



## ANALYSIS OF RISK FACTORS FOR CHRONIC ENERGY DEFICIENCY (CED) AMONG PREGNANT WOMEN

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### ABSTRACT

Chronic Energy Deficiency (CED) is a condition of inadequate energy intake that can have negative impacts on the health of pregnant women and fetuses, and increase the risk of pregnancy complications. Several factors can influence the occurrence of CED, including carbohydrate intake, protein intake, fat intake, maternal age, family income, pregnancy spacing, and food availability. A better understanding of these risk factors is expected to help in efforts to mitigate and manage CED in pregnant women. This study aims to identify the risk factors for CED among pregnant women at Limboto Health Center. This study employed a cross-sectional design. The sample consisted of 100 pregnant women at the Limboto District Health Center, selected using simple random sampling. Data were collected using MUAC (Mid-Upper Arm Circumference) measurements, 24-hour recall forms, and questionnaires. The research instruments used in this study have been validated (Sig 2-tailed < 0.05) and proven reliable (Cronbach's Alpha > 0.7), confirming their suitability for use. Data analysis used chi-square to examine the relationships between variables and logistic regression to identify the most influential variables. Statistical analysis revealed significant relationships between carbohydrate intake ( $p = 0.002$ ), protein intake ( $p = 0.003$ ), fat intake ( $p = 0.002$ ), age ( $p = 0.000$ ), family income ( $p = 0.009$ ), pregnancy spacing ( $p = 0.004$ ), and food availability ( $p = 0.000$ ). Fat intake had the greatest influence on Chronic Energy Deficiency (CED) (Exp (B) = 143.372). Factors such as carbohydrate intake, protein intake, fat intake, age, family income, pregnancy spacing, and food availability are associated with the occurrence of CED among pregnant women. Therefore, efforts to prevent and manage CED in pregnant women need to consider these factors, particularly in improving nutrient intake to support the health of both mother and fetus.

Keywords: age; chronic energy deficiency (CED); family income; food availability; nutrient intake; pregnancy spacing; pregnant women

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### INTRODUCTION

Chronic Energy Deficiency (CED) is a health phenomenon that frequently occurs in developing countries, including Indonesia. CED often affects vulnerable groups that require adequate nutrition for optimal growth and development, such as pregnant women. According to World Health Organization tahun 2023, the prevalence of CED among pregnant women remains high, ranging from 10% to 40%. Indonesia ranks high in CED prevalence in Southeast Asia, with approximately 8.7% of 3.2 million pregnant women affected (Kemenkes, 2023). In Gorontalo Province, the prevalence of CED among pregnant women reached 15.5% in 2023, with cases spread across various health facilities, including community health centers (Puskesmas). Puskesmas Limboto, one of 23 Puskesmas in Gorontalo Regency, reported the highest number of pregnant women with CED in 2024, with 104 cases (Dinas Kesehatan Provinsi Gorontalo, 2023).

Chronic Energy Deficiency (CED) is a condition where pregnant women experience a prolonged energy deficit. When the energy needs of pregnant women are not met, the risk of complications during pregnancy increases, such as low birth weight (LBW), premature delivery, and fetal developmental disorders. Additionally, women with CED are also at a

higher risk of anemia, preeclampsia, and even death (Pancawardani et al., 2022). The impact of CED is not only felt by pregnant women and fetuses in the present but also has long-term consequences. Children born to mothers with CED are at a higher risk of experiencing health problems, including stunting, cognitive developmental disorders, and various chronic diseases later in life. Therefore, it is essential to optimize the prevention of risk factors early on (Afriyanti, 2020). The risk factors for Chronic Energy Deficiency (CED) in pregnant women are complex and interrelated. The grand theory of Atwater (1899) on the relationship between macronutrient intake and the incidence of CED in pregnant women illustrates how an imbalance or deficiency in major macronutrients (carbohydrates, proteins, and fats) can lead to CED. This theory focuses on the role of each macronutrient in supporting the energy and nutritional needs of pregnant women, which is crucial for health and preventing CED (Zaina, 2021). Research conducted by Rahayu & Sagita (2019) revealed that adequate food availability significantly reduces the prevalence of CED in pregnant women in food-insecure areas.

Research on Chronic Energy Deficiency (CED) in pregnant women has evolved significantly, but some studies tend to focus solely on micronutrient intake without considering total calorie or macronutrient (carbohydrate, protein, fat) intake, which is also crucial. More holistic research that encompasses all aspects of nutrition, including carbohydrates, proteins, fats, as well as biological factors such as age, pregnancy spacing, and income, is necessary to understand the risk factors of CED comprehensively. Additionally, most existing research is observational, providing only a snapshot of CED status for a particular variable. Longitudinal studies are needed to understand the dynamics of different risk factors, including how socioeconomic status and maternal age can contribute to the risk of CED in pregnant women, particularly in Limboto Health Center, where no research has been conducted with similar variables. Based on the background description above, the researcher conducted a study aimed at analyzing the factors associated with Chronic Energy Deficiency (CED) in pregnant women at the Limboto Health Center

## **METHOD**

This study is a quantitative research with a cross-sectional design. The independent variables in this study are carbohydrate intake, protein intake, fat intake, age, income, pregnancy spacing, and food availability, while the dependent variable is Chronic Energy Deficiency (CED). The population of this study is all pregnant women at the Limboto District Health Center, Gorontalo Regency, with a sample size of 100 respondents. The sample was determined using simple random sampling technique. This study was conducted from November to December 2024. Data were collected through research instruments, including Upper Arm Circumference (UAC) measurements, 24-hour recall forms, and questionnaires. The research instrument in this study has undergone validity and reliability testing, with results showing validity (Sig 2-tailed < 0.05) and reliability (Cronbach's Alpha > 0.7), making it suitable for use. Data analysis was performed using univariate, bivariate, and multivariate methods. Univariate analysis was used to examine the frequency distribution and percentage of risk factors for Chronic Energy Deficiency (CED). Bivariate analysis used the Chi-square test to examine the relationship between independent variables and CED. Multivariate analysis used logistic regression to identify factors that simultaneously influence CED. This study has received ethical approval from the Health Research Ethics Committee of the Faculty of Sports and Health, Gorontalo State University, with approval number 260A/UN47.B7/KE/2024.

**RESULT**

Table 1.

Distribution of respondents' frequency based on carbohydrate intake, protein intake, fat intake, age, income, pregnancy spacing, and food availability, and the incidence of CED (n = 100)

Variable		f	%
Carbohydrate intake	Deficient	44	44
	Adequate	56	56
Protein intake	Deficient	45	45.0
	Adequate	55	55.0
Fat intake	Deficient	49	49.0
	Adequate	51	51.0
Age	Adolescent	34	34.0
	Adult	66	66.0
Income	Low	54	54.0
	High	46	46.0
Pregnancy spacing	No previous pregnancy	41	41.0
	Less than 2 years	32	32.0
	2-5 years	27	27.0
Food availability	Deficient	45	45.0
	Adequate	55	55.0
Incidence of CED	With CED	20	20.0
	Without CED	80	80.0

Table 1 shows that the majority of respondents have adequate carbohydrate intake (56%), adequate protein intake (55%), adequate fat intake (51%), are adults (66%), have low income (54%), have no previous pregnancy (56%), have adequate food availability (55%), and do not experience Chronic Energy Deficiency (CED) (80%).

Table 2.

Analysis of the relationship between carbohydrate intake, protein intake, fat intake, age, income, pregnancy spacing, and food availability with the incidence of CED (n = 100)

Variable		Incidence of CED				Jumlah		P-Value
		CED		Without CED		f	%	
		f	%	f	%			
Carbohydrate intake	Deficient	15	15.0	29	29.0	44	44.0	0,002
	Adequate	5	5.0	51	51.0	56	56.0	
	Total	20	20.0	80	80.0	100	100	
Protein intake	Deficient	15	15.0	30	30.0	45	45.0	0,003
	Adequate	5	5.0	50	50.0	55	55.0	
	Total	20	20.0	80	80.0	100	100	
Fat intake	Deficient	16	16.0	33	33.0	49	49.0	0,002
	Adequate	4	4.0	47	47.0	51	51.0	
	Total	20	20.0	80	80.0	100	100	
Age	Adolescent	20	20.0	14	14.0	34	34.0	0,000
	Adult	0	0	66	66.0	66	66.0	
	Total	20	20.0	80	80.0	100	100	
Income	Low	16	16.0	38	38.0	54	54.0	0,009
	High	4	4.0	42	42.0	46	46.0	
	Total	20	20.0	80	80.0	100	100	
Pregnancy spacing	No previous pregnancy	7	7.0	34	34.0	41	41.0	0,004
	Less than 2 years	12	12.0	20	20.0	32	32.0	
	2-5 years	1	1.0	26	26.0	27	27.0	
	Total	20	20.0	80	80.0	100	100.0	
Food availability	Deficient	16	16.0	29	29.0	45	45.0	0.000
	Adequate	4	4.0	51	51.0	55	55.0	
	Total	20	20.0	80	80.0	100	100	

Table 2 shows the results of the Chi-square test analysis, which found a significant relationship between the incidence of Chronic Energy Deficiency (CED) and carbohydrate

intake ( $p = 0.002$ ), protein intake ( $p = 0.003$ ), fat intake ( $p = 0.002$ ), age ( $p = 0.000$ ), family income ( $p = 0.009$ ), pregnancy spacing ( $p = 0.004$ ), and food availability ( $p = 0.000$ ).

Table 3.  
Analysis of the Most Influential Risk Factors for Chronic Energy Deficiency (CED) Occurrence

Variable	B	S.E	Wald	Sig.	Exp (B)
Carbohydrate intake	3.892	1.746	4.966	0.026	48.985
Protein intake	2.707	1.575	2.955	0.086	14.991
Fat intake	4.965	2.205	5.071	0.024	143.372
Age	24.533	3.756	0.000	0.995	4.515
Food availability	2.765	1.606	2.963	0.085	15.872
Konstanta	-6.560	2.607	6.330	0.012	0.001

Table 3 shows that carbohydrate intake ( $p = 0.026$ ) and fat intake ( $p = 0.024$ ) are variables that significantly influence Chronic Energy Deficiency (CED). Among these two variables, the most influential variable on CED incidence is fat intake, with an Exp (B) value of 143.372.

## DISCUSSION

### The relationship between carbohydrate intake and the incidence of Chronic Energy Deficiency (CED) among pregnant women

Based on the results of a study conducted on pregnant women at Limboto Health Center using the Chi-square statistical test, a p-value of 0.002 ( $<0.05$ ) was obtained, indicating a significant relationship between carbohydrate intake and the risk of Chronic Energy Deficiency (CED) among pregnant women at Limboto Health Center, Gorontalo Regency. These findings are consistent with the study conducted by Defani (2022), which stated that there is a relationship between carbohydrate intake and the incidence of CED among adolescent girls in the working area of Lubuk Kilangan Health Center in 2022. This is also in line with the research conducted by Dictara et al, (2020), which found a relationship between carbohydrate intake and the incidence of chronic energy deficiency among pregnant women in the working area of Sukaraja Health Center, Bandar Lampung City.

Measuring carbohydrate intake using the 3x24-hour food recall method in pregnant women is an effective technique for evaluating dietary patterns and carbohydrate consumption over three consecutive days. This method involves asking pregnant women to recall and record all food and drinks consumed over three days, including portion sizes and consumption times. Carbohydrates are the primary source of energy for the body, including for pregnant women who require additional calories to support fetal growth and meet their own energy needs. Inadequate carbohydrate intake can disrupt maternal metabolism, increasing the risk of Chronic Energy Deficiency (CED), which can affect both maternal health and fetal development (Telisa & Eliza, 2020). A decrease in carbohydrate intake can cause the pregnant woman's body to shift to other energy reserves, such as fat and protein, which can lead to nutritional imbalances and deficiencies in the long term. This condition increases the likelihood of CED, which can result in complications during pregnancy, such as intrauterine growth restriction, preterm birth, or even miscarriage (Yulianti, 2023).

According to the author's assumption, carbohydrates play a role as the primary source of energy needed to support fetal growth and maternal metabolism. A lack of carbohydrates in the diet can lead to energy deficits, contributing to maternal weight loss and increasing the risk of Chronic Energy Deficiency (CED). Furthermore, inadequate carbohydrate intake can affect blood glucose levels, hinder anabolic processes, and reduce glycogen stores, impacting the body's ability to meet nutritional needs during pregnancy. Therefore, consuming carbohydrates in sufficient and balanced amounts is crucial for maintaining the nutritional

status of pregnant women and reducing the risk of CED, especially when combined with adequate sources of protein, fat, vitamins, and minerals.

### **The relationship between protein intake and the incidence of Chronic Energy Deficiency (CED) among pregnant women**

Based on the results of a study conducted on pregnant women at Limboto Health Center using the Chi-square statistical test, a p-value of 0.002 ( $<0.05$ ) was obtained, indicating a significant relationship between protein intake and the risk of Chronic Energy Deficiency (CED) among pregnant women at Limboto Health Center, Gorontalo Regency. These findings are consistent with the study conducted by Dictara et al, (2020), which found a relationship between protein intake and the incidence of chronic energy deficiency among pregnant women in the working area of Sukaraja Health Center, Bandar Lampung City. This is also in line with the research conducted by Santia et al, (2020), which stated that there is a relationship between protein consumption and chronic energy deficiency among pregnant women at Bengkulu City Health Center.

Protein intake measurement in pregnant women was conducted using the 3x24-hour food recall method, which involves recording all food and beverages consumed over the past three days to obtain a more representative picture of dietary patterns. Protein is an essential nutrient that plays a crucial role during pregnancy, as it contributes to the formation of new tissues, including the placenta and fetus. Inadequate protein intake can disrupt fetal growth and increase the risk of Chronic Energy Deficiency (CED) in pregnant women (Santia et al, 2020). Protein also helps maintain maternal energy reserves, regulate metabolism, and repair damaged tissues during pregnancy. Protein deficiency can exacerbate CED, as the mother's body will prioritize basic needs and reduce nutrient flow to the fetus, potentially leading to fetal malnutrition and preterm birth complications (Sri Fauziana & Adhila Fayasari, 2020). Adequate protein intake also plays a role in maintaining the balance of essential hormones during pregnancy, such as insulin and growth hormone, which support metabolic processes (Prabaningtyas, 2020). According to the author's assumption, protein acts as a building substance that supports fetal growth and maintains maternal muscle mass and energy reserves. Inadequate protein intake can lead to a decline in maternal nutritional status, resulting in insufficient weight gain, increased risk of pregnancy complications, and impaired fetal development. Additionally, protein plays a role in the synthesis of hormones and enzymes that support energy metabolism, and its deficiency can exacerbate Chronic Energy Deficiency (CED). Therefore, meeting protein needs from both animal and plant-based food sources is crucial to reducing the risk of CED and ensuring the health of both mother and fetus during pregnancy.

### **The relationship between fat intake and the incidence of Chronic Energy Deficiency (CED) among pregnant women**

Based on the results of a study conducted on pregnant women at Limboto Health Center using the Chi-square statistical test, a p-value of 0.002 ( $<0.05$ ) was obtained, indicating a significant relationship between fat intake and the risk of Chronic Energy Deficiency (CED) among pregnant women at Limboto Health Center, Gorontalo Regency. These findings are consistent with the study conducted by Latif et al, (2019), which found a relationship between fat intake and CED among pregnant women in the working area of Tosa Health Center, Tidore Islands City. This is also in line with the research conducted by Anggraini, (2020), which reported a relationship between fat intake and CED among pregnant women in Wirokerten Village, Banguntapan District, Bantul Regency.

The measurement of fat intake in pregnant women using the 3x24-hour food recall method involves asking pregnant women to recall and record all food and beverages consumed over three consecutive days. Fat is an essential source of energy for the body, and during

pregnancy, the energy needs of the mother increase. If fat intake is inadequate, pregnant women can experience energy deficiencies that lead to Chronic Energy Deficiency (CED) and have negative impacts on the health of both mother and baby. Fat also plays a vital role in cell structure formation, especially during the first trimester of pregnancy, when fetal tissue and organ development occurs rapidly. Inadequate fat intake can disrupt this process, potentially leading to fetal developmental disorders. Additionally, fat in the diet of pregnant women is important for hormone synthesis, including hormones that support a smooth delivery process (Hakim et al., 2025). According to the author's assumption, fat plays a crucial role in providing energy, facilitating the absorption of fat-soluble vitamins (A, D, E, and K), and supporting fetal nervous system development. Fat deficiency in the diet of pregnant women can lead to nutritional imbalances, contributing to low maternal weight and increased risk of preterm birth and low birth weight (LBW) babies. Therefore, meeting fat needs by choosing healthy sources, such as unsaturated fats from fish, nuts, and vegetable oils, is an important factor in preventing Chronic Energy Deficiency (CED) in pregnant women.

### **The relationship between maternal age and the incidence of Chronic Energy Deficiency (CED) among pregnant women**

Based on the results of a study conducted on pregnant women at Limboto Health Center using the Chi-square statistical test, a p-value of 0.000 ( $<0.05$ ) was obtained, indicating a significant relationship between maternal age and the risk of Chronic Energy Deficiency (CED) among pregnant women at Limboto Health Center, Gorontalo Regency. These findings are consistent with the study conducted by Fitri et al, (2022), which found a relationship between maternal age and CED among pregnant women in the working area of Ganjar Agung Health Center, Metro Barat District, Metro City. This is also supported by the research conducted by Andini (2020), which reported a relationship between age and CED among pregnant women at Prambontergayang Health Center, Tuban Regency.

At a young age, particularly under 20 years old, pregnant women's bodies are still in the stage of growth and development, which increases their nutritional needs. However, young mothers often pay less attention to optimal nutrition, increasing the likelihood of Chronic Energy Deficiency (CED). At this age, pregnant women are not yet fully physically and emotionally mature, which can affect their understanding of the importance of balanced nutrition, thereby increasing the risk of CED (Andini, 2020). On the other hand, pregnant women over 35 years old are also vulnerable to CED. Although their bodies are generally more mature, various factors such as decreased metabolism, more complex health conditions, and reduced nutrient absorption can contribute to nutritional deficiencies (Husna et al., 2020). According to the author's assumption, pregnant women who are too young, especially under 20 years old, tend to have suboptimal nutritional status due to ongoing body growth, increasing the risk of Chronic Energy Deficiency (CED). Meanwhile, pregnant women over 35 years old are also at higher risk of CED due to decreased metabolic efficiency and the potential presence of underlying diseases that affect nutrient intake and absorption. Therefore, the ideal age for pregnancy with a lower risk of CED is generally between 20-35 years, with good nutritional monitoring to ensure the health of both mother and fetus.

### **The relationship between family income and the incidence of Chronic Energy Deficiency (CED) among pregnant women**

Based on the results of a study conducted on pregnant women at Limboto Health Center using the Chi-square statistical test, a p-value of 0.009 ( $<0.05$ ) was obtained, indicating a significant relationship between family income and the risk of Chronic Energy Deficiency (CED) among pregnant women at Limboto Health Center, Gorontalo Regency. These findings are consistent with the study conducted by Nirma & Ariyati, (2021), which found a relationship between dietary patterns and family income with the incidence of CED among pregnant women in the working area of Kertak Hanyar Health Center. Families with low income tend to face

difficulties in meeting basic needs such as food, shelter, and healthcare (Destriande et al, 2021). Low income can limit families' access to nutritious food and adequate healthcare facilities. In areas with high poverty rates, families often opt for cheap and easily accessible food that is low in nutritional value. This exacerbates the risk of Chronic Energy Deficiency (CED), particularly among pregnant women. CED in pregnant women can lead to pregnancy complications such as anemia, premature birth, and low birth weight babies, which can potentially add to the economic burden on families in the future (Martony, 2023). According to the author's assumption, low economic levels can limit access to nutritious food, adequate healthcare services, and a healthy environment. Financial constraints often lead to unbalanced food consumption, inadequate intake of protein, vitamins, and minerals essential for fetal growth and maternal health. Additionally, families with low income tend to face difficulties in accessing quality prenatal care, which plays a crucial role in monitoring the nutritional status of pregnant women. As a result, pregnant women with low economic conditions are more vulnerable to Chronic Energy Deficiency (CED), which can have negative impacts on maternal and fetal health, including the risk of low birth weight (LBW) and impaired fetal growth and development.

### **The relationship between pregnancy spacing and the incidence of Chronic Energy Deficiency (CED) among pregnant women**

Based on the results of a study conducted on pregnant women at Limboto Health Center using the Chi-square statistical test, a p-value of 0.004 ( $<0.05$ ) was obtained, indicating a significant relationship between pregnancy spacing and the risk of Chronic Energy Deficiency (CED) among pregnant women at Limboto Health Center, Gorontalo Regency. These findings are consistent with the study conducted by Nugraha et al (2019), which found a relationship between pregnancy spacing and parity with the incidence of CED among pregnant women in Kupang City. This is also in line with the research conducted by Handayani et al, (2021) which reported a relationship between maternal age, parity, and pregnancy spacing with the incidence of CED among pregnant women in the working area of Tanjung Agung Health Center, Muara Enim Regency.

Pregnancy spacing that is too close, particularly less than two years, has a strong relationship with the incidence of Chronic Energy Deficiency (CED) among pregnant women. Short pregnancy intervals do not provide sufficient time for the mother's body to replenish nutrient reserves depleted during previous pregnancy and childbirth. As a result, mothers are at a higher risk of experiencing CED due to increased nutritional needs that cannot be adequately met. This condition can impact maternal health and fetal development, increasing the likelihood of low birth weight (LBW) or other growth abnormalities (Ningrum, 2020). According to the author's assumption, pregnancies spaced less than two years apart can cause the mother's body to not fully recover from the previous pregnancy, resulting in limited energy and nutrient reserves necessary for fetal development. This increases the risk of Chronic Energy Deficiency (CED), which can impact fetal growth and maternal health. Conversely, pregnancies spaced too far apart can also be risky if maternal nutrition is not well-maintained, leading to a decline in nutritional status that affects subsequent pregnancies. Therefore, optimal pregnancy spacing planning is crucial to prevent CED and ensure the health of both mother and baby

### **The relationship between food availability and the incidence of Chronic Energy Deficiency (CED) among pregnant women**

Based on the results of a study conducted on pregnant women at Limboto Health Center using the Chi-square statistical test, a p-value of 0.000 ( $<0.05$ ) was obtained, indicating a significant relationship between food availability and the risk of Chronic Energy Deficiency (CED) among pregnant women at Limboto Health Center, Gorontalo Regency. These findings are consistent with the study conducted by Hendro Stenly Kadmaerubun et al, (2023), which

found a relationship between food availability and CED among pregnant women. This is also in line with the research conducted by Muryani et al (2022), which reported a relationship between food availability and the incidence of CED among pregnant women at Dana Mulya Health Center. Adequate food availability plays a crucial role in preventing Chronic Energy Deficiency (CED) among pregnant women. A balanced diet that includes carbohydrates, protein, fats, vitamins, and minerals is essential to support maternal health and fetal growth. When food is available in sufficient quantities and variety, pregnant women can meet their nutritional needs effectively, thereby minimizing the risk of CED (Nurhandini, 2022). Conversely, limited food availability puts pregnant women at risk of nutritional deficiencies that can lead to CED. Food shortages often result in pregnant women not getting enough calories and nutrients to meet their metabolic needs and support fetal growth. As a result, pregnant women with CED are more likely to have low birth weight and experience pregnancy complications such as anemia, preeclampsia, and premature delivery. Additionally, the fetus is at risk of growth restriction, low birth weight, and even cognitive developmental delays (Wulansari, A., & Herliana, 2020). According to the author's assumption, when food rich in protein, iron, and other micronutrients is readily available, pregnant women can meet their nutritional needs, thereby supporting optimal fetal growth and maintaining their own health. Conversely, limited access to nutritious food can lead to inadequate calorie and nutrient intake, increasing the risk of Chronic Energy Deficiency (CED) that can impact fetal growth, cause anemia, and lead to pregnancy complications. Therefore, equitable and quality food availability is a crucial factor in preventing CED and supporting maternal and infant health.

## CONCLUSION

The findings of this study can be concluded that there is a relationship between carbohydrate intake, fat intake, age, family income, pregnancy spacing, and food availability with the occurrence of Chronic Energy Deficiency (CED) among pregnant women. Therefore, efforts to prevent and manage CED in pregnant women need to consider these factors, particularly in improving nutrient intake to support the health of both mother and fetus.

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