the prepregnancy period, is greatly needed to reduce CED incidence in pregnant women, consistent with the WHO-UNICEF 2030 global targets (WHO-UNICEF, 2025).

CONCLUSIONS AND SUGGESTIONS

Based on research and analysis conducted, the following conclusions can be drawn. Economic status based on low family income level is significantly associated with CED occurrence in pregnant women, with a risk magnitude of OR 5.54 (95% CI: 2.67–11.47). Anemia status during pregnancy is significantly associated with CED occurrence, with a risk magnitude of OR 9.75 (95% CI: 3.50–27.19).

It is recommended that health workers, particularly midwives in primary care services, be more proactive in providing nutritional education utilizing affordable food sources, monitoring pregnant women's nutritional status, and providing iron supplementation and complementary food appropriately. The government must ensure distribution of funding and logistics for nutrition programs, particularly in remote areas, as well as strengthen the capacity of village health workers through continuous training. Cross-sectoral collaboration is vital to ensure every pregnant woman receives access to adequate nutrition services, including hemoglobin screening before and during pregnancy, so that CED and anemia risks can be reduced from the early stages of pregnancy.

Author's Contribution Statement:
Marhaeni: Conceptualization, Methodology, Investigation, Project Administration, Resources, Formal Analysis, Writing – Original Draft, Writing – Review & Editing, Funding Acquisition, Supervision. **Afriani:** Investigation, Data Curation, Validation, Writing – Review & Editing. **Wirawati Amin:** Methodology, Investigation, Data Curation, Writing – Review & Editing. **Hastuti Husain:** Methodology, Investigation, Formal Analysis, Writing – Review & Editing, Visualization.

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