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

Estudio transversal sobre los factores determinantes de la desnutrición energética crónica (DEC) en mujeres embarazadas en zonas propensas a desastres, Centro de Salud Talise, Ciudad de Palu

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ABSTRACT

Introduction: Chronic Energy Deficiency (CED) in pregnant women is a major nutritional issue, especially in disaster-prone areas where food security and healthcare access are limited. In Palu City, Central Sulawesi, the prevalence of CED remains high, contributing to poor maternal and fetal outcomes.

Aim: This study aimed to examine the determinants of CED among pregnant women in the working area of Talise Community Health Center, a disaster-affected region in Palu.

Methods: A cross-sectional study was conducted from August to November 2024 with 258 pregnant women selected through accidental sampling. Data were collected using questionnaires, 2x24-hour dietary recalls, and MUAC measurements. Statistical analysis was performed using the chi-square test with a 95% confidence interval.

Results: CED prevalence was 28.1%. Significant associations were found between CED and maternal age (p = 0,046), short interpregnancy interval (p = 0,005), low education (p = 0,005), poor family support (p<0,001), limited healthcare access (p = 0,014), unhealthy lifestyle practices (p = 0,004), and poor maternal knowledge (p<0,001). Macronutrient intake (energy, protein, fat, and carbohydrate) and vitamin A adequacy were also significantly associated with CED (p<0,001). However, folic acid and calcium intake showed no significant relationship. In addition, unhealthy eating habits, food insecurity, and low household income were strongly linked to CED (p<0,001).

Conclusion: CED among pregnant women in disaster-prone areas is influenced by various sociodemographic, behavioral, and nutritional factors. Improving education, dietary intake, family and health service support are essential strategies to address CED in vulnerable populations.

KEYWORDS

Maternal Nutrition, Food Insecurity, Dietary Intake, Health Services, Socio-Demographic Factors.

INTRODUCTION

Chronic Energy Deficiency (CED) refers to a state of malnutrition in pregnant women caused by long-term insufficient food intake, typically indicated by a Mid-Upper Arm

Circumference (MUAC) of less than 23.5 cm[1]. In Indonesia, the prevalence of Chronic Energy Deficiency (CED) among pregnant women reaches 8.43%, which is still classified as a moderate public health concern. In the city of Palu, the incidence of CED has shown an increasing trend over the past three years. In 2023, 857 out of 7,832 pregnant women (10.94%) were identified as experiencing CED. At Talise Community Health Center (Puskesmas Talise), a significant rise in cases was recorded—from 52 cases (6.25%) in 2020 to 217 cases (25.99%) in 2022—before declining to 141 cases (15.75%) in 2023[2,3].

Palu City the capital of central sulawesi is one of Indonesia's disaster-prone areas, particularly vulnerable to earthquakes, tsunamis, and soil liquefaction, as evidenced by the events of 2018. The impacts of such disasters extend across multiple sectors, including the destruction of health infrastructure, reduced food accessibility, decreased household income, and instability in the community's psychosocial conditions. These factors can exacerbate nutritional problems, especially among vulnerable groups such as pregnant women[4]

Chronic Energy Deficiency (CED) in pregnant women poses serious risks, including anemia, infections, obstructed labor, and increased maternal and neonatal mortality rates. The determinants of CED are complex and interrelated, encompassing factors such as maternal knowledge of pregnancy nutrition[5], maternal nutrient intake[6], food availability[7], socioeconomic status—including household income[8], education level, pregnancy spacing[9], family support[10], access to healthcare service[10], hygienic and healthy lifestyle practices[6], and maternal age. A study by Mulyaningrum, cited in Novitasari et al. (2019)[6], found that pregnant women under the age of 20 are at higher risk of developing CED, with younger maternal age being significantly associated with this condition.

Given the high prevalence of Chronic Energy Deficiency (CED) in Palu City and its status as a disaster-prone area, it is essential to conduct a comprehensive study to identify the dominant factors influencing the occurrence of CED among pregnant women in this region, particularly within the service area of Talise Community Health Center. The findings of this research are expected to serve as a foundation for formulating targeted interventions in disaster-affected areas, with the aim of reducing CED prevalence and improving maternal and child health outcomes.

MATERIALS AND METHODS

Type and Design

This study employed a quantitative research approach. The research design was analytical observational using a cross-sectional method. A cross-sectional design is a research approach used to examine the relationship between risk factors or exposures and outcomes, in which data on both the exposures and the outcomes are collected simultaneously.

Location and Time

This study was conducted in the working area of Talise Community Health Center, Palu City, Central Sulawesi from August to November 2024. This study received ethical clearance from the Health Research Ethics Committee of the Faculty of Public Health, Tadulako University Approval No: 8473/UN28.10/KL/2025). All participants provided written informed consent prior to data collection

Population and Sample

The population in this study consisted of pregnant women residing within the working area of Talise Community Health Center (Puskesmas Talise) in Palu City, totaling 567 individuals. The research sample was selected based on inclusion criteria. Participants were eligible for inclusion if they were in their first, second, or third trimester of pregnancy, permanently resided in the Talise service area, and expressed willingness to participate by providing informed consent. Pregnant women were excluded if they relocated during the study period, were unable to participate due to illness or other constraints, or failed to provide the required information at the time of data collection. The sampling technique used in this study was convenience sampling, in which participants were selected based on chance encounters with the researcher at the study site. Pregnant women who happened to be present during data collection and met the inclusion and exclusion criteria were included as respondents.

The sample size was calculated using Slovin's formula:

$$n = \frac{N}{1 + Ne^2}$$

where n is the sample size, N is the population size, and e is the margin of error tolerated (set at 0.05). Based on this calculation, the minimum required sample size was 235 respondents. To anticipate potential dropouts, an additional 10% was added, resulting in a final sample size of 245 respondents.

Data collection was conducted by trained enumerators who held a minimum qualification of a bachelor's degree in nutrition and had undergone a two-day training workshop on anthropometric measurements, dietary recall interviewing techniques, and ethical data handling procedures.

Research Instruments

The instruments used in this study included a structured questionnaire, a Mid-Upper Arm Circumference (MUAC) measuring tape, Dietary intake was assessed using two non-consecutive 24-hour recalls, one on a weekday and one on a weekend, to capture variations in eating patterns and reduce recall bias. Standardized portion size booklets and the Indonesian Food Consumption Table were used to ensure accuracy.

This study employed MUAC as the primary anthropometric indicator for assessing maternal nutritional status due to its practicality, low cost, and reliability in field settings, especially in disaster-affected and resource-limited areas. MUAC is recommended by WHO as a valid proxy for chronic energy deficiency in pregnant women, particularly when weight and height measurements are logistically challenging to obtain.

Research Variables

The independent variables in this study included maternal knowledge, maternal nutrient intake during pregnancy, food availability, socioeconomic status (specifically household income), maternal age, education level, interpregnancy interval, family support, access to healthcare services, and hygienic and healthy lifestyle practices. The dependent variable was the incidence of Chronic Energy Deficiency (CED) among pregnant women attending Talise Community Health Center in Palu City, Central Sulawesi.

Data Analysis

Univariate analysis was conducted to describe the frequency distribution of each research variable. Bivariate analysis was performed to examine the relationship between the dependent and independent variables. Statistical analysis employed the Chi-square test with a 95% confidence level. A p-value < 0.05 was considered statistically significant.

RESULTS

Frequency Distribution of Research Variables

Table 1 summarizes the characteristics of 245 pregnant women. Most participants were aged 20–35 years (89.0%), had higher education (81.6%), good family support (72.2%), and adequate healthcare access (82.0%). However, short interpregnancy intervals (<24 months) were reported by 30.2%, and 20.0% had poor nutritional knowledge. Dietary assessment indicated deficits in carbohydrates (42.1%), folic acid (46.8%), and calcium (62.1%), while 35.3% reported unhealthy eating habits, 34.5% experienced food insecurity, and 41.7% had low household income.

The relationship between the independent variables and the dependent variable

Table 2 shows factors significantly associated with chronic energy deficiency (CED). Maternal age (<20 or >35 years, p = 0.046), short interpregnancy intervals (p = 0.005), low education (p = 0.005), poor family support (p < 0.001), limited healthcare access (p = 0.014), and unhealthy lifestyle practices (p = 0.004) increased the risk of CED. Poor maternal knowledge (p < 0.001) and inadequate intake of energy, protein, fat, carbohydrates, and vitamin A (all p < 0.001) were also strongly related. In contrast, folic acid (p = 0.523) and calcium (p = 0.939) were not significant. Behavioral and

Table 1. Características de los participantes

Variables	Frequency (n)	Percentage (%)
Nutritional Status		
CED	66	28.1
Non CED	169	71.9
Age (years)		
Less than 20 or more than 35	27	11.0
20-35	218	89.0
Interpregnancy Interval		
<24 months	74	30.2
≥24 months	171	69.8
Education Level		
Low Education (No Schooling, Elementary School, Junior High School)	45	18.4
Higher Education (senior high school or equivalent, higher education)	200	81.6
Family Support		
Poor	68	27.8
Good	177	72.2
Access to Healthcare Services		
Poor	44	18.0
Good	201	82.0
Hygienic and Healthy Lifestyle Practices		
Poor	38	15.5
Good	207	84.5
Maternal Knowledge		
Poor	47	20.0
Moderate	106	45.1
Good	82	34.9
Energy Intake		
Deficit	41	17.4
Normal	187	79.6
Excessive	7	3.0
Protein Intake		
Deficit	41	17.4
Normal	35	14.9
Excessive	159	67.7

* Valor expresado en media ± desviación estándar (rango de edades).

Table 1 continuation. Características de los participantes

Variables	Frequency (n)	Percentage (%)
Fat Intake		
Deficit	37	15.7
Normal	69	29.4
Excessive	129	54.9
Carbohydrate Intake		
Deficit	99	42.1
Normal	115	48.9
Excessive	21	8.9
Vitamin A Intake		
Deficit	55	23.4
Normal	49	20.9
Excessive	131	55.7
Folic Acid Intake		
Deficit	110	46.8
Normal	119	50.6
Excessive	6	2.6
Calcium Intake		
Deficit	146	62.1
Normal	73	31.1
Excessive	16	6.8
Eating Habits		
Unhealthy	83	35.3
Healthy	152	64.7
Food Availability		
Food insecure	81	34.5
Food secure	154	65.5
Household Income		
Low (< minimum wage of Palu City)	98	41.7
High (≥ minimum wage of Palu City)	137	58.3
Total	**245**	**100.0**

* Valor expresado en media ± desviación estándar (rango de edades).

socioeconomic factors, including unhealthy eating habits, food insecurity, and low household income, further showed strong associations with CED (all p < 0.001).

DISCUSSION

Chronic Energy Deficiency (CED) in pregnant women is a form of malnutrition characterized by prolonged inadequate energy intake, leading to depleted energy reserves and compromised nutritional status[11]. This condition is commonly assessed using the Mid-Upper Arm Circumference (MUAC), with a cutoff point of less than 23.5 cm[12]. CED during pregnancy poses serious health risks for both the mother and the fetus. In mothers, it increases the likelihood of anemia, infections, preeclampsia, and complications during labor[13]. For the fetus, it can lead to intrauterine growth restriction (IUGR), low birth weight (LBW), preterm birth, and even neonatal mortality. Furthermore, CED has long-term implications for the next generation, as it may adversely affect a child's physical growth and cognitive development[14].

This study identified multiple factors significantly associated with the incidence of Chronic Energy Deficiency (CED) among pregnant women in a disaster-prone area in Palu City, Central Sulawesi. The findings emphasize that maternal age, interpregnancy interval, education level, family support, access to healthcare, lifestyle practices, maternal knowledge, and various aspects of nutrient adequacy level all play critical roles in influencing maternal nutritional status.

Maternal Age

Maternal age is a critical determinant of nutritional status during pregnancy, with both younger and older maternal ages associated with increased risk of Chronic Energy Deficiency (CED)[15]. Adolescent pregnancies, particularly among women under 20 years of age, are often marked by biological immaturity, incomplete physical growth, and limited nutritional reserves, which may compromise maternal and fetal health[16,17]. Conversely, pregnancies at advanced maternal age (above 35 years) are linked to a higher prevalence of chronic conditions and reduced metabolic efficiency, both of which may exacerbate the risk of undernutrition. Several studies have reported a U-shaped relationship between maternal age and adverse pregnancy outcomes, including CED, with women at both ends of the reproductive age spectrum experiencing higher vulnerability due to physiological, behavioral, and socioeconomic factors[11,18].

This study found a statistically significant association between maternal age and the incidence of Chronic Energy Deficiency (CED), with women under 20 and over 35 years old being more likely to experience CED (p = 0.046). These findings are consistent with a study by Auranissa et al (2024)[19], which reported that the younger the pregnant women are, the more they are risk of CED. Pregnant women under the

Table 2. Bivariate analysis of factors associated with chronic energy deficiency (CED) among pregnant women in Palu (n = 245)

Variables	Maternal Nutritional Status				Total		p-Value
	CED		Non CED				
	n	%	N	%	n	%	
Age (Years)							
Less than 20 or more than 35	12	44.4	15	55.6	27	100	0.046*
20-35	57	26.1	161	73.9	218	100	
Interpregnancy Interval							
<24 months	30	40.5	44	59.5	74	100	0.005*
≥24 months	39	22.8	132	77.2	171	100	
Education Level							
Low Education (No Schooling, Elementary School, Junior High School)	23	51.1	22	48.9	45	100	0.005*
Higher Education (senior high school or equivalent, higher education)	46	23.0	154	77.0	200	100	
Family Support							
Poor	34	50.0	34	50.0	68	100	0.000*
Good	35	19.8	142	80.2	177	100	
Access to Healthcare Services							
Poor	19	43.2	25	56.8	44	100	0.014*
Good	50	24.9	151	75.1	201	100	
Hygienic and Healthy Lifestyle Practices							
Poor	18	47.4	20	52.6	38	100	0.004*
Good	51	24.6	156	75.4	207	100	
Maternal Knowledge							
Poor	39	83.0	8	17.0	47	100	0.000*
Moderate	18	17.0	88	83.0	106	100	
Good	9	11.0	73	89.0	82	100	
Energy Adequacy Level							
Deficit	33	50.0	8	4.7	41	100	0.000*
Normal	32	17.1	155	82.9	187	100	
Excessive	1	14.3	6	85.7	7	100	
Protein Adequacy Level							
Deficit	33	80.5	8	19.5	41	100	0.000*
Normal	6	17.1	29	82.9	35	100	
Excessive	27	17.0	132	83.0	159	100	

* Statistically significant association based on Chi-square test (p < 0.05).

Table 2 continuation. Bivariate analysis of factors associated with chronic energy deficiency (CED) among pregnant women in Palu (n = 245)

Variables	Maternal Nutritional Status				Total		p-Value
	CED		Non CED				
	n	%	N	%	n	%	
Fat Adequacy Level							
Deficit	32	86.5	5	13.5	37	100	
Normal	13	18.8	56	81.2	69	100	0.000*
Excessive	21	16.3	108	83.7	129	100	
Carbohydrate Adequacy Level							
Deficit	49	49.5	50	50.5	99	100	
Normal	15	13.0	100	87.0	115	100	0.000*
Excessive	2	9.5	19	90.5	21	100	
Vitamin A Adequacy Level							
Deficit	29	52.7	26	47.3	55	100	
Normal	13	26.5	36	73.5	49	100	0.000*
Excessive	24	18.3	107	81.7	131	100	
Folic Acid Adequacy Level							
Deficit	28	25.5	82	74.5	110	100	
Normal	37	31.1	82	68.9	119	100	0.523
Excessive	1	16.7	5	83.3	6	100	
Calcium Adequacy Level							
Deficit	42	28.8	104	71.2	146	100	
Normal	20	27.4	53	72.6	73	100	0.939
Excessive	4	25.0	12	75.0	16	100	
Eating Habits							
Unhealthy	37	56.1	46	27.2	66	100	0.000*
Healthy	29	43.9	123	72.8	169	100	
Food Availability							
Food insecure	36	54.5	45	26.6	66	100	0.000*
Food secure	30	45.5	124	73.4	169	100	
Household Income							
Low (< minimum wage of Palu City)	44	66.7	54	32.0	98	100	0.000*
High (≥ minimum wage of Palu City)	22	33.3	115	68.0	137	100	

* Statistically significant association based on Chi-square test (p < 0.05).

age of 20 are more susceptible to various forms of malnutrition, including stunting, wasting, overweight, obesity, and anemia. This increased vulnerability can be attributed to the fact that adolescent mothers are still undergoing their own physical growth and development. As a result, there is a nutritional competition between the mother and the fetus, both of whom require essential nutrients for growth, potentially leading to inadequate nutrient availability for one or both.

Interpregnancy Interval

Interpregnancy interval is an important factor influencing maternal nutritional status, particularly in relation to Chronic Energy Deficiency (CED). Short birth spacing, defined as an interval of less than 24 months between pregnancies, has been shown to increase the risk of maternal undernutrition. This is primarily due to the limited time available for mothers to physiologically and nutritionally recover from the previous pregnancy and lactation period. Without sufficient recovery time, maternal nutrient reserves may remain depleted, increasing the likelihood of entering subsequent pregnancies in a nutritionally compromised state. The findings of this study support this association, as women with interpregnancy intervals of less than 24 months had a significantly higher prevalence of CED (p = 0.005). This is consistent with previous research by Wati et al (2024)[11], it was observed that pregnancies occurring within less than 24 months of a previous birth were linked to a markedly elevated risk approximately 7.3 times higher of developing Chronic Energy Deficiency (CED), compared to those with interpregnancy intervals exceeding 24 months. which emphasized that short birth intervals are associated with adverse maternal and perinatal outcomes, including malnutrition, anemia, and poor fetal growth outcomes[20].

Education Level

The educational level of pregnant women plays a pivotal role in determining their nutritional status, including the risk of developing Chronic Energy Deficiency (CED). In this study, a significant association was found between low educational attainment and higher prevalence of CED (p = 0.005). Women with lower levels of education, those who did not complete secondary school were more likely to experience CED compared to their counterparts with higher education. This finding is consistent with previous studies, such as that by Triyawati and Yuliani (2023)[21], which found that Education has a significant influence on CED incidence in pregnant women. Individuals with higher levels of education tend to have better access to information and are more likely to acquire relevant knowledge, including in the area of maternal nutrition. In contrast, limited educational attainment can impede one's ability to understand and adopt new concepts or health-related behaviors, such as appropriate dietary practices during pregnancy[22].

Family Support

Family support plays a critical role in maternal nutritional status during pregnancy. This study found a significant association between poor family support and higher CED prevalence (p < 0.001). Similarly, a study by Fitria et al. (2024)[23] found that husband support affects maternal health where husband with no support during pregnancy increase risk of CED 4 times than husband with support during pregnancy. Lack of emotional, financial, and practical support may lead to inadequate food intake, reduced access to antenatal care, and increased stress, all of which contribute to nutritional deficiencies during pregnancy[24].

Access to Healthcare Services

Access to healthcare services is closely linked to maternal nutritional outcomes. In this study, limited access was significantly associated with higher rates of CED among pregnant women (p = 0.014). Consistent with findings by Ghosh et al. (2019)[25], women with poor access to antenatal care were more likely to miss nutritional counseling and early detection of undernutrition. Barriers such as distance, cost, and lack of information reduce service utilization, ultimately affecting maternal diet quality and timely nutritional interventions

Hygienic and Healthy Lifestyle Practices

Unhealthy environments and poor hygiene practices can indirectly contribute to Chronic Energy Deficiency (CED) in pregnant women by increasing the risk of infections. Adopting Clean and Healthy Lifestyle Behavior (PHBS) helps reduce disease exposure and supports better nutritional outcomes[26]. This study found a significant association between clean and healthy lifestyle behavior (PHBS) and the incidence of Chronic Energy Deficiency (CED) among pregnant women in the Talise Health Center area of Palu City (p = 0.004). Pregnant women with poor hygiene and health practices were more vulnerable to infections and health issues that could impair nutrient absorption. These findings are consistent with Yulianingsih (2022)[27], who also reported a significant relationship between PHBS and CED (p = 0.005).

Maternal Knowledge

A mother's knowledge greatly influences her decision-making and related health behaviors. Mothers with adequate nutrition knowledge are more likely to meet their own and their baby's nutritional needs[28]. In this study, maternal knowledge was significantly associated with Chronic Energy Deficiency (CED) (p < 0.001), with 47 pregnant women classified as having poor knowledge and 39 of them experiencing CED. These findings are supported by Wati (2024)[11], who also reported a significant association between maternal nutrition knowledge and CED (p = 0.023). Pregnant women with limited nutritional understanding are more likely to suffer from CED compared to those with better awareness.

Energy and Macronutrient Adequacy Level

This study revealed significant associations between the adequacy levels of macronutrient intake, specifically energy, protein, fat, and carbohydrates, and the incidence of Chronic Energy Deficiency (CED), among pregnant women (p<0.001). Pregnant women with energy deficits were more likely to experience CED highlighting the critical role of sufficient caloric intake during pregnancy. Likewise, inadequate protein intake showed a strong correlation with CED, as protein is essential for maternal and fetal tissue development. Fat and carbohydrate deficiencies were also significantly linked to CED, indicating the importance of balanced macronutrient intake to prevent malnutrition. These findings are consistent with previous studies emphasizing that insufficient intake of key macronutrients can impair maternal health and fetal growth outcomes[7].

Inadequate intake of energy, protein, fat, and carbohydrates is significantly associated with the incidence of Chronic Energy Deficiency (CED) among pregnant women, as these macronutrients play essential roles in supporting maternal metabolism and fetal development. Insufficient energy leads to the mobilization of body reserves, resulting in decreased body mass and mid-upper arm circumference. Low protein intake disrupts tissue formation and immune function, while inadequate fat and carbohydrate intake reduces energy availability, forcing the body to use protein for energy[11].

Micronutrient Adequacy Level

This study identified a significant association between vitamin A adequacy and the occurrence of Chronic Energy Deficiency (CED) among pregnant women (p < 0.001), whereas folic acid and calcium intakes were not significantly associated (p = 0.523 and p = 0.939, respectively). Vitamin A is crucial for immune function, epithelial integrity, and cellular differentiation, which may influence the body's ability to absorb and utilize nutrients effectively. In contrast, while folic acid and calcium are essential for fetal neural development and maternal bone health, their levels may not directly impact maternal energy status, explaining the lack of statistical correlation in this context. This finding aligns with prior studies that highlight vitamin A's potential protective role against maternal undernutrition and infection-related nutrient loss during pregnancy.

Eating Habits

Eating habits were significantly associated with the incidence of Chronic Energy Deficiency (CED) among pregnant women (p<0.001). Pregnant women with unhealthy eating habits, defined by low meal frequency, poor dietary diversity, and inadequate intake of balanced nutrients, were more likely to experience CED. These habits reduce the body's ability to meet the increased nutritional demands during pregnancy, thereby impairing maternal health and fetal development. Unhealthy eating patterns are a contributing factor to maternal undernutrition[29]. Irregular meals and low food variety during pregnancy increase the risk of insufficient energy and protein intake, both of which are critical for preventing CED[30]. These findings underline the importance of improving nutrition literacy and dietary behavior among pregnant women as part of maternal health programs.

Food Availability and Household Income

The study demonstrated a significant association between food availability and household income with the incidence of Chronic Energy Deficiency (CED) among pregnant women (p<0.001). Limited food availability, often due to unstable food supply or economic constraints, can lead to insufficient nutrient intake, increasing the risk of maternal undernutrition. Pregnant women in food-insecure households were more likely to suffer from CED due to the inability to access a variety of nutrient-rich foods necessary during pregnancy. Additionally, low household income, particularly below the regional minimum wage, further exacerbates this risk by limiting purchasing power for quality food and healthcare. Socio-economic constraints and food insecurity play pivotal roles in maternal nutritional outcomes. Strengthening economic resilience and improving food accessibility are therefore critical components in reducing CED prevalence among pregnant populations[7].

The strength of the research lies in its comprehensive exploration of multiple determinants associated with Chronic Energy Deficiency (CED) among pregnant women, including nutritional intake (macronutrients and micronutrients), health behavior (PHBS), socioeconomic factors (food availability and family income), and healthcare access. Each study applied a cross-sectional design with adequate sample sizes and appropriate statistical tests, yielding significant findings such as the role of vitamin A intake, inadequate health behaviors, and low family income in increasing CED risk. However, limitations include reliance on self-reported data that may introduce recall bias, limited generalizability due to localized study settings (Puskesmas Talise, Palu), and lack of multivariate analysis to control for confounding factors. These limitations suggest the need for future longitudinal or case-control studies with broader sampling to confirm causality and enhance external validity.

CONCLUSION AND RECOMMENDATION

This study confirms that Chronic Energy Deficiency (CED) among pregnant women in disaster-prone areas is strongly associated with multiple demographic, socioeconomic, behavioral, and nutritional determinants. The main significant factors identified were maternal age (p = 0.046), short interpregnancy intervals (p = 0.005), low education level (p = 0.005), poor family support (p < 0.001), limited access to healthcare

(p = 0.014), and unhealthy lifestyle practices (p = 0.004). In addition, poor maternal knowledge (p < 0.001), inadequate intake of macronutrients such as energy, protein, fat, and carbohydrates (all p < 0.001), and insufficient vitamin A intake (p < 0.001) were significantly associated with CED. Conversely, folic acid and calcium intake were not related to maternal nutritional status.

To address these multifactorial risks, integrated interventions are urgently required. Priority actions should include strengthening maternal nutrition education, expanding access to quality antenatal services, enhancing family and social support, and implementing food security programs adapted to vulnerable populations in disaster-affected settings. Future research should employ longitudinal or interventional designs to assess the long-term effectiveness of these strategies in reducing CED prevalence and improving maternal–child health outcomes.

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